A Vintage Hi-Fi TV Sound Unit

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A common complaint from TV viewers over the years has been that the sound quality produced by a receiver doesn't match the picture quality. Anyone who watches a jazz concert for example will be familiar with the sight of a bass player plucking away like mad to no audible effect whatsoever from the TV set's "super hi-fi full-range 2½in. speaker"! The general design of the audio output stages used in hybrid colour sets followed much the same lines as those found in the "midget" radios of thirty odd years ago. The tiny output transformers and under-sized speakers live on, producing noises that are no more acceptable than they were long ago.

One obvious solution would be to extract the TV sound and feed it to a decent audio system. Various ways of doing this have been described in past articles. There are problems with this, not the least of them being the live TV chassis. For a long time I toyed with the idea of producing a small add-on unit that could be plugged into the audio output valve socket in a hybrid receiver to give reasonable quality sound with a minimum of trouble. The targets I set for the design proved rather difficult to achieve however.

Requirements

First and foremost there had to be a push-pull output stage, with all the attendant advantages such as cancellation of hum voltages and magnetizing currents in the output transformer, permitting the use of a modestly sized unit without incurring other penalties. It had to be a true plug-in replacement for the standard output valve (usually a PCL86), drawing the same heater and h.t. currents. This implied no more than 13·3V at 0·3A for the heaters, and around 230V at 45mA for the h.t. supply. A minimum of two triodes and two pentodes would be required (a.f. amplifier, phase inverter and push-pull output), but even the use of double valves seemed to be ruled out since most triode-pentodes require some 12·5-16V each for the heaters for a start. The idea remained no more than that for a long time, until I found the complete answer during one of my trips down memory lane for a vintage TV article.

I was browsing through some ancient service manuals – they must have been literally thrown out by someone, since my son rescued them from a rubbish tip – when I came across one for the Ferguson Models 983T and 988T. These were Band I only receivers released in early 1951. The 988T was a 12in. table model while the 983T was housed in a console cabinet. This made it possible to employ an 8in. speaker in the 983T. It was complemented by the addition of a push-pull output stage – they did things like that in those days! It was evident that this had involved the same design problems that had been exercising my mind, and it was highly satisfying to discover how they'd been overcome.

The valves chosen were ECL80s, small triode-pentodes that were originally designed for use as the field blocking oscillator and output stage but which came to see service in all sorts of applications – in audio, sync and multivibrator circuits, even as the frequency changer in some sets. Their advantage was the modest heater requirements – 6·3V at 0·3A – though for some applications there was the disadvantage of a common cathode for both sections of the valve. The total h.t. consumption for a pair of them would amount to very nearly the 45mA mentioned earlier, with a 200V h.t. rail.

Circuit Description

The circuit used in the 983T, modified very slightly for this add-on unit, is shown in Fig. 1. V1A is a voltage amplifier and, to overcome the common cathode restriction, V2A is an inverter with unity gain (controlled by

