The compute mode is initiated by opening S1 and closing S2 (Fig. 1.2c). After 2·5seconds, S2 automatically opens and the amplifier input is left floating, with C_f still connected between input and output and holding a stored charge. A meter coupled to the integrator output will show the distance travelled after 2·5s of acceleration.

The "hold" period can occupy several tens of seconds, and is usually at the discretion of the operator. To begin a new computer run, S1 is closed, discharging C_f through R_r, thus resetting the integrator output to zero. The input E_{ic} in Fig. 1.2c, is to allow an initial condition to be applied to the integrator, as in the case of a motor car which does not start from rest, but is already in motion when it accelerates. When computing and resetting times are shorter than about 1s, voltmeter answers will appear to be given at the instant of pressing the button which initiates the S1, S2 cycle.

The above description relates to a "single shot" computer run, where the operator adjusts, takes a reading, adjusts, and so on. In the repetitive mode, the hold facility is ignored and the computer keeps on repeating the answer curve, for display on an oscilloscope, chart recorder, or XY plotter.

DIODE FUNCTION GENERATOR

In many computer applications it is necessary to generate a voltage which varies according to some non-linear function not provided by normal operational amplifier techniques. The diode function generator of Fig. 1.2d will allow a mathematical function to be constructed from a series of straight line tangents, as shown in Fig. 1.4a.

Each straight line characteristic is obtained from a single diode-resistor network, and when the outputs from several networks are summed together a complete function will result. The shape of the final approximated curve is determined by adjustment of the network resistors. Apart from powers of x, and other functions, roots are achieved by placing the function generator in the feedback loop of an operational amplifier.

A single diode network appears in Fig. 1.4b, and the slope of its output characteristic can be varied by adjustment of R_1. The diode breakpoint (the voltage at which the diode starts to conduct) is dependent on the value of R_b.

MULTIPLIER

The computing potentiometer will multiply a variable by a constant, but special techniques must be used to multiply one variable by another variable. The process employed in modern computers is akin to modulation, where the gain of a circuit is controlled by an applied voltage.

The multiplier should yield a product of correct sign when multiplying negative or positive variables, and this is readily achieved with the self-excited time division circuit of Fig. 1.2e. The time division multiplier operates on the principle of modifying the mark-space and amplitude of a square wave in accord with two voltage inputs. The filter of Fig. 1.2e extracts the mean level of d.c. from the square waveform. An additional advantage of the Fig. 1.2e circuit is that it can be arranged to cater for more than two variables. For example, inputs $X1$, $X2$, and $X3$ multiplied by input Y.

Next month: Commencing the construction of UNIT "A".