The Reduction of Interference from Static

Some Further Points of Interest to Constructors

"By M.I.R.E."

FOLLOWING on last week's discussion regarding the reducton of static interference by means of the directional effect of aerials and loops by taking advantage of a difference in direction of arrival of the static and the desired signals, it is proposed to outline some more points of interest. It will be remembered that it was shown that a method of sorting out signal from static, or at least increasing the static to signal ratio in favour of the signal, could be put into operation by pointing a directional aerial towards the signal in such a way that its receptivity would be at a maximum in that direction, but its receptivity would be relatively less, and preferably a minimum towards the direction of static.

FIELD FOR RESEARCH.

This has opened up a tremendously wide field for research, and eminent engineers and physicists have devoted many years of research to improving methods of putting this principle into operation, and thus arming the receiver with a much-needed defence against the attacks of its most bitter enemy.

The simple directional aerial is of little use because its directivity is more a theoretical than a practical consideration. Unless the design is carried to an extreme by having a wire about 150 feet or more long, run along the ground on insulators, and only a few inches distant from the ground, then there is little advantage to be gained from it. The effective height of such an aerial would naturally be far short of one, say, twenty-five or thirty feet high, but nevertheless a surprising number of stations can be tuned in with a multi-valve set, owing to the flexibility of the radio-frequency valves and their liability to give enormous amplifications on extremely weak signals. This type of aerial may also be formed by laying a well insulated cable along the top of the ground, the one end being attached to the receiver and the free end pointing towards the station it is desired to receive. The free end should be well insulated of course.

Another form is often referred to as an "underground aerial" and consists of the before described well-insulated cable buried in the ground up to two or three feet and still pointing its free end towards the distant station.

RADIO TRANSMITTER DISTURBANCES.

As has been described previously in this column a radio transmitter sends out two disturbances, one of which is in the "aether" and consists of electro-magnetic waves which travel through space while the other represents electric currents which, travel through the earth. To just what extent these disturbances affect the receiver depends on two factors, the first of which is the wavelength or frequency of the currents used at the transmitter, and the second is the nature of construction or electrical conductivity of the intervening ground. With a given wavelength and salt-water between two stations, providing certain constants of the stations are known, the actual percentage ratio of aerial to earth components of the wave transmitted and received can be determine with satisfactory accuracy. Immediately, however, the intervening earth consists of ground of unknown conductivity, the computation becomes very unsatisfactory.

It has also been explained in these columns that the amount of energy picked up by a receiver (and therefore the signal strength) is dependent on the height of an aerial (from an electrical and not necessarily a geometrical point of view). The higher the electrical height the greater the energy received from the wave arriving from the transmitter.

"UNDERGROUND AERIALS."

An application of these principles to the question of low highly directional aerials and buried wires resolves itself down to a consideration of the wavelength in use and the nature of the ground at the receiver as well as the ground intervening between the transmitter and receiver. The effective height of an aerial may be very great owing to the fact that the ground underneath it is composed of very poor material which might just as well be considered an insulation and it may be necessary to go down, say twenty feet, to get to good material. If such an aerial is twenty geometrical feet high above the ground, then the total geometrical height would be reckoned at forty feet with the added "height" under ground. Providing the earth connection is buried twenty feet into the good material the advantages offering will be made use of otherwise anything picked up by increased height will be used up in aerial resistance.

RECEPTIVITY OF LOW AERIALS.

It will now be seen that it is a very difficult problem to determine the receptivity of low or buried aerials because for a start, it is not known just what the ratio of space to earth currents are, nor is just what extent the earth currents which do arrive will affect the receiving system because the wire slightly above earth should act as a true aerial, while the buried wire should respond to the earth currents only. The wire laid along the surface of the ground should receive nothing whatsoever if the ground it is laid down on is good wet soil because it should be non-inductive theoretically. Its geometrical height above earth would consist of the thickness of the insulation of the wire as a matter of fact! This would actually be so if the surface of the ground consisted of copper-sheet for instance.

