rectifying valve is nearly always used. This valve generally is a two-electrode valve, with heated filament. With a valve which has a filament and an anode it is evident that when the filament is heated it will emit negative electrons.

Characteristics of Power Units.

VOLTAGE depends on the current derived, and the internal resistance of the rectifying valve. This must be low with respect to the external resistance (Philips 373, valve about 300 ohms at 4 volts).

Tests for "ripple" (hum) have been made when high tension supply units are used and compared with "B" battery supply, and also tests for induction by lighting supply (reception test of Daventry). Everything depends on the smoothing condensers and choking coils for the current derivation and voltage. (With a certain percentage ripple.)

Alternating Current Valves.

THE simplicity of working connected with high tension supply units brought about the idea that filament current could also be derived from the alternating current supply. There were however, many drawbacks. The filaments of radio valves at present are very thin, and this being so their heating properties are very small.

It therefore follows that when a filament is fed with alternating current the filament oscillates with the same frequency as the alternating current supply, that is to say, a maximum and a minimum are obtained twice during each cycle. The emission, therefore, shows the same fluctuation and a hum is clearly audible in the telephones when filament current is so applied.

This drawback can be overcome by applying sufficient heat to the filaments. This will cause a much higher filament current consumption, but as they are not fed by an accumulator it matters very little. The feeding transformer must supply more current, it is true, but indicated in watts the increase is practically negligible.

This, however, is not the only difficulty. The alternating current voltages passed to the grid of a radio valve must circulate in the grid circuit. This grid circuit consists of resistances, capacities, self-induction or combinations. These generally are connected on one side to the grid of the valve and on the other side (generally negative) to the filament. If this is done with a valve where the filament is fed by alternating currents, one will realise that the potential of the filament is not constant with respect to the grid, but instead, a variable one, corresponding with the frequency of the alternating current. For this reason this side of the filament alternatively has a positive and a negative potential with respect to the grid, and this causes alterations in the anode current which is audible as hum.

In order to avoid this the filament must be shunted by a resistance of which the centre is connected to the grid circuit. This can be accomplished by means of the sliding contact on a potentiometer, or the transformer used must have the centre of the secondary winding tapped.

If sufficient precautions are taken that those parts carrying alternating current (transformers, filament current mains, etc.) cannot cause induction, good results can be obtained in this way with amplifying valves. Even ordinary power valves can be used on a modest scale in low-frequency amplifiers. At present better types have been developed in the D105 and D143 with a filament current of .65 amps., and the E series as well as other specialised valves.

The greatest difficulties, however, are caused by feeding the detector valve with alternating current. The working of the grid condenser with leak resistance to obtain rectification renders the valve still more sensitive to the influence of alternating currents and the capacitive charges of the grid with respect to the end of the filament, more especially when reaction coupling is applied which causes a hum as the result of anode current oscillations produced as stated above. The methods for dealing with this trouble are not at all sufficient, and only when a new principle is used (separate heating) has it become possible to construct a detector valve which works absolutely free of hum with alternating current.

The emission of electrons is not obtained by a filament but by a separate tubular surface which is indirectly heated by a filament fed with alternating current. This filament is connected to an alternating current voltage of 2.5 volts, and consumes 1.5 amps. Valves of this class are the 227, H102T, and F215. This latter has the same characteristic as H415, while the former and second are 201H type.

Connection to the grid circuit is, of course, not by means of the filament, but by the electron emitting cathode which has no electric contact with the filament. For connection to the grid circuit a connection is provided with the cathode (on the cap).

These alternating current valves provide a solution of the problem of filament current supply, and when replacing the negative grid voltage battery by a resistance, shunt a condenser in the anode circuit, or, still better, use a small high-tension supply unit.

The modern trend is towards the use of indirectly-heated valves in all sockets of the receiver but the last, it being found satisfactory to feed the ordinary D.C. valve from an A.C. filament source when the valve is not followed by a further amplifying stage, i.e., on the "power" or output socket of the receiver.

Due to uniformity of electron emission all along the cathode and other reasons which are rather technical to be of general interest in these columns, it is possible to design and manufacture independently-heated A.C. valves having characteristics far surpassing the best possible from a directly-heated filament valve, i.e., battery-operated type.

