CURRENT DUMPING AMPLIFIER

The recent controversy on 'the current dumping amplifier (December 1975 issue and subsequent letters) has not come up with any consensus as to whether it is just an elegant method of applying feedback or whether there is an element of feedforward in it. It can be shown quite easily that with an amplifier of finite open loop gain (and consequently finite feedback), the current dump trick achieves much more than feedback alone possibly could. An expression is derived below for the current dump configuration given by Mr Walker and Mr Albinson in *Wireless World* (Dec. 1975), but the amplifier considered has a finite open loop gain and a finite input impedance. With these constraints, and assuming an arbitrary non-linear transfer function for the current dump block, an expression can be derived wherein it can be shown that the error in the current through Z_4 is exactly compensated for by the current through Z_1 provided the conditions given in equation 4 are satisfied.

$$V_{01} = A(V_{in} - V_1) \tag{1}$$

$$V_1 = (Z_f \| Z_3 \| Z_{in})\left(\frac{V_{01}}{Z_3} + \frac{V_{in}}{Z_{in}} + \frac{N(V_{01})}{Z_2}\right) \tag{2}$$

$$V_L = (Z_L \| Z_1 \| Z_4)\left(\frac{V_{01}}{Z_1} + \frac{N(V_{01})}{Z_4}\right) \tag{3}$$

Simplification yields the combination required to make V_L independent of $N(V_{01})$

i.e. $\dfrac{Z_1 Z_2}{Z_3 Z_4} = \dfrac{1}{1 + \dfrac{1}{A}\dfrac{Z_3}{Z_{in}\|Z_2\|Z_3\|Z_4}}$ (4)

For an infinite gain op-amp, equation 4 reduces to Walker's original form. To confirm this result an amplifier was made with a variable open loop gain (A). This variation in open loop gain was obtained in an elegant manner by connecting a potentiometer across the compensating terminals of the operational amplifier used. The circuit was designed to have minimum distortion for an open loop gain of approximately 52dB, corresponding to 20dB of feedback. Fig. 2 shows the results which confirm that increasing feedback beyond a particular value makes the distortion figure worse. In fact with all the current dump elements removed and the same amount of feedback (20dB), the distortion measured 3.1% against the null reading of 0.4%. This should remove any doubt about the effectiveness of the method, and Mr Walker and Mr Albinson of the Acoustical Manufacturing Company should be congratulated on innovating a most elegant method for removing distortion and for eliminating thermal problems associated with the output stages of high power audio amplifiers.

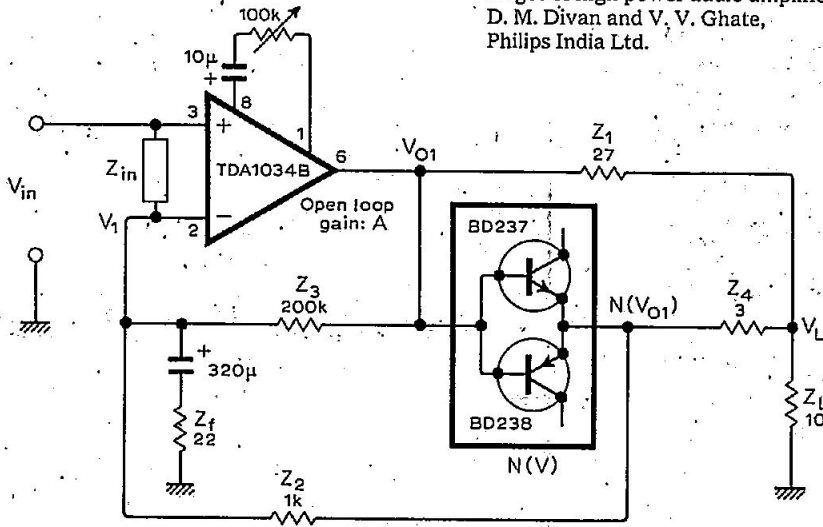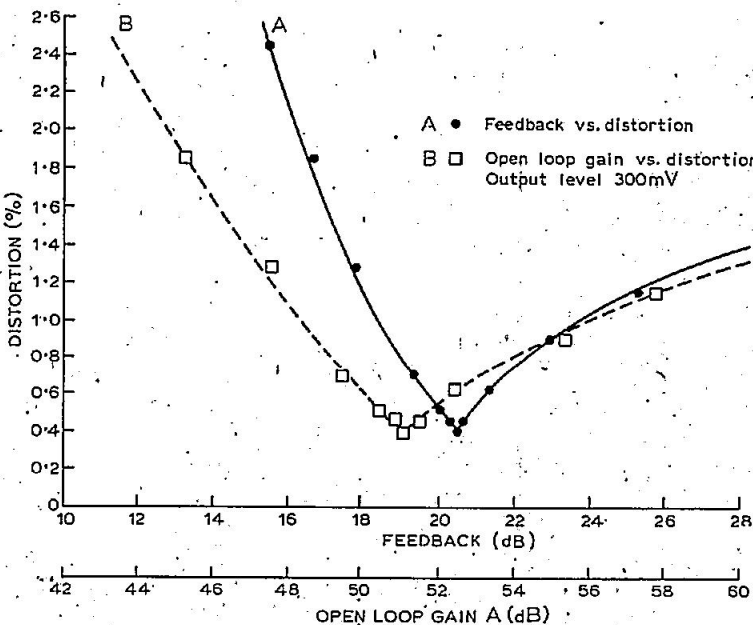D. M. Divan and V. V. Ghate,
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Fig. 1

A ● Feedback vs. distortion
B □ Open loop gain vs. distortion
Output level 300mV

Fig. 2