5%). If simplicity and economy are the governing considerations, a reserve of about 3W can, if the amplifier is carefully designed, give a generally acceptable standard of performance. In large rooms or small assembly halls, however, the conditions will probably merit a maximum output power of at least 20W. The type of output stage used will depend on the maximum audio power demanded of the amplifier. Consequently, the design of amplifying equipment will normally proceed from output to input, the requirements of the output stage dictating to a large extent the design of preceding stages.

OUTPUT STAGES

For output-power reserves of up to about 5W, single-valve output stages in which the valve operates under class A conditions are considered satisfactory. Triode valves used as power amplifiers yield a relatively distortion-free output, but their power-handling capacity is generally inadequate. The power-handling capacity of pentodes, however, is sufficient to permit their use in such stages and although the inherent distortion is high, negative feedback can be used to reduce it to an acceptable level.

There exists a choice of two basic forms of output stage from which a good-quality audio output of more than 5W can be delivered to the voice-coil of a loudspeaker. The two well-known forms are:

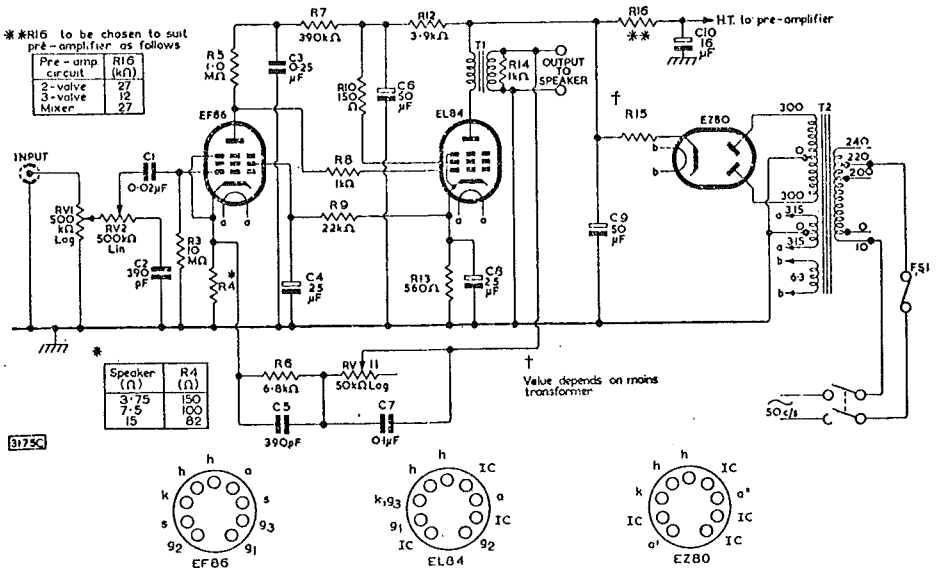
1. A class AB push-pull pentode (or tetrode) output stages;
2. A class A or AB push-pull triode output stage.

The choice between these is largely a balance between economy and performance.

Pentode Push-pull Stages

The use of pentodes of the 12W anode-dissipation type operating in a conventional class AB push-pull stage enables an effective output of 12 to 13W to be obtained easily assuming an output transformer efficiency of about 80% (which is a fairly conservative estimate for the efficiency). The appropriate supply voltage, limited by valve ratings, is about 300 to 320 V. The power efficiency (that is, the ratio between the audio output power and the d.c. input power) of such a stage is fairly high, being 50%, for example, in a typical stage using two Mullard output pentodes, type EL84. Harmonic distortion, however, is of the order of 3 to 4% at full output and, thus, a large amount of negative feedback is necessary to reduce the distortion to an acceptably low level (say 0·5%) at maximum output.

