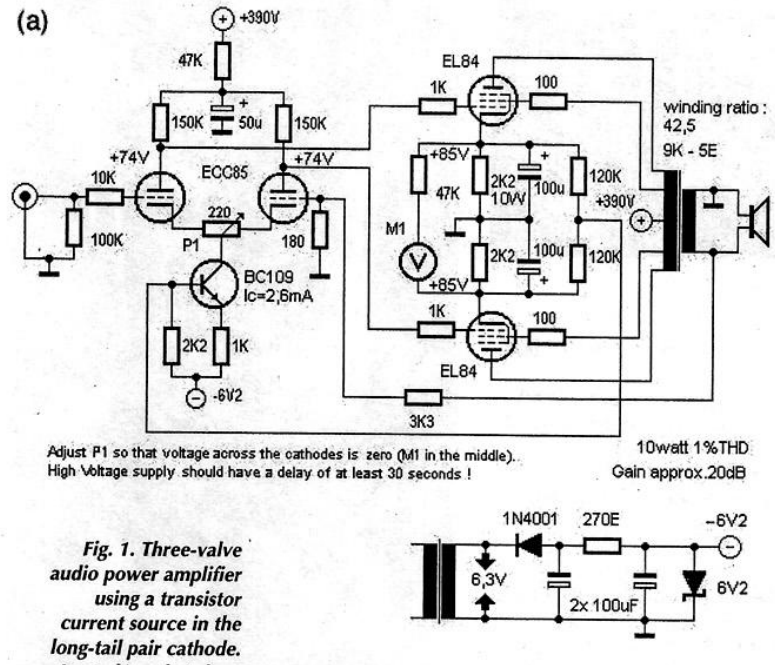


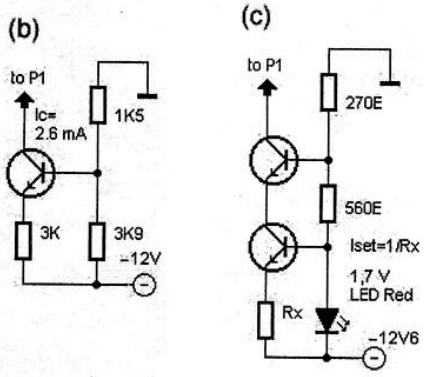
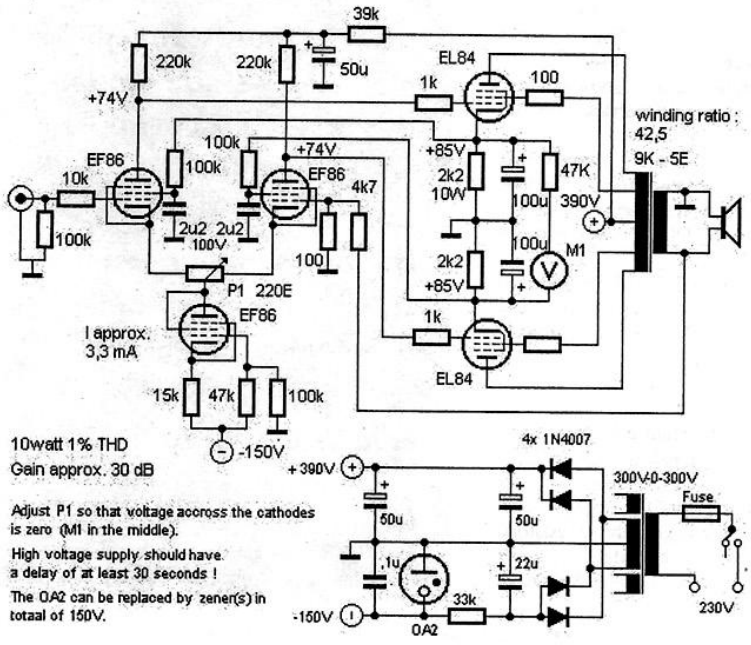


Fig. 1. Three-valve audio power amplifier using a transistor current source in the long-tail pair cathode. Insets b) and c) show alternative ways of forming the current source. In the original design, –6.2V was chosen as the source supply rail due to the convenience of the 6.3V heater winding.



or so. In this way the balance of the output stage remain stable over a very long period.

Overall feedback is accomplished by the 3.3kΩ resistor, the 5Ω transformer winding and the negative input of the long-tail pair. Total gain of the amplifier is approximately 20dB while overall feedback is approximately 6dB.

Transformer alternatives

The Amplimo VDV8020 toroidal output transformer would be the perfect choice as output transformer. The primary impedance of this toroidal transformer is 8kΩ and ultra-linear taps are provided. Frequency response is exceptional with –3dB points at 2Hz and 134kHz.

An extremely high coupling factor, very low leakage inductances and low internal capacitances have achieved this. There are no conflicting resonances below 100kHz. This performance is achieved through the use of multi-sectioned windings together with special combinations of series and parallel connections. The multi-segment secondary winding has a 5Ω impedance, contrived to be suitable for both 4Ω and 8Ω loudspeakers.

In 1993, Amplimo was the first company in the world to supply toroidal output transformers with a quality factor greater than 290 000. This factor is synonymous with frequency range.

Other suitable transformers are the Hammond 1608 or 1650F (USA), the BorderPatrol OTTP-610 (England), the Sowter U004, U064, UA23 or U082 (England).

A vintage Unitran 9U13 is used as output transformer throughout this project. This Dutch transformer is made back in the sixties. Unitran manufactured some fine transformers.

All transformers mentioned are still in production, except for the Unitran.

Amplifier 1 in summary

This amplifier circuit has no coupling capacitors, it works well and it is very stable.

As is common with DC-coupled valve amplifiers, the heater filaments must be up to temperature before the HT is applied to the circuit. This means a power-up delay of at least 30s.

Cathode capacitors on the output valves ensure that AC signals cannot feed back to the input stage through the current source transistor.

We designed this amplifier to give good performance yet remain simple. One area that could possibly benefit from a little extra complexity is the current source.

The suggested circuit works only with output valves biased fully in Class A. If for any reason the power supply voltage rises by, say 10%, then the output valves will be automatically overloaded.

In a recent design, we used a regulated DC power supply for the driver stage. This makes the circuit more flexible.

Amplifier design 2

We designed a second DC-coupled amplifier using three EF86s and EL84s in push-pull. Shown in **Fig. 2**, this circuit provides even better stability.

To enhance stability, the current source incorporates an EF86 pentode and the long-tail pair uses two more EF86s. Stability is improved because the DC differences in the output stage taken from the cathodes of the EL84s are fed to the screen grids of the EF86s of the long-tail

Fig. 2. Stability is improved by replacing the dual triode with two EF86 pentodes and using the same pentode as the active device in the current source.