We now consider the use of the multiplier UNIT "D" in solving equations.

THE MULTIPLIER IN EQUATION SOLVING

Fig. 10.1 sets out four multiplier configurations to show how equation terms may be handled. As a self-contained computing element, UNIT "D" will multiply input voltages X and Y to give a product $XY/10$, see Fig. 10.1a. Note that arrows are normally used with the multiplier symbol to identify input and output terminals.

Division of two variable voltages is achieved, in Fig. 10.1b, by placing the multiplier in the feedback loop of an operational amplifier. However, with division, certain limitations are imposed. The Y input must be of single polarity, which rules out a.c. waveforms unless they are d.c. biased above or below $Y = 0$, but ramp or step functions will be accepted if they do not change their sign. With the X input, voltages can be 0 to ± 10V d.c., or a.c. peak.

Because an extra filter capacitor (shown dotted in Fig. 10.1b) is needed to prevent amplification of low-level carrier ripple by the open-loop, high gain amplifier, frequency response is restricted to 10Hz for the division operation, when switch S11 is in the 50Hz position. It is sometimes possible to arrange a problem so that the reciprocal is multiplied, and thus avoid the limitations of Fig. 10.1b division. A related configuration in Fig. 10.1c gives an output $XY/(1 + X)$, for inputs of $\pm X$ and $\pm Y$.

In the final example of Fig. 10.1d, the multiplier is combined with integrators, and therefore handles time varying voltages. By solving the equation $dA/dt = 2\pi R \times dR/dt$, which describes the rate at which the area of a circle changes with a growth of radius, the layout of Fig. 10.1d can be used to investigate,

ANALOGUE COMPUTER

PE AC

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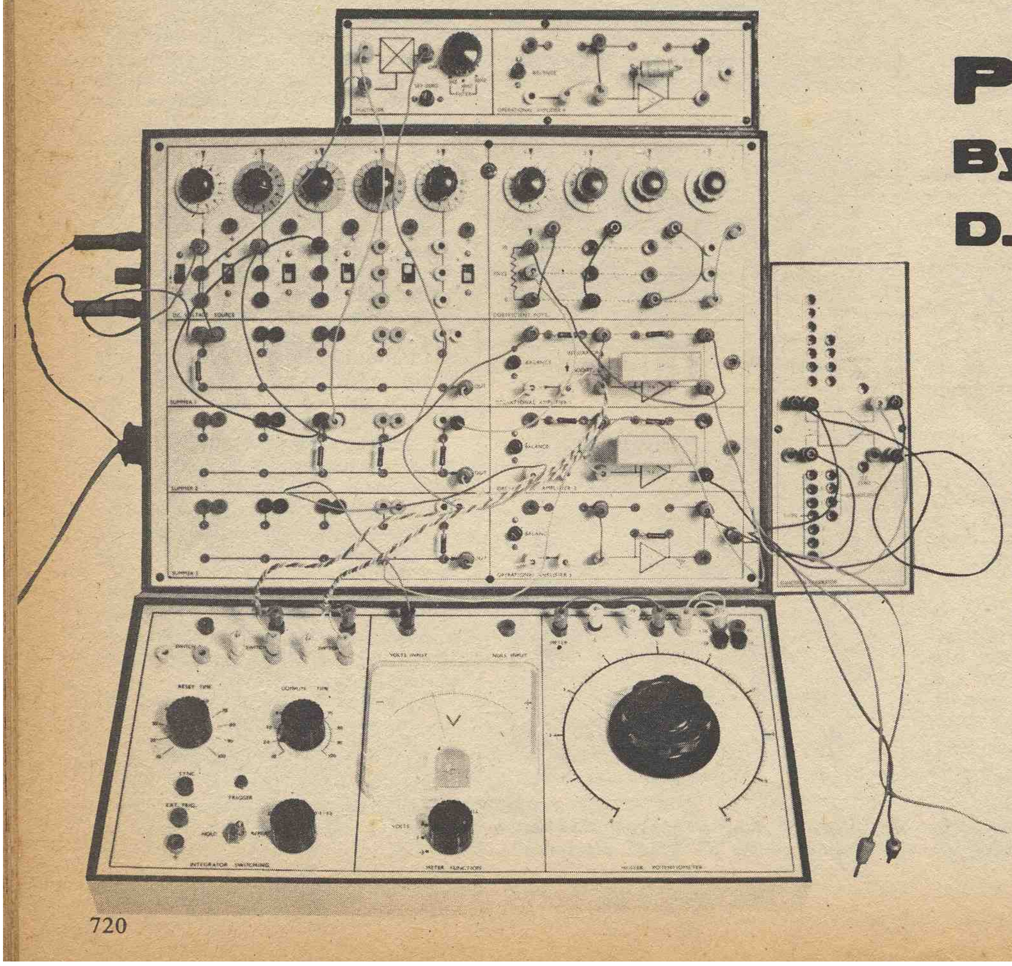

The Practical Electronics Analogue Computer in its complete and comprehensive form. The whole of this equipment has been fully described in this series of articles which is concluded this month