In order to make certain that only earth currents are picked up it is customary to lay the insulated wire in brackish water as the latter has a lower resistance than even salt water.

It is claimed by the exponents of the underground aerial that there is very great freedom from static interference because the greater percentage of static arises in the atmosphere and that static waves are purely space waves. This is so, but the space waves tend to induce currents in the surface of the earth, and these are picked up in the aerial, and, furthermore, there are natural as well asman-made earth currents which tend to disturb such a pick-up system materially, and do not have an appreciable effect on an overhead system.

DIRECTIVE AERIALS.

Considered briefly, these directive forms of aerial show considerable advantages over orthodox designs, providing the user is prepared to instal a couple of extra valves in the receiver to make up for the loss of sensitivity due to the smaller pick-up of the aerial. Naturally such aerials can only be used to receive in a given direction unless several of them are installed in such a way that all the stations it is desired to receive are capable of being picked up on one or other of them. However, in New Zealand the average receiver is used on the Australian stations, principally when distant reception is being carried out and static is causing most interference. Hence, anywhere in New Zealand, if an aerial is laid down in such a manner as to cause the free end to point towards Sydney, the aerial will satisfactorily enough include Brisbane and Melbourne in its compass.

There are one or two points of practical interest and one is that the self-capacity to earth of the low or buried aerial is much greater than one of orthodox design, and in order to have a fair length as well, the tuning of the system may be found to be difficult. It is therefore wise to instal a series condenser between the lead to the receiver and the aerial terminal. This condenser should preferably be a variable one, although a fixed one of a value of .0003 will be found to work well enough. A variable condenser with a maximum capacity of .0005 is desirable, especially with the buried wire. To get best results, this condenser should be varied with respect to the first tuning dial on the receiver until maximum signals are obtained. Any variation of the series condenser will call for a slight readjustment of the first dial or aerial tuning control of the receiver.

It is quite possible where there is plenty of open ground to lay down an aerial twice or three times as long as usual and still get good signals with sharper directive effects. The series condenser is now an absolute necessity, and it should be variable. The Beveridge aerial has been mentioned in these columns before, and this takes the form of a wire actually longer than would be called for in a straight-out tuning system. In this case, two wires are used, one as the aerial, and the other as a transmission wire to bring the energy from the aerial to the receiver and at the same time make the aerial system reversible in direction. A special resistance is joined between the far end of the aerial and earth to assist this effect at different receivers working at different wave-lengths are energised by this system.

It should be noted that directive systems are not really practicable on short-wave systems, for instance, below 100 metres. It was mentioned at the commencement of this article that a factor determining the energy transferred to the receiver was the nature of the earth between the stations as regulating the amount of earth current which would arrive at the receiver. As before-mentioned, this varies with wave-length. On wave-lengths above 10,000 metres probably over 50 per cent. of the energy received comes through the earth, but below 100 metres the earth currents dissipate themselves owing to the resistance of the earth and they do not carry more than a few miles at most. Palpably, therefore buried earths are quite impracticable for the reception of the ultra-short wave stations, which are such a source of interest at present. Those of an experimental turn of mind will find great interest in trying out stunts on the lines of the few pointers treated in this discussion.

INTERFERENCE

POWER LINE AND OTHER CAUSES

TRACING THAT TROUBLE.

In many cases in New Zealand listeners are now experiencing serious interference from power-line leakages and noises from various electrical appliances. Some power board engineers have taken up broadcast listening in their leisure and probably they will now realise how serious a matter power line interference is to broadcast listeners-in.

An American investigator of man-made sources of electrical interference writes:—

"Sparks are produced in the normal operation of many types of electrical apparatus (such as motors, doorbells, buzzers, gasoline engines, X-ray apparatus, violet-ray machines, some forms of battery chargers, rural telephone ringers, heating-pad thermostats). Sparks are also sometimes produced at defective insulators, transformers, etc., of electric wire lines. Sparks usually give rise to electric waves which travel along the electric power wires and by them are radiated out and are then picked up by radio receiving sets. The noise thus produced in a radio set may come from a disturbance which has travelled several miles along the electric power wires.

