Construction Continued

The Production of Reaction

ITS USE AND ABUSE

INSIDE a valve when in action, we have the filament heated by the A battery, which causes a stream of electrons to be shot off or "emitted" from the filament. These electrons, being negative, are attracted to the plate, which is always positive on account of the B battery current which flows from plate to filament and back to the B battery. The voltage impulses of signals that come to the grid have a great effect upon the conductivity of the space between the filament and grid with regard to the flow of electrons, so that as the grid becomes more or less negative, the flow of electrons decreases or increases. In this way the small impulses on the grid are able to produce larger changes in the plate circuit, and thus amplification is obtained.

FROM this it is seen that there is more energy flowing in the plate circuit than in the grid circuit, so that if we can feed back a little of the plate circuit energy in such a way as to increase that which is already in the grid circuit, this increase will be amplified and appear as a still greater increase in currents flowing in the plate circuit.

THERE is always a certain amount of "damping" in a wireless circuit, which tends to make signals die down. We can prolong the dying-down process by supplying energy to compensate for that which is lost, so in an oscillatory circuit we can feed in energy and wipe out the effects of damping.

If we use reaction to feed energy back into the grid circuit of a valve we can so adjust matters that the oscillations produced by passing waves are prolonged and die away gradually, or we can feed back a larger amount, so that once oscillations are started, they are maintained indefinitely. This latter conditions is called "self-oscillation," and occurs when the energy fed back balances that lost in overcoming resistance, and so on.

This process is equivalent to reducing the damping of the circuit, and it is most beneficial in increasing the sharpness of tuning of the circuit, since the lower the losses by damping, the sharper the tuning, and this holds good up to the point at which self-oscillation commences, when the damping is said to be reduced to zero.

THE actual method of producing reaction is quite simple. It is usually done by including in the plate circuit of the valve a coil which is arranged to act inductively upon the tuning coil in the grid circuit, by one of the usual methods of inductive coupling. When coils are so placed, currents flowing in one coil cause similar currents to flow in the other by the familiar process of electro-magnetic induction. Hence, this arrangement is often called reaction coupling.

So much for the good points of reaction. We must not forget that reaction wrongly used is a curse instead of a blessing, not only to the user, but to all his neighbours as well. It is quite easy to see how this may be if we remember that reaction is capable of producing continuous oscillations in the grid circuit of a valve. If that grid circuit is connected to an aerial, it is obvious that oscillations will flow in the aerial, and the whole becomes a miniature transmitter radiating rather weak continuous waves.

This radiation takes place upon whatever wavelength the user of the set is receiving, and so if he is trying to receive broadcasting, the radiation will be right on top of the waves from the broadcasting station and will produce howls and whistles in the receivers of everyone within a couple of miles or more, who may happen to be listening to the same station. Moreover, the speech heard in the oscillating receiver will be more or less distorted and spoiled, although a little louder than when reaction is properly adjusted.

TO make proper use of reaction when receiving broadcast, it should be adjusted so that the circuit is almost oscillating, but not quite. This is in the case of weak signals. When strong signals are being received, reaction may be very much reduced or brought to zero, full volume being still obtained.

Modern circuits are designed with a view to preventing detector oscillation from reaching the aerial, so that interference may be reduced to a minimum.

TIPS AND JOTTINGS

FILAMENT VOLUME CONTROL.

AS has been mentioned in past issues, dimming of filaments, either R.F. or detector, must not be carried to excess, or tone will suffer. Dimming must not be carried too near the point where the valve ceases to function, because distortion and bad tone are liable to be introduced. Detuning with the dials is satisfactory where a station spreads over a wide space on the dials, so that the detuned position is a number of degrees from the maximum. Rules cannot be laid down to exactly suit all receivers and all conditions, and ideas are given so that operators may find out which method best suits their case.

"HARNESS" FOR A.C. SUPPLY.

AMERICAN firms are now manufacturing what is called "adapter harness," by means of which an ordinary battery-operated set may be changed in a few minutes into an A.C. operated set without any structural or wiring changes. There is a transformer unit from which proceed several flexible cables, one for connection to the mains socket. To the other cables are attached several adapters, which are plugged into the respective valve sockets in the set for filament operation. Necessary grid-bias is also provided.

D.C. GENERATOR LIGHTS FILAMENTS.

THE Day-Fan Electric Company, of Dayton, Ohio, has made a new departure in batteryless receivers. This firm is now turning out sets in which a small motor generator giving direct current is driven by the alternating mains supply. For silent running the generator is suspended by straps and springs in the cupboard below the receiver cabinet.

NEW A.C. VALVES.

FIVE types of Cossor mains valves will soon be available. The chief point of interest about these valves from a listeners' point of view is that they can be used to replace the valves in any existing receiver. The only alteration in the receiver is the short-circuiting of the A positive and A negative terminals with a piece of wire. A pair of terminals at the top of each valve is then connected in parallel with the six-volt winding of a special transformer which supplies the heating power. B current is supplied in the same way as previously, from eliminator or battery.

BURNING THE SOLDERING IRON

YOU will find that the soldering iron soon becomes burnt if left too long in the gas flame, and all the tinning becomes oxidised. If this has happened badly, it is necessary to remove the coating with a rough file, and this soon destroys the iron. If, however, a "tin can" be used as a small "furnace," the burning is, to a large extent, avoided. The tin can is placed over the gas flame, and becomes red hot, the "iron" being inside. Two iron wires can be placed across the can for the purpose of supporting the soldering iron. The tin can should not be too large, or the iron will not get sufficiently hot. It should be, roughly, a very loose fit for the iron.

