

## CURRENT INTEGRATOR

This device allows us to determine the integral  $\int i \times dt$ , where  $i$  is the current flowing from the computing circuit to ground. For this purpose a resistor is inserted in the circuit, causing a voltage drop of 100 mV; this voltage is amplified to 100 V, which voltage in turn is used to charge a 0.4- $\mu$ F capacitor (polystyrene); when the voltage of the capacitor has reached its full value (required time with full scale current: 5 sec), the capacitor is automatically discharged, and a counter is activated. Thus, the number of counts on the counter indicates the current integral (full-scale current in microamperes  $\times$  5 sec  $\times$  number of counts = microcoulombs). A small panel meter with a scale of 0–100 is provided on which the charge beyond one full count can be read; in operation the needle of the meter rises in each count from 0 to 100, and then drops back to zero. The wiring diagram, exclusive of the counter, is shown in Fig. 25.32. Three full scale current values are provided: 50, 200, and 1000  $\mu$ A. The accuracy of the integrator can be expressed in the deviation of the time to achieve a count from the theoretically required one. In most usage it is unavoidable that the integrator works a good part of the time at values higher or lower than the full-scale value. On the most critical range the error in time (which is zero from 500 to 2000  $\mu$ A) does not exceed 1% from 50 to 2800  $\mu$ A. In general, use beyond twice the full scale current is undesirable. On the other ranges the accuracy of 1% is maintained even over a wider band. The integrator may be used to integrate the current within a network as indicated in Fig. 25.33.

If the current flows to or from ground, i.e., if one pole of the integrator may be grounded, another device may be used. This latter device provides for an automatic switching of ranges; this is important, because the accuracy of an integrator may suffer if it operates at only a small fraction of its full scale current. Moreover, if no automatic switching is provided, the counter must be read just before switching.

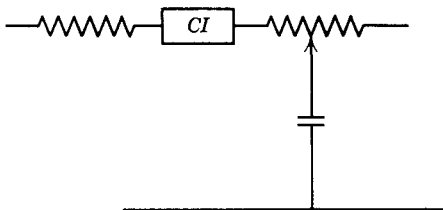


Fig. 25.33. Placing current integrator (CI) in network.

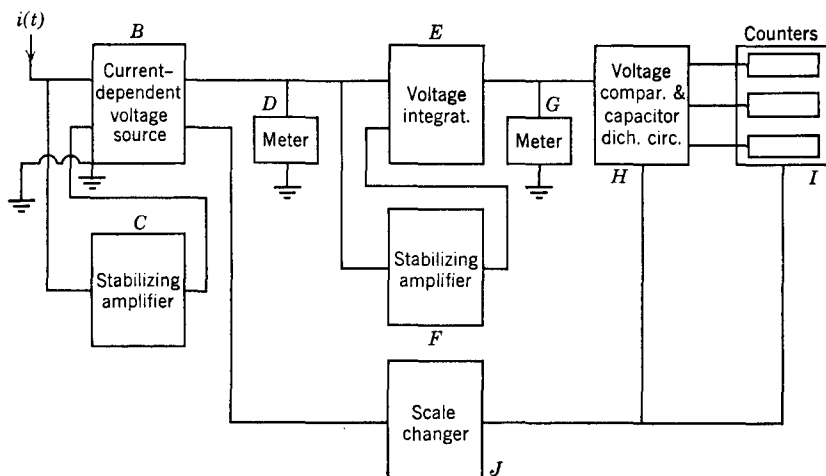


Fig. 25.34. Block diagram of current integrator, one pole grounded.

All these disadvantages are eliminated by the integrator, the block diagram of which is shown in Fig. 25.34. The integrator makes use of the current-dependent voltage source, shown in Figs. 25.18 and 25.19. The complete diagram of the integrator is presented in Fig. 25.35.

## 26. COMPUTER DESIGN

In the previous section, components for computers were discussed. In this chapter considerations governing the design of the total computers will be reviewed. These considerations are rather different for geometric and combined analogs on the one hand and for network computers on the other.

### 26.1. Design of Geometric and Combined Analogs

#### GEOMETRIC ANALOGS

The problems encountered in the construction of such analogs can be grouped in three classes, viz.: (1) representation of the shape of the prime system; (2) application of boundary conditions; (3) measurements of voltages and currents.

