THEORY OF OPERATION

GENERAL

This part will analyze the operation of each circuit in the Model 260-6P. Because of the great similarity between all 260s, previous models will not be discussed. Although component symbols may vary between models, circuit operation is essentially the same.

DC VOLTAGE MEASUREMENT (fig. 1)

All DC voltages are converted into a current of from 0 to 50 uA. This current is indicated on M1, which has scales corresponding to the different voltage ranges to allow a direct voltage measurement. In order to accurately calibrate the meter circuit, R1 and R2 are provided. M1 actually requires a current of approximately 48 uA for full-scale deflection, and meter shunt R1 is adjusted to pass enough current to allow a total current of precisely 50 uA to flow. Next, to assure an exact 250 mV drop at full scale, R2 is adjusted to make a total meter circuit resistance of exactly 5,000 ohms.

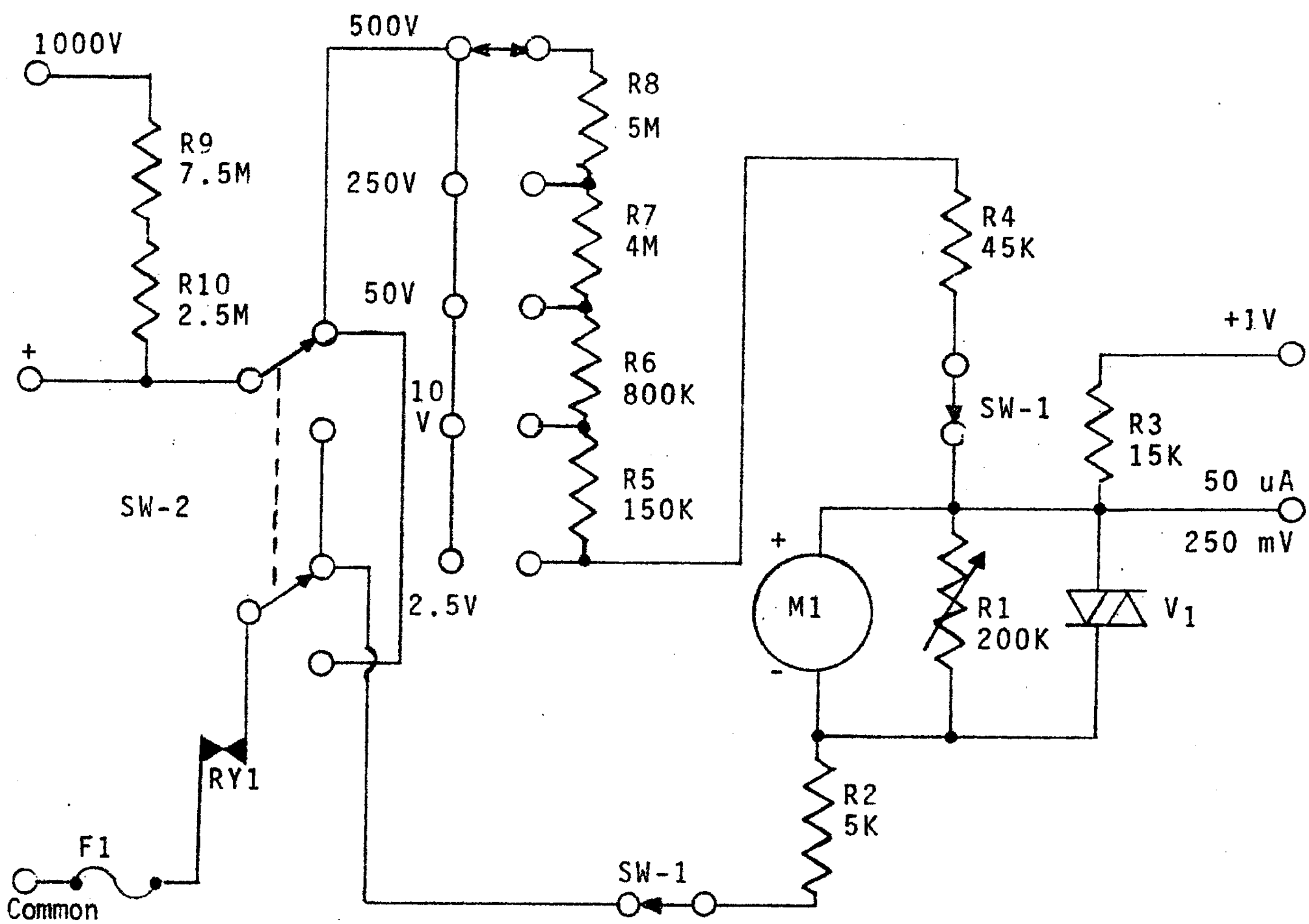

Fig. 1 DC Voltage Measurement, Model 260-6P

Once the meter circuit is calibrated, additional fixed resistors are used (R3 thru R10) to provide higher voltage ranges. These resistors, in series combination with the meter circuit resistance, allow precisely 50 uA to flow where a full-scale voltage is applied to the VOM terminals. R4 thru R8 are selected by the range switch SW-1. R3 is permanently connected to the meter circuit, and R9-R10 are always connected to the "+" input jack.

Varistor V1 affords meter movement protection from large overloads while not affecting the normal accuracy of the VOM.

SW-2 reverses the polarity of the input leads in the event they are incorrectly connected to the circuit under test, while F1 and RY1 provide additional overload protection.