Valve Characteristics.

THERE are three main factors or characteristics which serve to indicate the "goodness" of a valve.

The first of these is the "amplification factor" of the valve, giving some indication of the voltage gain of the valve, i.e., how many signal volts may be expected in the plate circuit from one volt applied to the grid.

The next factor is plate impedance, which indicates how much of the valve opposes the setting-up of the desired signal currents variation on its plate circuit. The impedance normally should be low.

Generally speaking, a high amplification factor is desirable, but this is usually accompanied by a rise in impedance, the latter disadvantage offsetting the former advantage, so that these two factors must be jointly considered to arrive at a true estimate of the merit of the valve. This characteristic is known as "slope," or "mutual conductance." It is usually expressed in "milliamperes per volt" and gives valuable information as to the number of milliamperes of signal current released in the plate circuit of the valve for each volt of applied signal grid potential.

Thus the steeper the slope of the valve, i.e., the greater the M.A.'s per volt, the more effective it is.

To indicate the enormous advances made in A.C. valve manufacture we may compare a modern example with the D.C. general purpose quarter ampere valve.

	D.C.	A.C.
Amplification factor	8	24
Impedance	10,000	8,000
Slope	0.8	3.0

From these figures it is readily seen that it is possible to design an A.C. set not merely a "convenient" set in that it eliminates battery troubles, but a definitely superior set to one battery operated.

The initial troubles experienced in the manufacture of A.C. valves have been overcome by at least the leading manufacturers, so that there is now no reason why the modern A.C. valve should not last practically as long as its D.C. brother.

The first general purpose A.C. valves (directly heated) gave trouble due to an "opening" of the filament circuit because of a manufacturing trouble experienced in getting the "pinch" of the filament support to bite deeply enough through the oxide coating of the filament to maintain good permanent contact with the metal beneath.

The earlier indirectly heated valves, as used in the detector sockets of the first American A.C. receivers, had a distressing habit of burning out after a very short life. This was wont to take place just inside the insulating thimble of the cathode.

Both of these troubles have now been overcome, and the reader need not hesitate to "go A.C." on account of short-lived valves, provided, of course, that he buys a high-grade receiver in which the necessary protection demanded for A.C. valves has been taken into serious account by the designer.

The use of receivers deriving all their power requirements from the A.C. mains has greatly helped along the development of "real" power valves. When operating from battery supply the use of a "real" power valve imposed such a drain on the financial resources of the average user—due to incessant and expensive battery renewals—that the use of valves suitable for giving really big volume without distortion became prohibitive.

All this is changed with A.C., operation, because even the largest "combination" sets draw quite a small amount of "power" from the house supply mains, and we need no longer starve the speaker on account of prohibitive running costs. We can thus enjoy realistic volume, and our thanks are largely due to A.C. operation.

In the early stages of A.C. development it was only feasible to make large sets for A.C. operation, but there are now on the New Zealand market completely A.C. operated receivers as small as two valves, of moderate price, and completely satisfactory operation.

The use of A.C. has then conferred the following benefits on the radio user. It has provided excellent battery substitutes and charging aids by which the user may, with his existing D.C. set, enjoy better reception with less maintenance worry.

It has provided means whereby the D.C. set may be modernised for complete battery elimination, and at the same time improved in results. It has enabled better sets to be built, and these to be completely operated from an A.C. power source. It has made possible realistic volume and tonal quality hitherto impracticable, and last, but decidedly not least, it has reduced radio operation costs.

Hence it is hardly necessary to remark that A.C. operation of radio receivers has definitely come to stay, and represents one of the greatest advances that have been made in radio of recent years.

Australian Stations

NEWS comes from Sydney that station 2BL, Sydney, is the first of the A class Australian stations to have a new transmitter, and this is now being built. This will give 2BL an aerial power of 5000 watts, which means an increase of nearly three times the present power of that station. There is also a suggestion to move the transmitting station of 2BL further away from Sydney as, owing to its greater power, city residents will experience some difficulty in tuning it out, if desired, to hear 2FC, Sydney, without interference.