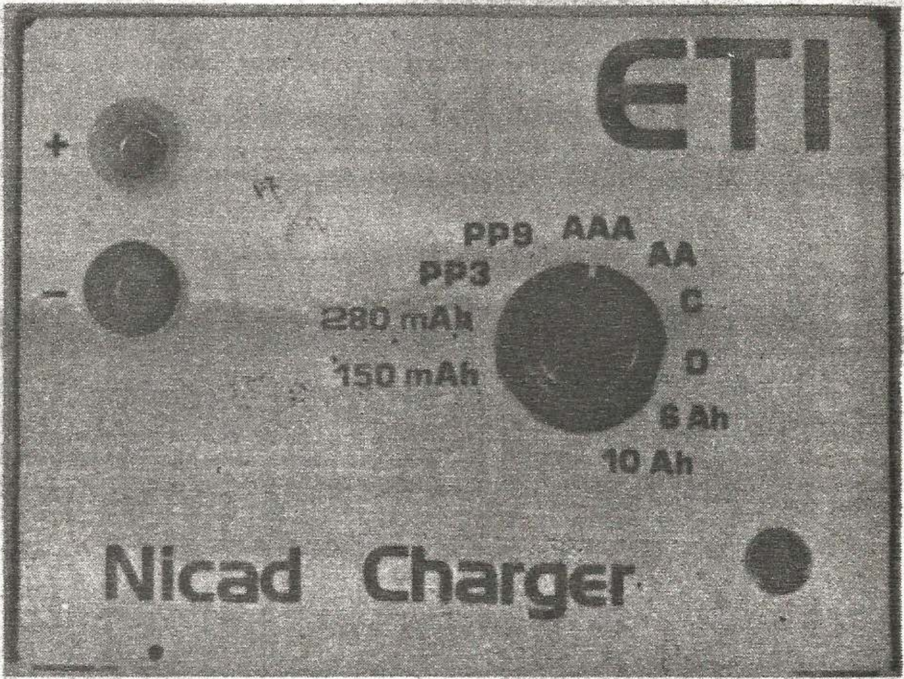
Ni~Cd CHARGER

Not content with giving you the best value for money, we now come up with a good method of saving it!



IF YOU OWN OR use battery powered equipment then the price of batteries and the monotonous regularity with which replacements are necessary must surely cause manical depressions as well as burn holes in the proverbial pocket.

One answer is to buy Nicad cells — although you may have to arrange a second mortgage initially, because they are pretty expensive (about three times the cost of yer average cell). Their great advantage is that they are rechargeable and can have a working life of well over 500 recharges. Just think of all that money you could save!!!

Being Constant

Nicads need to be charged with a more or less constant current. This current is derived as a function of the capacity of a cell and the length of time being charged. To clarify this point we can take for an example a cell — size AA (equivalent to U11, HP11 etc). Capacities of cells vary from manufacturer to manufacturer but an AA sized nicad has an approximate capacity of 0.5Ah. Simply speaking, if 500 mA is drawn from the cell it will provide power for one hour. If 50 mA is drawn then the cell will provide power for 10 hours. Similarly, to recharge the cell to full capacity (assuming 100% efficiency) it would take 500mA for one hour or 250mA for two hours, etc.

Problems Problems

This is where the basic problem lies. Because of the make-up of the cell, if an overcharge is given eg 250mA for 3 hours, then permanent damage can be caused to it.

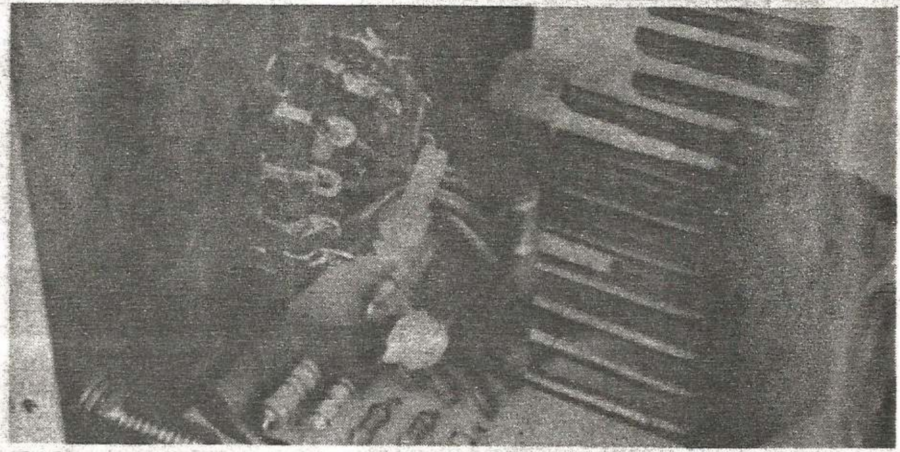
So, at any given charging current the cell must be disconnected at the time of full charge, or so it would appear. It is, however, a little known fact that at currents less than $\frac{C}{16}$ (where C is the capacity of the cell then no permanent damage can occur, no matter how long the cells are connected to the charger. The ETI nicad charger is designed with this criteria in mind. It will comfortably charge up to six cells in series (of the same type) at a rate of $\frac{C}{16}$ amps

The values given for R2-11 were theoretical, derived from Ohm's law. The charging current can be checked easily by connecting an ammeter across the Output (the current remains constant whatever the load) and take readings with each resistor in circuit and change if necessary.

Building Up To It

Construction is simple — there are only 6 components in the main part of the circuit (not counting the current setting resistors R2 to R11).

Note the transistors Q2 needs a reasonable heatsink.



HOW IT WORKS

One of the most convenient methods of obtaining a constant current is to use a voltage regulator and a current limiting resistor, as in Fig. 1.