DC CURRENT MEASUREMENT (fig. 2)

Currents are measured with a ring shunt composed of resistors R11 thru R15. In the 1 mA position, all resistors shunt the calibrated meter circuit (see DC voltage measurement for description). As SW-1 selects higher current ranges, the resistance shunting the meter circuit is decreased. Due to the ring configuration, the resistors removed from the shunt are placed in series with the meter circuit.

Separate jacks are provided for the 10 A range and the 50 uA range.

AC VOLTAGE MEASUREMENT (fig. 3)

The AC voltage to be measured is converted into a current and rectified by a modified full-wave bridge rectifier, consisting of D1, D2, R23, and R24. When the input is positive (with respect to common), diode D1 conducts. The resulting direct current divides between R23 and the series combination of the meter circuit, R22, and R24. When the input voltage becomes negative, diode D2 conducts. This time the direct current divides between R24 and the series combination of R23, R22, and the calibrated meter movement. Thus the meter circuit conducts during both halves of each input cycle.

Potentiometer R22 calibrates the 250 V AC range. Once this has been done, R25 can be adjusted using the 2.5 V AC range. R26 thru R30 are the multiplier resistors used to create the five AC voltage ranges.

RESISTANCE MEASUREMENT (fig. 4)

Resistance is measured by measuring the voltage drop across a known resistance. The voltage source is either the 15 V "D" cell (Rx1 and Rx100 ranges) or the 9 V transistor radio battery (Rx10 k range). On the Rx1 range, the known resistance is R16. The sum of R16 plus the resistance of the fuse F1, relay contacts RY-1, and switches SW-1 and SW-2 is equal to the mid-scale value (12Ω) of the Rx1 range.