ELIMINATE THE SPARK.

"One remedy for such types of interference is to eliminate the spark. This is possible if the spark is an electrical leak and not necessary to the operation of the machine in which it occurs. Many very useful electrical machines, however, depend for their operation on the making and breaking of electrical circuits while they are carrying current and whenever this happens a spark is produced. It is impossible to eliminate these machines, so that it is necessary to make the spark of such nature or so to arrange the circuits that the radio frequency current is reduced or prevented from radiating.

"To prevent the radio frequency current produced by a spark from getting on to the lines connecting the sparking apparatus some form of filter circuit is necessary. A condenser (1 microfarad, more or less) connected across the sparking points will short-circuit a considerable amount of the radio frequency current, or a condenser connected from each side of the line to ground will serve the same purpose. A choke coil in each side of the line in addition to the condensers connected to ground forms a simple filter circuit which should prevent frequencies in the broadcast range from getting on the line. A high inductance (choke coil) or high resistance connected in each side of the line changes the characteristics of the circuit so as to reduce the amount of power radiated. If such a filter circuit is not effective or is impracticable, the apparatus may in some cases be surrounded by a solid metal sheet or wire screen which is thoroughly grounded. The screen should completely surround the apparatus. This may be difficult. For example, in shielding the ignition system of a gasoline engine the spark coils and all wires and other parts of the system must be enclosed in metal shields, and these must be very well grounded.

"When any connections are made to the power line, in order to avoid fire and personal injury, only apparatus that is carefully tested as to voltage and current-carrying capacity should be used and the power company should be consulted before making the installation. Additions to the power lines should be made only by qualified persons.

TRACING THE SOURCE OF TROUBLE.

"The first thing to do in tracing the source of trouble is to make sure that it is not in the receiving set itself. The next thing is to open the electric switch at the house meter; if the interfering noise is still heard in the radio set, the source is then known to be outside the house. It is then desirable to report the situation to the electric power company. Many of the companies have apparatus for the purpose of following up complaints of this kind. Usually a sensitive receiving set with a loop aerial is used to determine the direction from which the interference noise comes, and this outfit is taken from place to place until the source is found. The location of such sources is often a very difficult and baffling undertaking. The trouble sometimes comes from a spark discharge over an insulator to ground, or between a pair of wires, or it may be that the wire is touching some object such as a tree, pole, guy wire, etc. Such a spark discharge is a loss of power to the operating company and a potential source of serious trouble, and for these reasons the company is probably more interested in finding and eliminating this type of trouble than the radio listener. Large leaks and sparks may often be observed at night, especially in hot weather. However, sparks which are too small to be readily noticed may cause serious interference to radio reception.

CLEAN THE COMMUTATOR.

"Where D.C. motors are in operation near a radio receiving set interference is sometimes caused, especially when the brushes on the motor are sparking badly. The sparking should be reduced as much as possible by cleaning the commutator and setting the brushes properly. The remaining interference is sometimes overcome by placing two condensers (about 2 microfarads each) in series across the power supply line and connecting their midpoint to a good ground system.

"Another source of interference is the ringing machine used in rural telephone exchanges. Telephone engineers can reduce or eliminate interference by connecting a filter between the machine and the ringing keys."

"VALVE" NOT "TUBE"

AMERICAN EDITOR'S PREFERENCE.

One American radio editor has perceived in the English term "valve" a more apt word than "tube" which is generally used in America. The editor of the New York "Popular Radio" of December, says:—

"After having received a number of letters questioning the license we have taken in using the term 'valve' in place of 'tube' we feel constrained to say something in defence of this policy. One slightly irate reader complains with some feeling that we have been 'high hatting' him. 'Popular Radio' obviously has no interest in 'high hatting' its readers, but it does have a sincere desire to keep its terminology as scientifically accurate as possible, and, following the growing tendency of the radio engineering profession, it has forsaken the ambiguous term 'tube' for the more descriptive one of 'valve.' After all, a tube may mean a container for toothpaste or the Hudson River Vehicular Tunnel."