CONCERNING MICA.

THERE is no other natural substance, or artificial substitute, that possesses the same perfect cleavage, transparency, lack of colour when in thin sheets, flexibility, toughness, and resistance to temperature changes, or chemical decomposition. Finally it has exceptionally high electrical insulating properties.

Commercial mica is usually either of the potash or magnesian varieties, known respectively as muscovite or phlogopite. Indian ruby mica is found to be the best dielectric for condensers, whilst silver amber is widely used for separating the commutator segments on D.C. dynamos and motors.

The Loudspeaker.

When the impedance of the loudspeaker is twice that of the last valve, the greatest amount of undistorted volume will be obtained from the valve. Thus the loudspeaker should at least have an impedance higher than that of the last valve. An output transformer of suitable number of turns will suitably increase the impedance of the speaker circuit.

LIMIT OF SHORT WAVES

IT has now been definitely established that with ordinary receiving and transmitting valves it is impossible to work on wavelengths of less than about two metres. This rather contradicts several of the rumours which were current when amateurs first became interested in super-short-wave- working, and many almost impossible claims of successful working on one and even half a metre were made.

Valves Set a Limit.

Valves set a definite limit to the minimum wavelengths workable, for below a certain range (usually about ten metres) the capacity of the electrodes becomes too great to be balanced out. The size of the electrodes may be reduced a little to lower the capacity effect they present, but the mass cannot be cut down too far or the valve will not function.

Need for Accuracy.

A wavelength of 5 metres means a frequency of 60 millions of cycles per second, and the need for accurate tuning adjustment will be obvious. As an instance of the extreme care necessary in adjusting ultra-short-wave sets, it may be mentioned that in 5-metre experiments conducted recently at WGY, Schenectady, the actual transmitter was placed in the centre of a Hertz-type aerial (a vertical wire, one half of which is aerial and the other earth) and tuned by ropes from a distance of approximately 100 yards.

BATTERY AND ELIMINATOR

IF the ordinary listener were asked for criticism on the present standard valve set for broadcast reception he would probably concentrate on the batteries. The filament accumulator is troublesome because it requires periodical recharging and, in addition, exhibits a preverse tendency to run down just when it is most wanted.

As regards high tension, the dry-cell battery is a recurring charge on the wireless budget, and after the first few weeks of service usually develops artificial "atmospherics" of its own.

The remedy seems to lie in the use of eliminator units which are adapted to derive all the current and voltage necessary to run a multi-valve set direct from the electric lighting mains. At the present time the ideal combination is probably to be found in the indirectly-heated cathode type of valve in which special "false" filaments are fed directly from the mains, with a special eliminator unit for supplying the plate voltage from the same source.

Eliminator units designed to produce both filament and plate supply from the mains are, of course, available, but the indirectly-heated valve has the advantage that it is peculiarly free from noise, whilst owing to the fact that no current flows through the actual cathode, the latter is maintained at the same potential throughout its length and thus operates at maximum efficiency.

High-tension Eliminators

With regard to high-tension eliminators, it is generally found that the alternating-current type gives more satisfactory results, all round, than the D.C. type, though, of course, the latter is cheaper to install. In the former type the A.C. transformer completely separates the eliminator units from the outside mains, and thus protects the receiving set from variations in load and corresponding fluctuations in voltage.

WATER FOR ACCUMULATORS

In the article on construction of a B acumulator on April 13, "Megohm" stated as follows: "If distilled water is difficult to procure, water that has been boiled and allowed to cool is a good substitute. Where there is choice, rain-water is better than artesian, as mineral salt."

The above was not intended to be a recommendation to use anything but distilled water where it could be procured, and there is a distinct preference shown for the use of rain-water rather than artesian, for the reason stated.

A chemist writes to say that he cannot understand the object of boiling the water, as it will only destroy bacteria. The idea of boiling the water is not the writer's own idea, but well known to many, and is intended to purify the water as much as possible in a simple way, such as might have to be resorted to in country places. Even the presence of lime in water will be reduced by boiling, as instanced by the coating deposited inside a kettle when certain kinds of artesian water are boiled, though such water is certainly not suitable for accumulators.

Our correspondent is quite correct on the subject, of distilled water, about which he is naturally well informed, and it is undoubtedly the proper liquid to mix with the acid in accumulators. As a matter of actual experiment, however, the writer has made up accumulators with water direct from the tap, with common commercial sulphuric acid, and found them to function for long periods just as well as others made up on more scientific lines. But he does not advocate using anything but pure acid and distilled water, except in a case of necessity, as there is always a certain amount of risk with impure materials. Our correspondent also points out that rain-water does not require boiling if collected in clean vessels.

A CORRECTION.

In the article on the B eliminator last week near the top of the third column a slip occurred in dealing with 50-cycle A.C. There would be 50 impulses per second in each direction, and not 25, as stated.

Tune Carefully.

Listeners are reminded of the importance of tuning-in on all stations to the maximum dial position. The slightest detuning may cause distortion, except in the case of a receiver that is very unselective—a type that nobody cares to own nowadays. Listeners who suffer from distorted reception should tune in very carefully, listen to the loudspeaker, especially the lowest notes, and tune in so that distortion is absent, or at a minimum. It is often surprising what a little care in this way will do to improve reception for the whole evening. Volume may be controlled by the R.F. filament rheostat.

B Eliminator for Small Sets.

It was hoped that this would be dealt with in this issue, but the article has been unavoidably held over until next week.