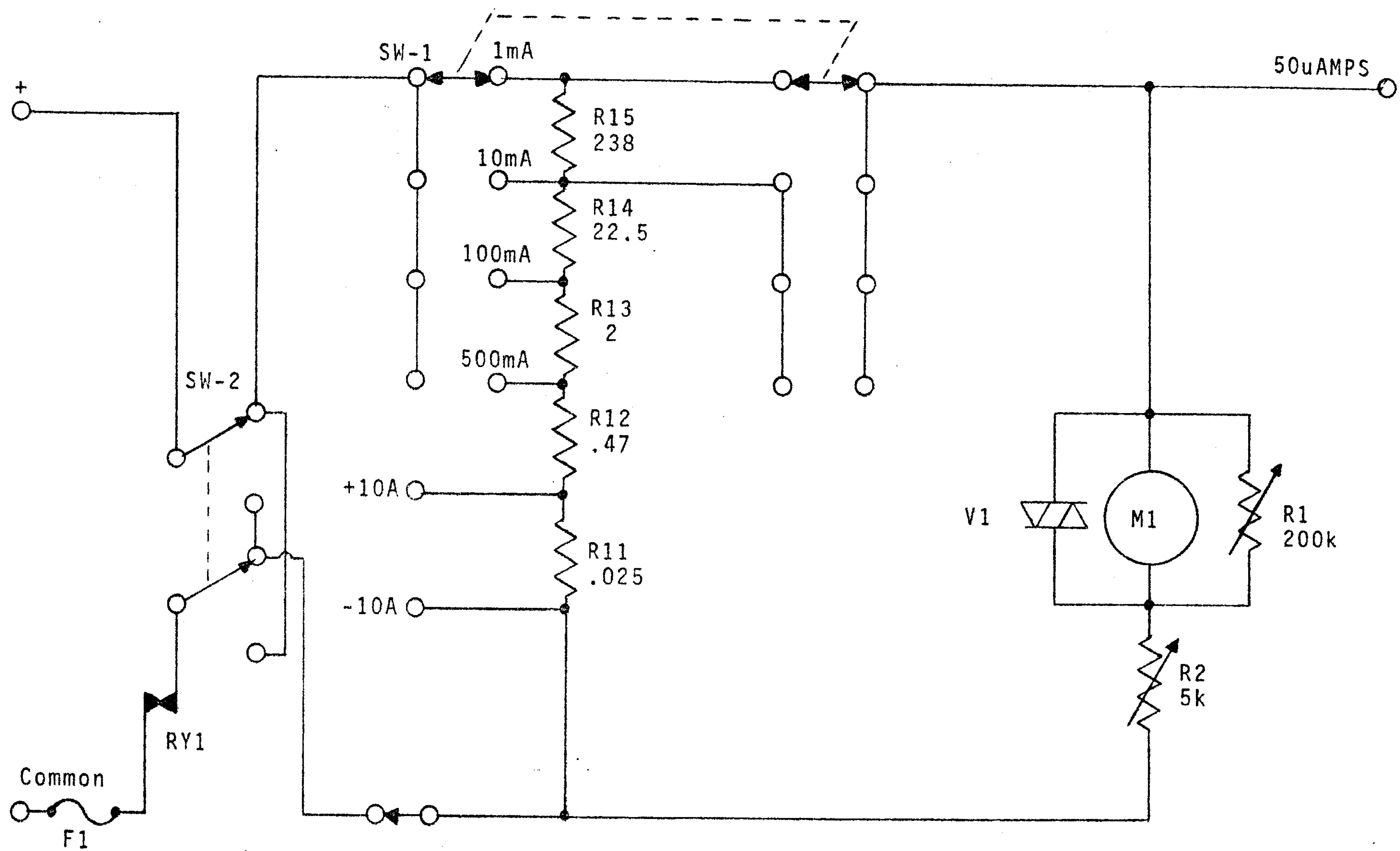

Fig. 2. DC Current Measurement, Model 260-6P

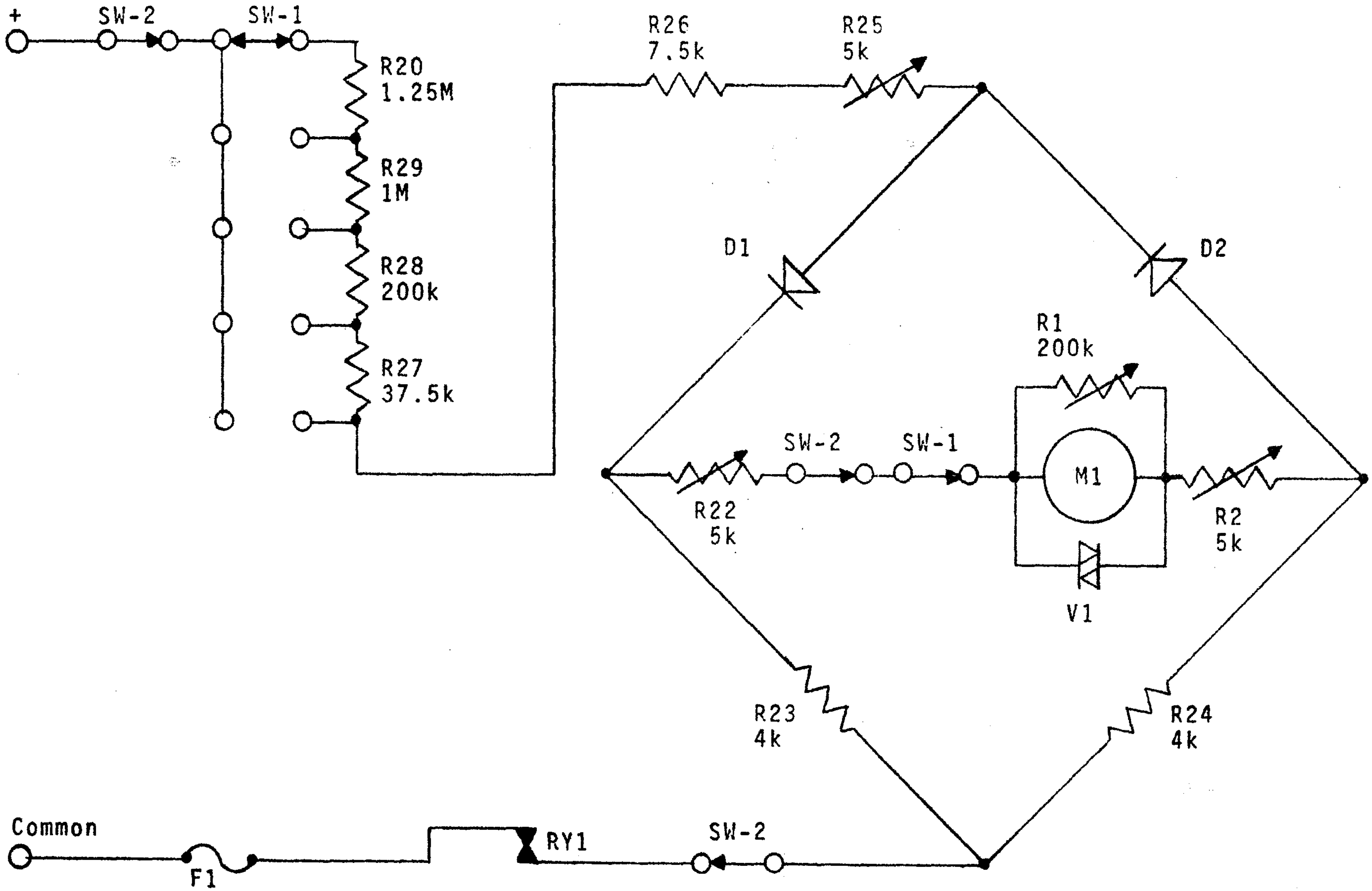

Fig. 3 AC Voltage Measurement, Model 260-6P

Therefore, if an external resistance of 12 ohms is connected across the VOM (which places the resistor in series with R16), the voltage drop across R16 would be exactly half the full-scale voltage and the pointer would indicate mid-scale. Zero ohms control R21 compensates for battery aging, extending the useful life of the battery.

Circuit operation on the Rx100 range is very similar. A total resistance of 1200 ohms (the mid-scale value) is connected in series with the battery. Again, an external resistance of 1200 ohms would cause the voltage drop across the internal resistance to be one-half its full-scale value and the pointer would indicate mid-scale.

Circuit operation on the Rx10 k range is similar, except that the series resistance becomes 120 k ohms.

