automatic battery charger

Recharging lead-acid batteries is often assumed to be an extremely straightforward matter. And that is indeed the case, assuming that no special demands are being made on the life of the battery. On the other hand, if one wishes to ensure that the battery lasts as long as possible, then certain constraints are placed upon the charge cycle.

Figure 1 illustrates the ideal charge current characteristic for a normal 12 V lead-acid battery which is completely discharged. During the first phase (A–B), a limited charging current is used, until the battery voltage reaches approximately 10 V. This restriction on the charging current is necessary to ensure that the charger is not overloaded (excessive dissipation). For the next phase (C–D), the battery is charged with the '5-hour charging current'. The size of this current is determined by dividing the nominal capacity of the battery in ampere-hours (Ah) by 5. At the end of this period the battery should be charged to 14.4 V, whereupon the final phase (E–F) starts. The battery is charged with a much smaller 'top-up' current, which gradually would decrease to zero if the battery voltage were to reach 16.5 V.

The circuit described here (see figure 2) is intended to provide a charge cycle which follows that described above. If the battery is completely discharged (voltage < 10 V), so little current flows through D3 that T1 is turned off. The output of IC1 will be low, so that the base currents of T2 and T3, and hence the charging current, are determined solely by the position of P1.

If the battery voltage is between 10 and 14 V, D3 is forward biased and T1 is turned on. The output of IC1 still remains low, so that the charging current is now determined by both P1 and P2. If the wiper voltage of P3 exceeds the zener voltage of D1, then due to the positive feedback via R4, the output voltage of IC1 will swing up to a value determined by the zener voltage of D1 and the forward voltage drop of D2. As a result T1 is turned off and the charge current is once again determined by the position of P1. In contrast to phase A–B, however, the higher output voltage of IC1 means that current through P1, and hence the charging current, is reduced accordingly.

Since D2 is forward biased, the effect of resistors R2 and R3 will be to gradually reduce the charging current still further, as the battery voltage continues to rise.

To calibrate the circuit, P3 is adjusted so that the output of IC1 swings high when the output (i.e. battery) voltage is 14.4 V.

By means of P1 the 'top-up' charge current is set to the 20-hour value (capacity of the battery in Ah divided

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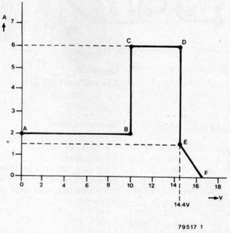

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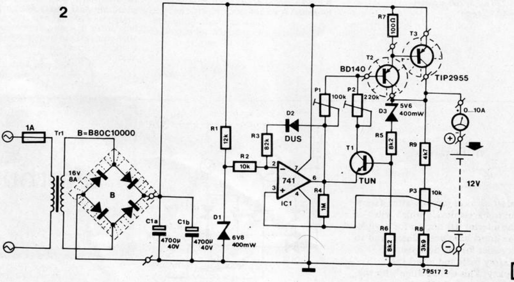

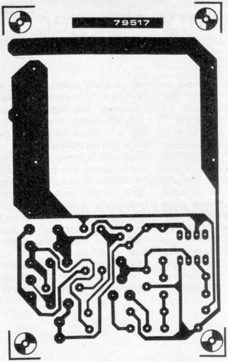

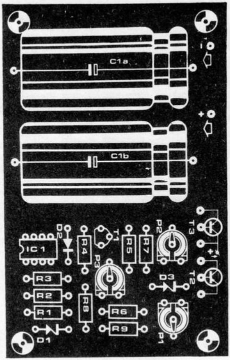

Parts list.

Resistors:
R1 = 12 k
R2 = 10 k
R3 = 82 k
R4 = 1 M
R5,R6 = 8k2
R7 = 100 Ω
R8 = 3k9
R9 = 4k7
P1 = 100 k preset
P2 = 220 k . . . 250 k preset
P3 = 10 k preset

Capacitors:
C1a = C1b = 4700 μ/40 V

Semiconductors:
T1 = TUN
T2 = BD138, BD140
T3 = TIP2955
D1 = 6V8, 400 mW zener diode
D2 = DUS
D3 = 5V6, 400 mW zener diode
IC1 = 741

Miscellaneous:
Tr = 16 V, 8 A mains transformer
B = B80C10000 bridge rectifier
fuse = 0.5 A slo-blo

by 20) for voltages between 14.5 and 15 V. Finally, with a battery voltage of between 11 and 14 V, P2 is adjusted for the nominal (5-hour) charging current.

The initial charging current (phase A–B) is set by the value of the 'top-up' current, and depending upon the characteristics of the transistors, will be approximately 30 to 100% greater.

Siemens Components Report Volume XIII, No. 1 March 1978.