The representation of the shape on conducting sheets is practically always done by cutting the shape, after drawing it on the sheet (either side; sometimes use of the nonconducting surface is cleaner). In

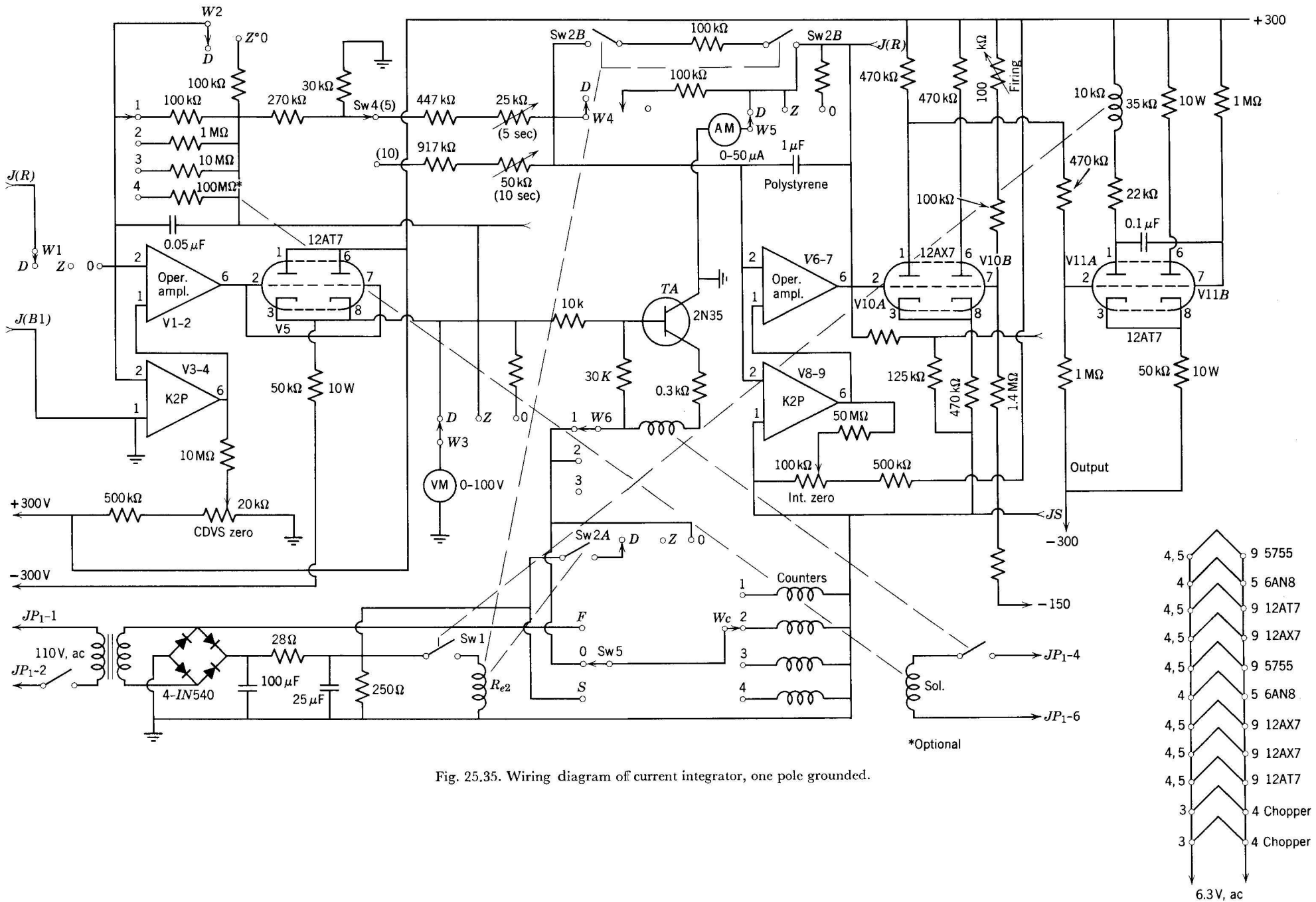


Fig. 25.35. Wiring diagram of current integrator, one pole grounded.