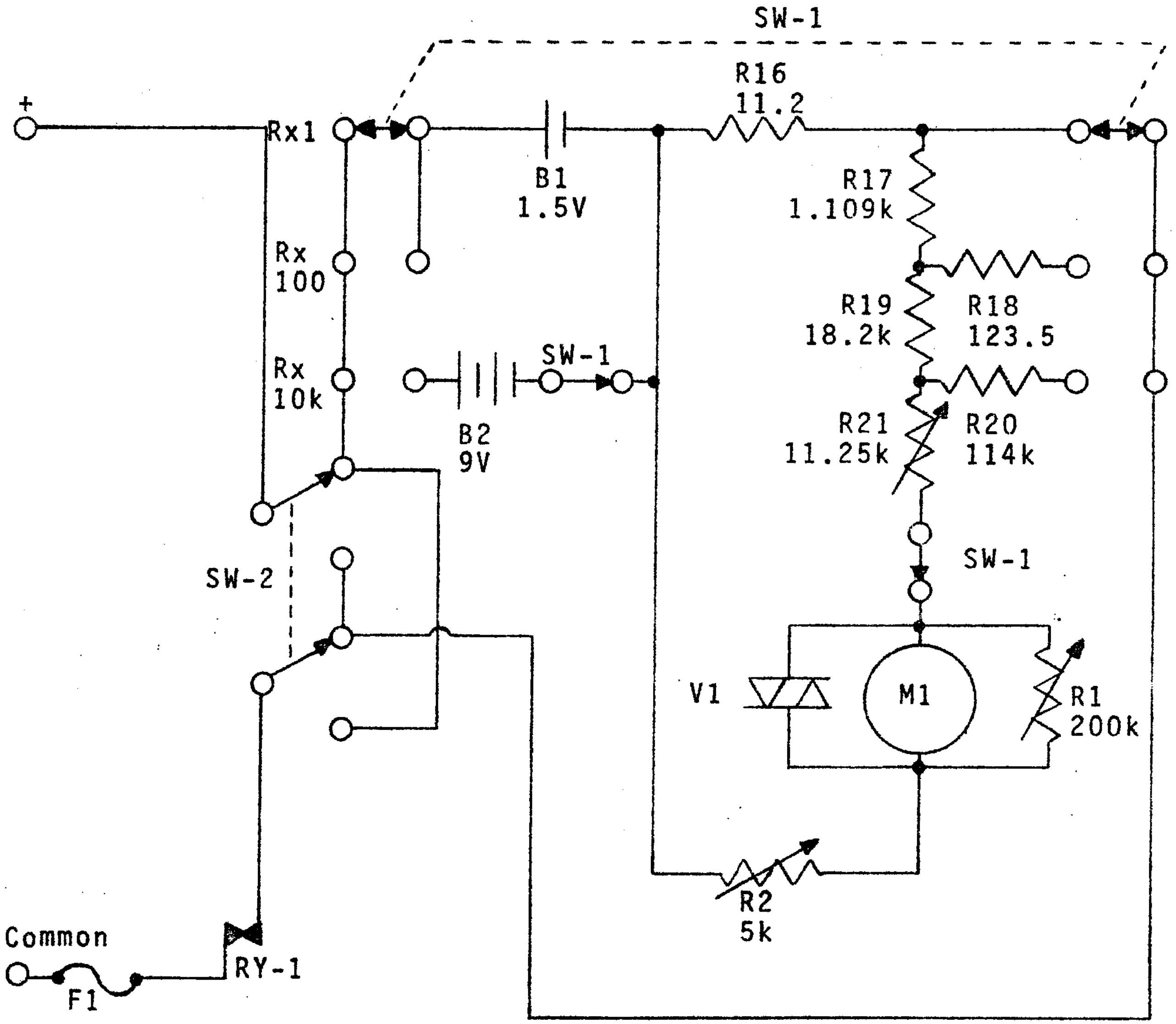

Fig. 4 Resistance Measurement, Model 260-6P

OVERLOAD PROTECTION (fig. 5)

Overloads greater than four or five times normal are sensed by the diode bridge D3 thru D6. V2 and R31 decrease the sensitivity of the bridge. When an overload is sensed, transistor Q1 is turned on thru R32. Saturated Q1 forward-biases Q2, saturating Q2. If the overload is of sufficient duration, Q1 is latched on by feedback from Q2 via D7. C4 provides a short time delay to prevent false triggering on transients.

When Q2 saturates, it energized RY-1. Two independent switches on RY-1 perform separate functions. One switch opens the common path in the VOM input, while the other switch disconnects the 9 V battery to prevent a continuous current drain. Both switches remain open until the reset button on the front panel is depressed.

To reduce the overload circuit sensitivity on the Rx10 k and 250 V ranges, the negative lead of the 9 V battery is connected to the junction of D3 and D6. This places D3 in series with the emitter-base junction of Q1. The overload must overcome this additional diode voltage drop before it can activate the overload relay.