BROADCAST TESTS

FROM HOME LINER.

Aboard the Aberdeen liner Demosthenes, which left England for Australia on December 7, is Mr. H. A. Hankey, secretary of the Wireless Association of Great Britain, who was on his way to Australia to carry out short-wave broadcasting tests. Mr. Hankey will conduct experiments both on the voyage out and home and during the five weeks he will be in Australia. Messrs. Geo. Thompson and Co, Ltd., owners of the Aberdeen Line, attach so much importance to it that they are providing Mr. Hankey with a first-class passage to Australia and back in the Demosthenes. Unfortunately Mr. Hankey's wavelength is unknown, but any listeners "picking up" the Demosthenes on the voyage will be able to report to Mr. Hankey, care of the agents, Dalgety and Co., Ltd. The Demosthenes was due at Melbourne on January 28.

MOTOR-CAR AERIAL

EASY TO INSTAL.

A condenser-aerial is one of the best types of pick-up devices to use with a radio set in a motor-car. The idea of the condenser-aerial is old, and it is surprising that it is not more used by the experimenter who wants an aerial that will give a maximum of signal strength with a minimum of size. The condenser-aerial, as its name suggests, is formed of two plates of metal suspended several feet apart, with the upper one well insulated.

The lower plate is used for the earth, and the upper one for the aerial. This aerial may be modified for use in a car by fastening the upper plate just inside the top of the car, and using the body of the car for the lower plate.

The upper plate may be of almost any kind of metal. The larger this upper plate the better will be the results. Medium-mesh copper or brass screening, or a piece of thin sheet copper or brass will make the most efficient and best looking aerial, Even ordinary tinfoil or lead foil may be used by fastening a large sheet of it to the top of the car and sewing a piece of cloth over it to keep it from getting torn.

An insulated wire should be soldered to the metal plate and brought down to the aerial binding post on the set, taking care that the plate and the lead to it do not touch any of the metal parts of the car body. The ground binding post should be connected to the metal body of the car, or to the grounded terminal of the storage battery.

A student failed in an examination in all the five subjects he took.

He telegraphed to his brother: "Failed in all five. Prepare papa."

The brother telegraphed back: "Papa prepared. Prepare yourself."

SHORT-WAVE RECEPTION

NEW VALVE PROMISES WONDERS.

Important developments in the construction of short-wave receivers are likely to be one outcome of the invention of the new English shielded plate receiving valve which was mentioned recently in these columns. The main effect of the shield is to reduce the capacity of the valve almost completely. In the ordinary valve the capacity between the plate and the grid is comparatively great, and the valve really resembles a small condenser. The effect of this, if the valve is used as a high-frequency amplifier for very short waves, is that the capacity of the valve acts as an almost complete short-circuit in the valve itself, to an incoming signal impulse. The consequence is that an incoming signal passes right across the valve without being amplified, and no gain is obtained in the high-frequency amplifying valve. This effect has hampered the construction of a short-wave receiver incorporating a high-frequency amplifier.

TO ADD RADIO FREQUENCY.

The new screened valve, however, will overcome this weakness of the ordinary valve, and its influence may ultimately be greatly to increase the scope of short-wave broadcasting. At present the real value of short-wave broadcasting is partially limited to the transmission of programmes from one country to another for rebroadcasting. The majority of listeners hear the programme after it is relayed, instead of picking it up direct from the overseas station. It is likely, however, that the use of screened valves in high-frequency amplifiers will result in the production of a simply operated short-wave receiver, which will give fairly consistent loudspeaker reception from short-wave stations in all parts of the world. The value of this will be that the listener will be able to tune-in whatever overseas station he likes.