the reverse, too much grid bias, or too little "B," and here again the remedy is obvious.

In recommending a power valve for the last stage, one must take into consideration the current it will use. If the owner of the battery set does not have an eliminator, and a means for charging an "A" battery, it would be unwise to try to sell him a power valve which will run his batteries down rapidly. Far rather do the best one can for his set as it is, and tell him that he cannot handle much more volume without putting himself to a great expense.

### In Old Sets.

THE few points we have now gone over are the most common causes of distortion, particularly in factory-built receivers. However, in sets of older design and those made by home constructors, there are many other points that can cause trouble. Probably transformers and grid leaks are the most common.

Very many transformers are too small and, as explained before, have not the primary inductance and cannot match the valve preceding it; consequently distortion takes place. Furthermore, they cause tonal distortion by cutting off, usually, the low notes. The serviceman should make certain that good transformers are used in any set for which good quality is expected.

Look over the transformers to see if there are any loose bolts, as often a loose lamination will give rise to a rattling on very loud passages. In resistance capacity coupled sets, check over the values of the grid leaks and condensers. Here is the rule for values.

The resistance in the anode circuit should be from two to three times the resistance of the valve impedance. The grid resistance should be four times the anode resistance and the coupling condenser can now be obtained from the table given herewith.

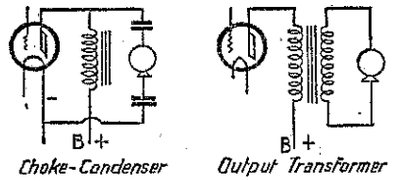
| Grid leak. (megs.) | Condenser. (mfds.) |
|---|---|
| 0.5 | .02 |
| 1.0 | .01 |
| 2.0 | .005 |
| 3.0 | .0035 |
| 5.0 | .002 |

### Defective Connections.

CHECK over the set for defective connections, particularly open grid circuits. Try reversing the windings of one or the other or of both transformers, if two are used, and see if this makes any difference. As a matter of fact, after resistance coupling the transformer will in very many cases have the secondary connected up in the reverse manner in order to get the best results.

### Detector Overloading.

DISTORTION on the high frequency side of a set is not uncommon, and being mixed up with some form of instability, often gets through to the audio stages and causes distortion. Often distortion is caused in the radio amplifier by too great a signal being imposed on




**An output filter not only often cures distortion, but it is a safeguard for the speaker.**

the detector, causing detector overloading. Detector overloading can be detected by an accentuation of sibilants and the upper frequencies. These disappear when the volume is reduced. The voltage on a grid leak detector should be from 20 to 50 volts. It needs to be fairly high in order to handle the volume. Where an anode resistance is used in the detector circuit the voltage must be considerably higher in order to compensate for the loss through the resistance.

Distortion due to the detector can often be identified by the double hump in the tuning, that is louder signals are obtained on either side of the resonant point on the tuning dial. The cure in this case is either to make an extra aerial tapping so that the aerial can be brought in direct to the detector or use a smaller aerial. Of course one could change over to anode bend detection, but this is not always possible. In the case of anode bend detection check very carefully the grid bias. Try increasing it to see if any improvement is made.

A choke which has a peak somewhere about on the wave-length of the station to which is listening will also cause instability and so will battery coupling. Too high a value of grid leak will often cause distortion and a not infrequent cause is a free grid on the detector or screen grid valve. In the case of the detector this may lead to grid choking, or there may be sufficient leakage in the valve holder, or in the grid condensers to prevent excessive choking, while in the case of the s.g. valve very often almost satisfactory results can be obtained even though the grid is free. Where loud signals are to be handled the value of the grid leak resistance should not be more than 2 megs. It could be even reduced to one for local station work. If h.f. current is getting into the audio amplifier, a choke and condenser should be used in the detector circuit. The choke should have a value of about 200,000 microhenries and low self capacity of three or four microfarads. The by-pass condenser should be of the capacity of .0003 mfds.

### L.S. Coupling.

APART from h.f. amplification another fault may possibly appear, due to incorrect coupling between the last valve and the speaker. If an output transformer is used, check up the ratio. The ratio of the output transformer should be equal to the square root of twice the valve impedance divided by the speaker impedance or

$$R = \sqrt{\frac{\text{valve impedanve} \times 2}{\text{speaker impedance}}}$$

Where push-pull valves are used one does not multiply the valve impedance by two.

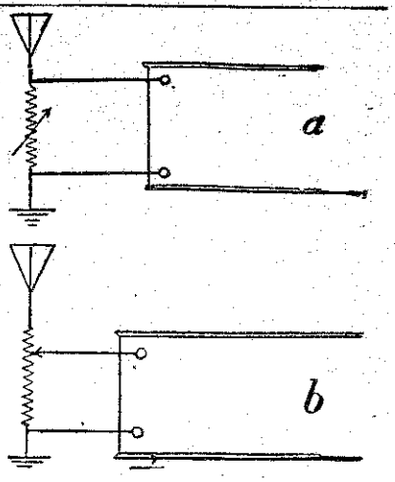
This, however, is not a common cause of distortion, because if put in commercially, they are usually correct.

Speaker impedance should be that at 250 cycles.

Often the inclusion of a filter will improve a set that is prone to distortion.

THE second part of the question relates to distortion in an a.c. set using a dynamic speaker. In general what has been laid down for the battery-operated set holds good for the a.c. set. However, the procedure is slightly different and there are other complications which may possibly enter in. In the first place the set must be turned on and the type of distortion noted. Tune very carefully to a station and test for overload. It is possible that the owner of the set has not been tuning his set correctly. Particularly is this true for super-heterodyne receivers, which distort chronically if all the stages are not in resonance and these tuned correctly to the incoming wave.

By listening to the speaker it is usually easy to tell if the distortion is located either in the speaker itself




**Detector overloading can be prevented by the use of pre-radio volume control. A uses a resistance of 100,000 ohms, b a potentometer of approximately the same value.**

or in the receiver. As the speaker is more complicated than the magnetic cone speaker, more troubles are likely to centre in it, and more attention must be paid to it than in the case of the battery-operated set. Distortion in a speaker may be due to a loose centering device allowing the moving coil to rub against the pole faces when heavy volume is being handled. Very often by moving the cone of the speaker this rub can be felt and so cured. It may, of course, be necessary to take the speaker away and make the adjustment on the work bench. If the centring device appears to be quite in order, test the pot for magnetism, which test can best be carried out by holding a screwdriver or some metal object against the centre piece, which should strongly attract the metal. If this is weak, the trouble is in the field supply. This may be of two types. The pot winding may be incorporated in the set as a choke or may be supplied by a separate rectifier. In the latter case

(Concluded on page 26.)