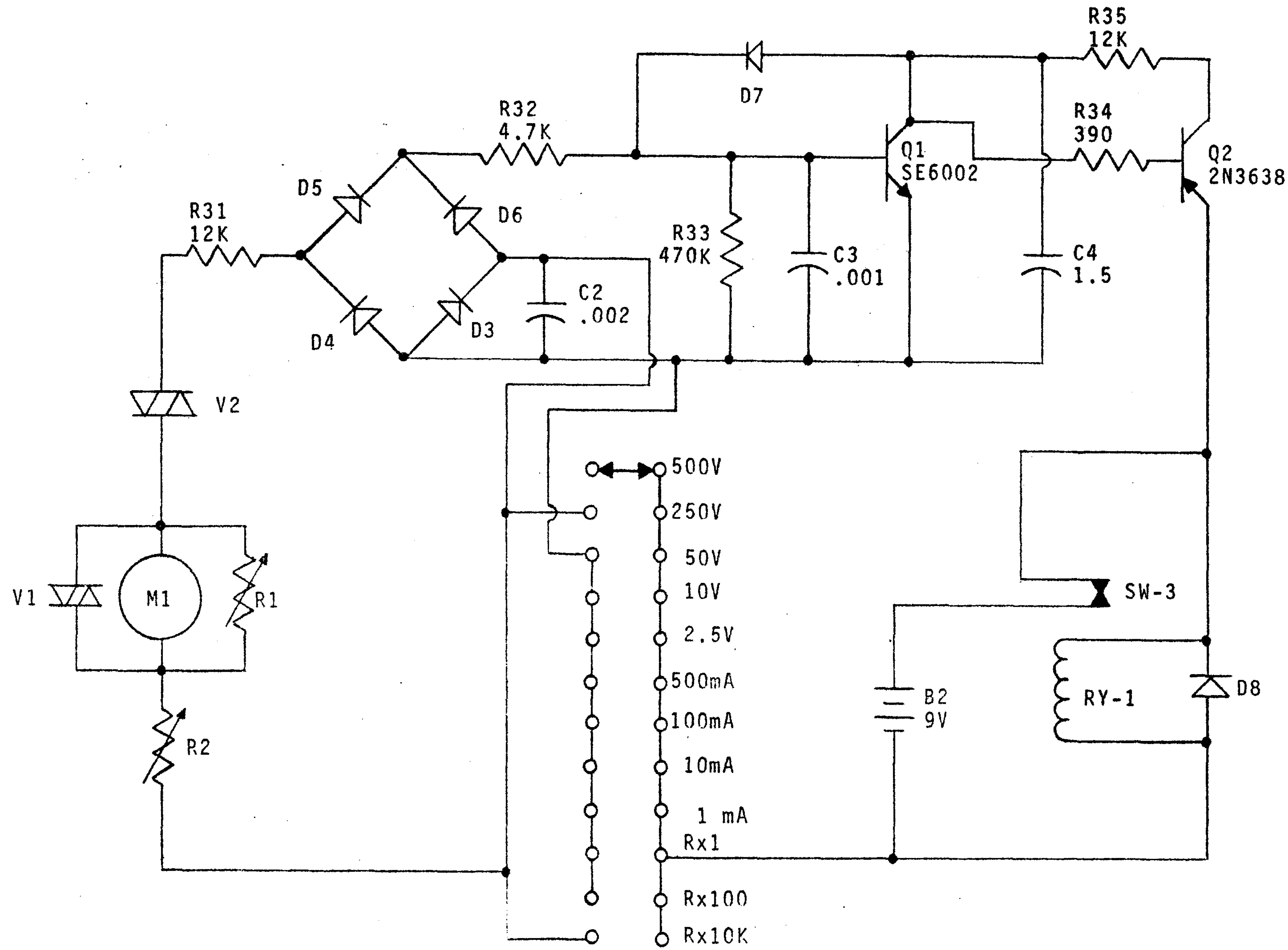

Fig. 5 Overload Protection, Model 260-6P