The Shielding of Receivers

Why This Should be Necessary

IN this issue, "Pentode" describes a fully shielded neutrodyne receiver, and a few notes on the reasons for shielding should be of value to all constructors. Shielding is the term applied to the practice of surrounding parts producing or carrying an electric current, and which are capable of creating electrostatic or electromagneti fields around themselves. Every conductor carrying an electric current will influence the surrounding medium for some distance with lines of force,. This is known as the eletric field, and conductors have the property of becoming charged with inductive electricity from these fields. The process may be likened to a fire which, radiating heat, warms an object some distance from it.

The higher the frequency of the alternating current, the more widespread will be the field surrounding their conductors. One would expect then that the radio frequency amplifier and the detector circuit would be surrounded by very dense magnetic fields which would excite in neighbouring components similar electric currents. In very many places, these currents are harmful; they may reinforce other currents and produce oscillation, or they may oppose other currents, and cause decided loss in signal strength.

A characteristic of electromagnetic and electrostatic fields of force is that they will pass through insulators practically as if the insulators were not in existence. This explains why electromagnetic waves will pass through the ether to our receiving sets while yet the ether is an insulator. Direct current itself may be confined within conductors by covering these with insulation, or by leaving them exposed to air, but high frequency electric fields behave in a manner the exact opposite of the behaviour of the direct current. When a conductor is placed in an electromagnetic field, the lines will set up little eddy currents in the conductor, and so dissipate their force. Were an insulator to be placed in the position of the conductor, the lines of force would pass straight through it. Conductors used to confine these fields are called shields, and their proper application in radio receivers is called shielding.

Were it possible to separate these components carrying high frequency current by a great distance, the fields of force would be dissipated before they could influence other components of the set. The field of a good active coil will spread to a distance of a foot or two from the coil before losing the strength required to generate undesirable currents in other coils or conductors. The field around the wire carrying a heavy plate current will be full of activity at a distance of several inches. When a receiver having a total length of 30 inches contains two or more radio frequency coils and condensers, a collection of iron core transformers, and miscellaneous valves and wires, the inter-action is indeed great, and some steps must be taken to prevent it.

The Effect of Shielding.

PROPERLY applied shielding accomplishes two objects. It prevents harmful feed-back of energy from the parts in one amplifying stage to parts in the preceding amplifying stages. This reduces the receiver's tendency towards oscillation, and makes it more stable. For this reason the plate wires of a receiver are kept short and clear of other wires, especially of the grid wires. In the second case, the shielding prevents the pick-up of energy radiated from parts of the amplifying stages or radiated from the antenna system. In this way, stray electric currents caused by power interferences, static, etc., are kept to a minimum, and the selectivity is increased. This latter is made possible by the isolation of the coils and the impossibility of their picking up strong signals as from a local transmitter. The action of any kind of shield is to catch the wandering lines of force, turn their energy into eddy current in the shield, and thus prevent the lines of force passing to other components.

Unquestionably, there are many advantages to be gained by shielding, but the gains cannot be had without some penalties in the form of lost energy. For shielding to be effective, the energy of the lines of force which are to be confined must be changed into eddy current losses, and thus much energy wasted.

The shielding metal must be a good conductor, so that these eddy currents may be easily formed. If high resistance conductors are used the shield would be a partial insulator, and the lines of force would tend to pass through instead of being wasted.

Copper, aluminium, and brass are the metals most suited as shields, their relative values being in the order named; iron or steel must never be used for shielding high frequency currents or circuits as these have a relatively high resistance as compared with those metals already specified. Aluminium has a resistance in ohms per mil. foot of 17.02; copper, 10.37; and brass, 42.11. Cast steel has a resistance of 114.5; tin, 69.17; and cast iron, 435. Silver is the best conductor, having a resistance in ohms of 9.56 per mil. foot, thus silver would be the ideal shielding material, but for obvious reasons a compromise has to be made, and aluminium, combining cheapness with efficiency is the metal usually chosen, although copper screens are by no means common.

Construction of Shields.

IT is impossible to build a perfect shield because all metals used for this work have some resistance, and therefore cannot absorb all the radiated lines of force. The fewer the openings, the less the amount of the electromagnetic or electrostatic fields will pass through and influence the components outside the shield. The corners of the shield must be tightly clamped or soldered together, and openings made to pass wires through should be no larger than that actually required. Wherever a wire passes through a shield, it should be very heavily insulated.

Most constructors will find difficulty in making the shields, for it is fairly difficult to bend them accurately, while soldering with aluminium shields is out of the question, so that the home constructor will have to confine his attention to the dearer copper shield. The guage of metal generally recommended is about 20, though the heavier would be a slight improvement, but would be difficult to work with.

Realising the difficulty of the constructor, arrangements have been made that the size of the shield used in receivers to be described in the "Radio Record" shall be standardised, and the size most suitable is 9in. x 5in. x. 6in. This does not mean that a shield can be only this size, but in order that the constructor may procure his shields ready made, thus saving a great deal of labour, this size has been standardised for all receivers.

Shields of a standard size can be obtained from most dealers. Two samples have been submitted to us for consideration, and both should be propositions that appeal to the amateur constructor who does not wish to go to the trouble of constructing his own. Messrs. Johns, Limited, Auckland, have produced two very fine examples of their work. Both are made up in standard size, and are able to be collapsed. The sides are secured by a grooved rod running along the corners. Thus the sides, the top, and the bottom, can be securely fastened together, and there is no possibility of stray lines of force passing out into the adjacent section of the set. Both shields are made in aluminium, the difference being that one is made of a heavier guage aluminium than the other. This work is executed at John's, Limited, factory in Auckland.

Samples of a somewhat similar type of shield have reached us from Abel Smeeton, Ltd., Auckland. These are the Radiokes products, and are beautifully finished in block crystalline lacquer and mounted with highly polished nickel-plated corner posts and clamping nuts.

Needless to say, both these types of box shields are admirably suited to the shielded 5 neutrodyne, but the constructor wishing to make his own may obtain sheet copper or aluminium from any reliable radio dealer.

Revolutionary Developments

INQUIRIES are often made regarding the likelihood of sudden revolutionary developments in radio receivers. In this connection those who pin their faith upon their present sets will find consolation in the announcement of a recognised authority. He writes: "Radio has become standardised to such an extent and the conditions under which radio must operate have become so firmly fixed that the chance of outstanding change in receiver design are exceedingly remote. There are always those who wait for the ultimate receiver; who expect revolutionary changes are just around the corner. There are some, no doubt, who expect this in radio. However, if one looks back over the developments of the last four years, he finds scarcely any outstanding change in circuit design, the only great improvement being made in the matter of power supply."