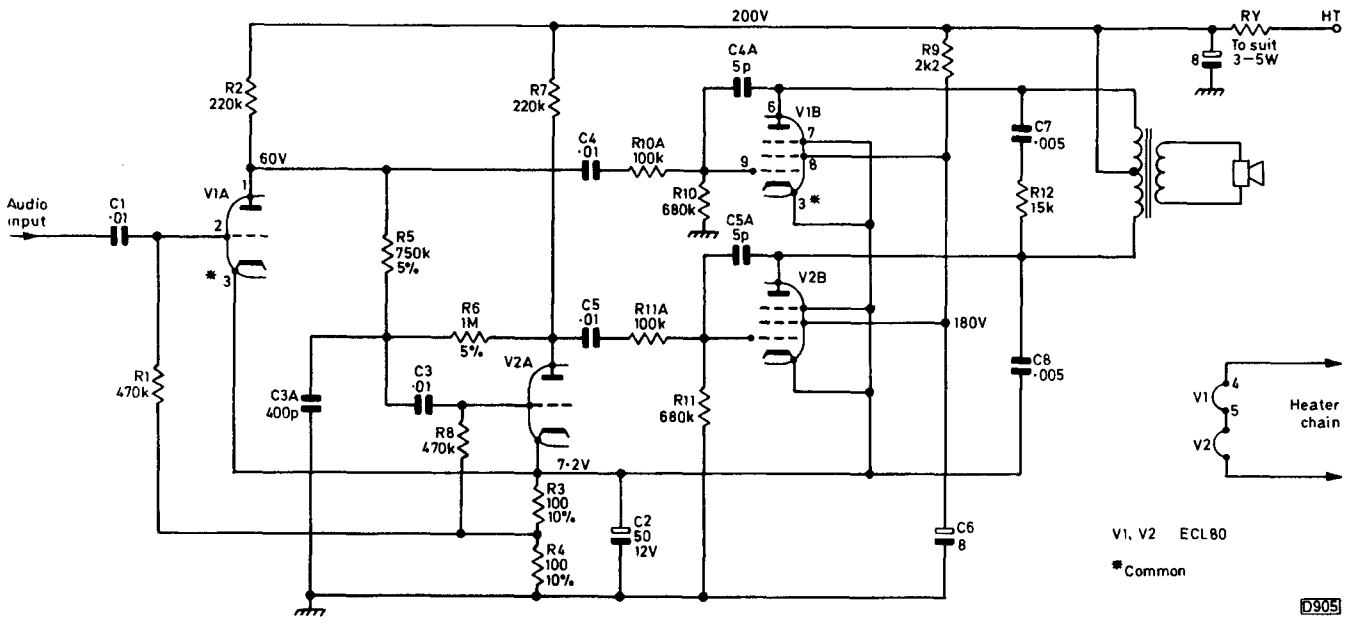

Fig. 1: Circuit of the vintage hi-fi sound adaptor module.

feedback via R6). The antiphase outputs obtained at the anodes of the two triodes drive the push-pull output pentodes. It's a delightfully simple circuit that can be built up quickly and easily.

Construction

Literally everything required was already to hand – in some cases from the junk box! The valves in particular were no problem, since the ECL80 was an extremely popular valve and a dedicated hoarder such as you-know-who is bound to have quantities of them stashed away. The chassis consists of a standard two-gang metal box, switch sockets for the use of, which was conveniently stamped on its base to give knock-outs for conduit entry. Two of these knock-outs were just the right size for B9A valveholders. A standard twelve-position tagstrip was rivetted down the centre of the box to carry much of the wiring, the box itself being inverted so that all components except the valves and the output transformer are contained within it.

The transformer is a standard RS multi-ratio type – I'd several in stock from way back. As I couldn't find any reference anywhere to the correct matching for a pair of ECL80s in push-pull, I adopted the reasonably reliable formula of multiplying the anode resistance of a single valve by 1·4. In many cases this gives an acceptable approximation, as was confirmed by the results achieved with this unit. The ECL80's pentode section has an anode resistance of 11kΩ, indicating the need for a 15·4kΩ anode-to-anode load for a pair. This was satisfied by using primary tappings 1 and 4, with 2 as the centre tap. As I was using a 3Ω speaker, the secondary tappings were C and D.

Modifications

Simple though the circuitry is, it will be apparent at even a quick glance that if anything should go wrong the circuit has the makings of a very efficient cathode-coupled multivibrator. With hindsight, it seems likely that stray capacitances formed by the wiring in the original Ferguson sets had some beneficial stabilising effects. During the initial testing of my version I found that there was supersonic oscillation, the only direct confirmation of this being a heavy negative voltage at the grid of V2A. It was suppressed by adding a 400pF capacitor (value selected at random) between the junction of R5/6 and chassis. The oscillation was caused by positive feedback, which degraded the frequency response. Fitting C3A greatly improved matters. It transpired that Ferguson subsequently modified their circuit, adding 100kΩ grid stoppers and 5pF feedback capacitors in the output stages (R10A/R11A/C4A/C5A). I didn't find this necessary, but these components could be added if instability is experienced.

Interconnections

All connections to the TV set were made via a B9A plug, itself very old new stock – if you see what I mean! Ordinary thin flexible leads were used for the h.t. and heater supplies and for earthing, with a fine screened cable for the audio input. The exact connection will depend on the set being adapted. In most cases the input from the slider of the volume control is taken to the grid of the triode section of the PCL86 (pin 1). Thus the amplifier's input will be tapped from this pin. In GEC hybrid colour sets however the volume control is connected between the triode and pentode sections of the PCL86, so in this case pins 1 and 9 of the adaptor must be connected together and the a.f. taken from pin 8. The earth connection (an ordinary cable plus the screening) is taken to pin 2, which in GEC sets is connected directly to chassis. In other sets it will be necessary to add a shorting link beneath the valveholder. The h.t. is tapped from pin 6 (pentode anode). If it's necessary to reduce the h.t. voltage (in general 200V should not be exceeded) this can be done very conveniently by removing the h.t. and anode leads from the original audio output transformer and linking them via a suitable resistor with decoupling – if the rail is already at about 200V, simply bridge across the transformer. For sets using a PCL82 audio valve the connections are the same for the audio input and h.t. (pins 1 and 6 respectively), with either pin 2 or 8 used for earthing via a link inserted in the set. The heater connections are 4 and 5 in both cases.

Results

The results were most satisfying and made the whole project worthwhile. The most noticeable improvement is with music that's been heard many times before, for example that with the test pattern or commercials. The sound has that elusive and hard to describe quality that makes for listening pleasure: the frequency response seems to be even throughout the range, with the lower notes clear and the treble free of tinniness. The sound will be enhanced even more if a good external speaker is used. At present I'm using (not unnaturally) a vintage 8in. unit taken from a Bush TUG68. Do try this little amplifier: it's very easy to build and will repay the time spent.