One of the amplifiers described in the Mullard book is the 3-3 which they say gives reasonably high quality. As its harmonic distortion content at full output is, however, only 1 per cent, we consider that it rates in hi-fi classification. (I have two in use and find them excellent in every way.) The schematic diagram is given in Fig. 8–I use the design with controls. A list of components required is not given as, to repeat what we have already written, we cannot promise that you can get them. However, if friends or a local shop or radio society can help the details are on the diagram. The output transformer must be the best available (I use an Elstone) with a primary impedance of 5 kohm. Fig. 9 gives a suggested layout with the tagboard inset, and Fig. 10 is a graph giving the frequency response of the amplifier.



(a) complete circuit diagram of amplifier

(b) circuit diagram of control-less amplifier

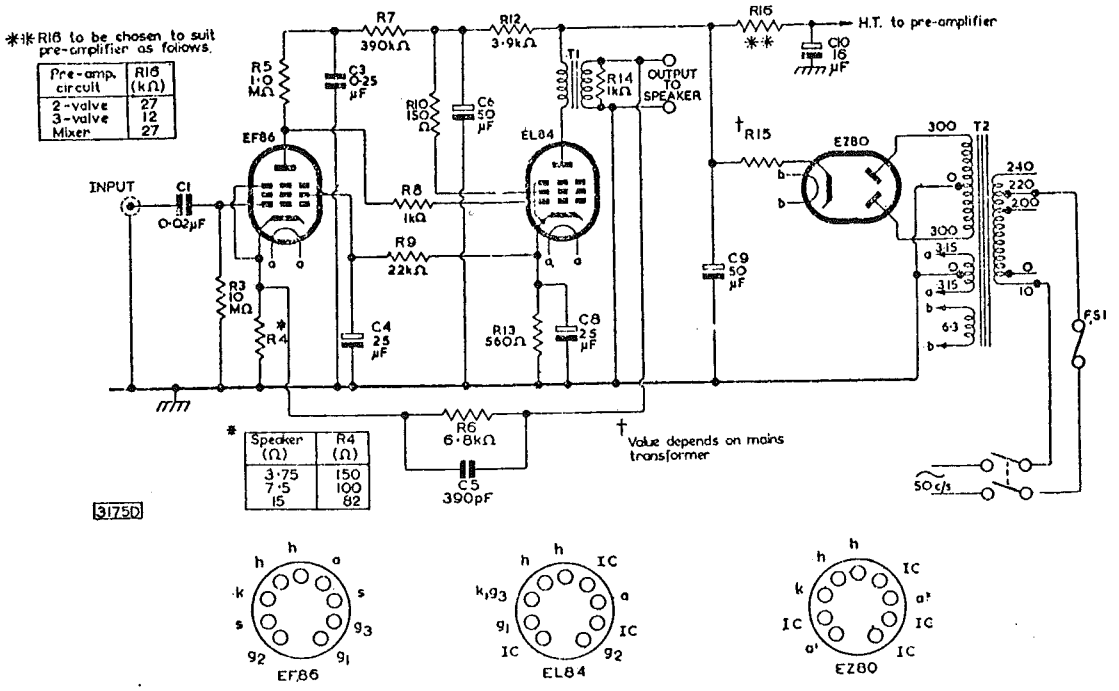
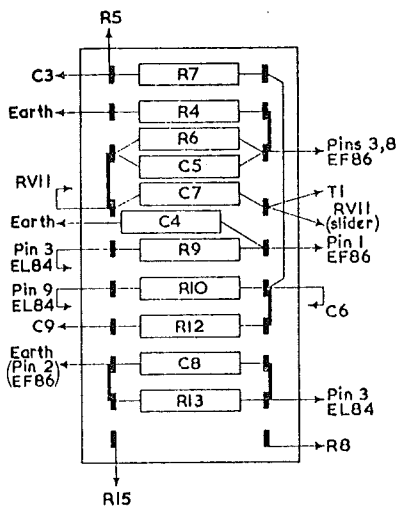
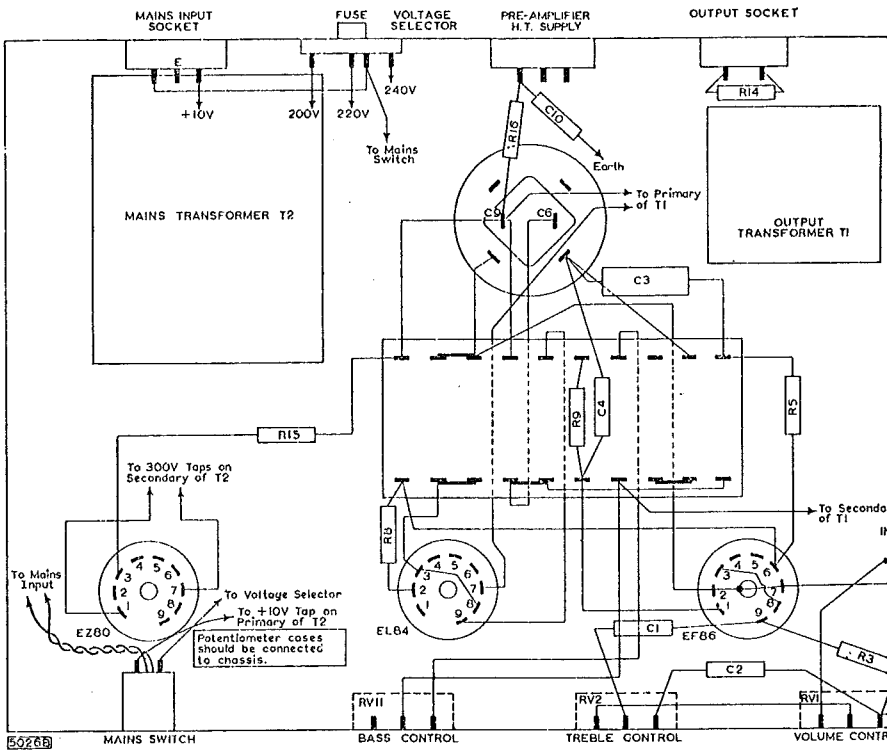


