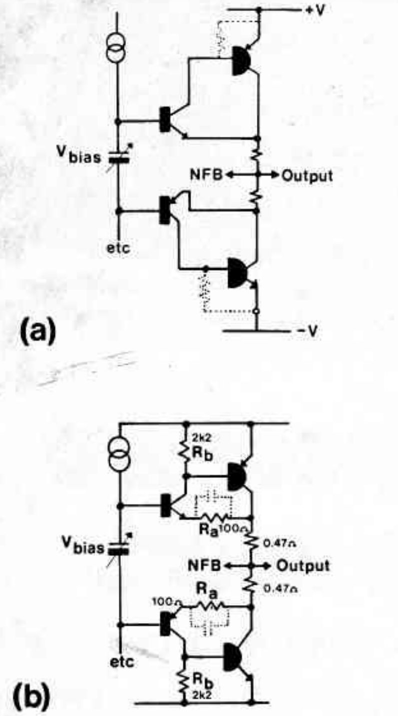
Fig4 TRIPLET ARRANGEMENTS WITH POWER 'DARLINGTON' TRANSISTORS



At this stage, the question arises as to whether the amplifier should be a direct-coupled or a capacitor output design. My earlier 75 watt design used a direct-coupled configuration, and was one of the earliest systems to exploit the advantages in LF loudspeaker damping offered by such an output stage. (I often wonder to what extent I was responsible for the current fashion in which it hardly seems respectable to offer a 'hi-fi' design which has a capacitor between the output and the LS unit.) In the years since 1971, when I first became interested in direct-coupled designs, I have arrived at a somewhat different appreciation of the advantages and disadvantages, and am no longer so sure of any clear-cut preference.

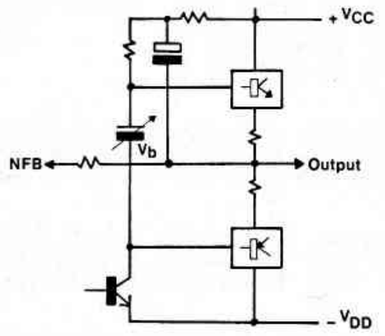
Basically, my thinking is this. If one has well-designed speaker units, with not too much internally introduced impedance between the bass driver and the terminals on the back of the box, and if these speakers are situated well away from the corners of a fairly spacious, well damped listening room—in which room resonance characteristics will not dominate the performance of the speakers at the LF end—then a direct-coupled amplifier design might show a *small* advantage in bass end clarity. However, these requirements are often not met, for reasons of LS design or the exigencies of the placing of the speakers in the listening room, and in these cases the advantages of the direct-coupled design are non-existent while the disadvantages in cost and complexity remain.

The advantages of the capacitor output-coupled amplifier are that since it only uses a single HT supply line, it cannot, under fault conditions, pour DC through the speaker, and it is much easier to design a system which doesn't need output transistor protection and doesn't suffer from switch-on thumps.

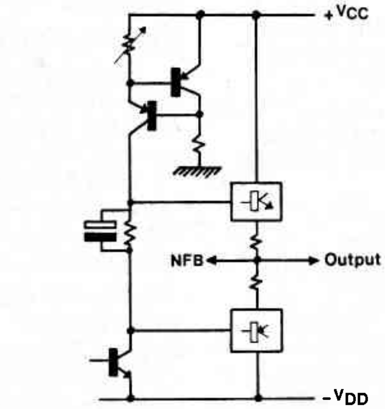
So, the decision was taken to use capacitor coupling at the output.

Relatively few design decisions now remained. Of these, the most significant was whether to give the second, class-A amplifier stage a bootstrapped collector load (fig. 5a), or to use a 'constant current' source (fig. 5b). The merits of these two arrangements are fairly well balanced. For example, the 'bootstrapped' driver will give a slightly larger output power for the same HT voltage, and is simpler, while the constant-current source arrangement will give a slightly lower second-harmonic distortion figure, which allows the same overall THD figure to be obtained with a lower open-loop gain—which makes the preceding circuitry simpler.

Fig5 ALTERNATIVE DRIVER STAGE LOAD SYSTEMS



(a) 'BOOTSTRAPPED'



(b) CONSTANT CURRENT SOURCE

The final design of the circuit is shown in fig. 6. The output transistors chosen, Motorola MJ 2501 and MJ 3001 power Darlingtons, have a generous safe operating area (fig. 7), and will allow this circuit to be driven into zero impedance or highly reactive LS loads without any other protection than an output fuse.

The input transistor, T_1, is fed through an input HF filter, R_2C_3, of the same type used in the 75 watt design, which limits the rate of change of the input signal voltage and avoids the possibility of slew-rate limiting or transient-intermodulation effects. The base potential of this transistor is derived from the voltage divider R_1R_4, in which R_4 is adjustable so that the DC level at the output mid-point can be set to half the HT voltage. Because of the 47μF capacitor C_2 across this potential divider, the output mid-point voltage will rise only very slowly following switch-on, which avoids the generation of switch-on 'plops'.

Overall negative feedback is applied through R_{11}, R_6 and C_5, and gives a final gain of 22×. To avoid the feedback bypass capacitor, a 100 μF/10 volt Tantalum bead type, or the input transistor TR_1, becoming reverse-biased on switch-off, the capacitor is bypassed by a normally non-conducting silicon diode. HF stabilisation of the amplifier is achieved, as in the 75 watt design, by a 220 pF capacitor between the collector of the second stage amplifier TR_3 and the emitter of TR_1. By rolling off the gain of the amplifier at a predictable rate, it is possible to avoid any likelihood of transient distortions. It is also possible by this means to obtain as high a phase- or gain-margin in the amplifier as one wishes. This gives a very well controlled square-wave into reactive-load performance, and a much nicer sound. However, this also leads to a relatively higher THD figure at 20 kHz than the much more commonly used commercial technique of a capacitor between base and collector of TR_2 (which leads to bad

Fig6 POWER AMP