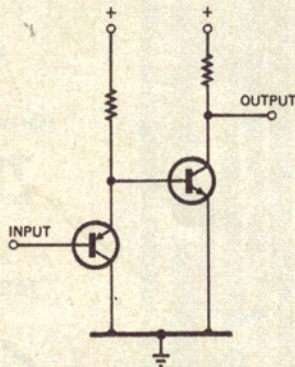


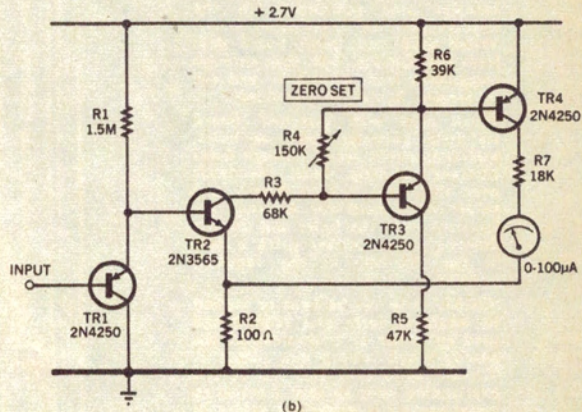
# The Mixed Double — and a DC Millivoltmeter

This mixed double has nothing to do with tennis. But it is a promising new circuit technique stemming from Australia and described recently by R. H. S. Riordan of CSIRO in *Electronics Letters* (August, 1971). It is a new form of balanced input stage which it is claimed overcomes the disadvantages of the long-tail pair, as used in DC amplifiers. In the long-tail pair, the input is not at earth potential unless a split supply is used; furthermore the gain is only half that of an equivalent single transistor stage. The basic arrangement of the new mixed double is shown in figure (a); it will be seen that this uses one PNP and one NPN transistor. A practical application of this circuit to a simple DC millivoltmeter is shown in figure (b). This gives a sensitive voltmeter operating from a single 2.7V battery providing full scale deflection from about 10mV input. The DC amplifier has a loop gain of about 25dB, an input impedance of about 100M and an input offset current of about 5nA, with linearity better than 99 per cent of full scale deflection.

TR1 operates as a common collector stage with TR2 as a common emitter stage. The voltage gain of TR1 is slightly less than unity, but it should have high current gain to minimize the input offset current. The



(a)



(b)

current gain of TR2 is not important, but its high-frequency current gain determines the overall frequency response. Optimum temperature compensation is said to be obtained when base-emitter voltages of the two transistors are equal. With types 2N4250 and 2N3565, temperature coefficients of 70-100µV/degree C were obtained; this is worse than a conventional input stage using matched transistors, but it is adequate for many purposes; much better results might

be obtained if transistors were designed for this application. Temperature coefficient of the voltmeter shown is put at about 200µV/degree C, due mainly to the uncompensated stage.

One possible application for a sensitive millivoltmeter of this type might well be as the heart of a transistorized harmonic detector for TVI work — other uses are likely to occur to readers.

(From "Radio Communication".)