Fig. 8. Schematic diagram of Mullard 3-3 amplifier (1962).



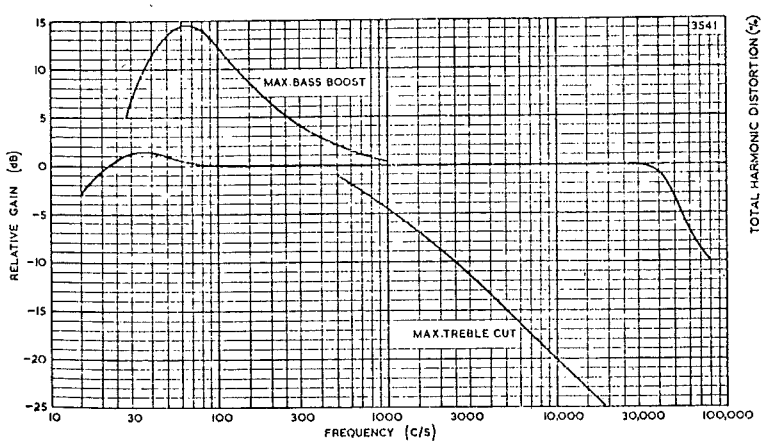
tagboard



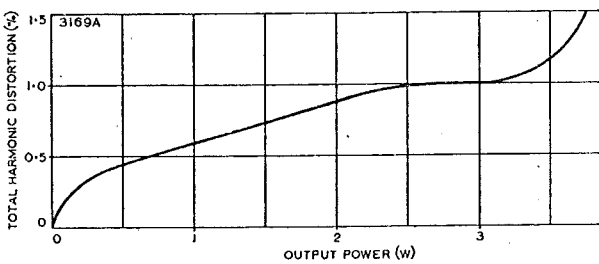
suggested layout of components

Fig. 9. Wiring diagram Mullard 3-3 amplifier.

Fig. 10. Performance curves of the Mullard 3-3 amplifier.



Frequency response of amplifier showing relative gain without application of tone controls, and also showing relative gain with maximum application of tone controls.



variation of total harmonic distortion with ou power