R1 determines the current. If a five volt regulator is in use then a constant 5V is held across it. From Ohm's law the current $I = {}^{5}/_{R}$. The common connection is essentially a negative feedback loop, acting to maintain a constant current through the resistor and into the load.

A slight disadvantage of this sort of circuit is the power dissipated from the resistor. With 5V across it and say a current of 500mA through it, the power P,

P = IV = ½ amp x 5 volts
= ½ watts.

This means the use of a large and quite expensive resistor.

The circuit used in the ETI Nicad Charger uses a fairly standard type voltage regulator, formed by Q1 and Q2, but the current limiting resistor R2 (Fig. 2) only has the V_{BE} of Q1 across it — 0.6 volts for silicon transistors. If the V_{BE} of Q1 drops then its collector voltage increases, increasing the base voltage of Q2, whose emitter voltage therefore increases (and vice versa if V_{BE} of Q1 increases). A negative feedback loop has been formed, which maintains a relatively constant voltage across R2, of OV6.

The current through R2 is also the current through the load so Ohm's law gives the correct resistance for the required current, identical to that already discussed, but with the advantage that lower power resistors can be used (due to the lower voltage), even at high currents.

eg. P = IV = 500 mA x 0.6 volts
= 0.3 watts.

It is simply now, a matter of choosing the required current and calculating the resistance.

TABLE 1

Position	Resistor	Current	Type of cell & Capacity
1	R2	9mA	150 mA Hour Button cell
2	R3	17mA	280 mA Hour Button cell
3	R4	5.5mA	90 mA Hour PP3
4	R5	75mA	1.2 A Hour PP9
5	R6	11mA	0.18 A Hour AAA
6	R7	31mA	0.5 A Hour AA
7	R8	125mA	2 A Hour C
8	R9	250mA	4 A Hour D
9	R10	375mA	6 A Hour
10	R11	625mA	10 AHour

Table 1. Showing switch SW1 positions related to cells under charge.

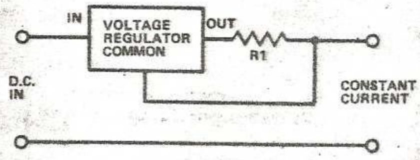


Fig. 1. A Standard method of providing a constant current, using a voltage regulator, resistor and feedback.

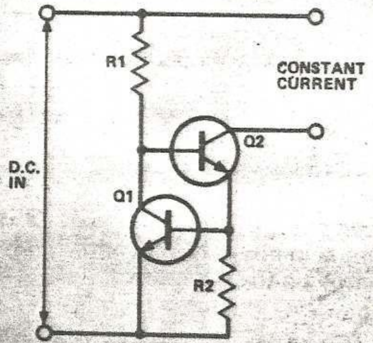


Fig 2. Improved constant current source.

PARTS LIST

RESISTORS
(all ¼W, 5% except where shown).

R1	1K
R2	68R
R3	39R
R4	120R
R5	10R
R6	56R
R7	22R
R8	5R6
R9	2R7 ½ watt
R10	1R8 ½ watt
R11	1RO ½ watt

CAPACITORS

C1	1000u 25V

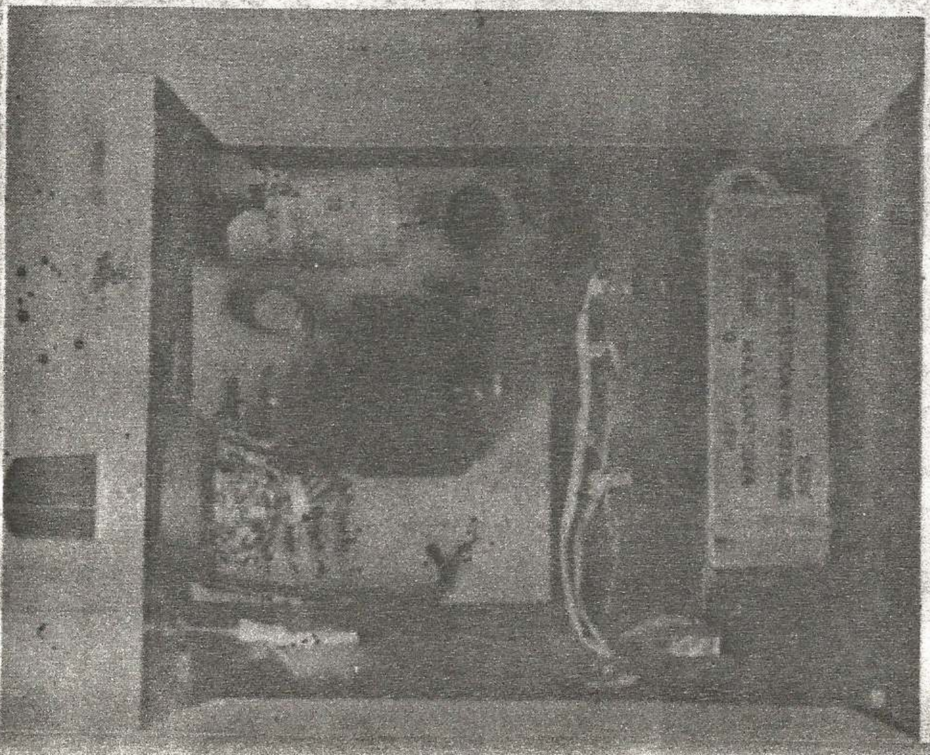
SEMICONDUCTORS

Q1	BFY 50
Q2	TIP 33A
BR1	1Amp 50V

MISCELLANEOUS
FS1 + Holder
TR1 12 V 1 Amp mains transformer
SW1 1-Pole 10-way Rotary Switch
Suitable connections to cells
Case to suit.

BUYLINES

There should be no problems in obtaining any of the components from any stockist.



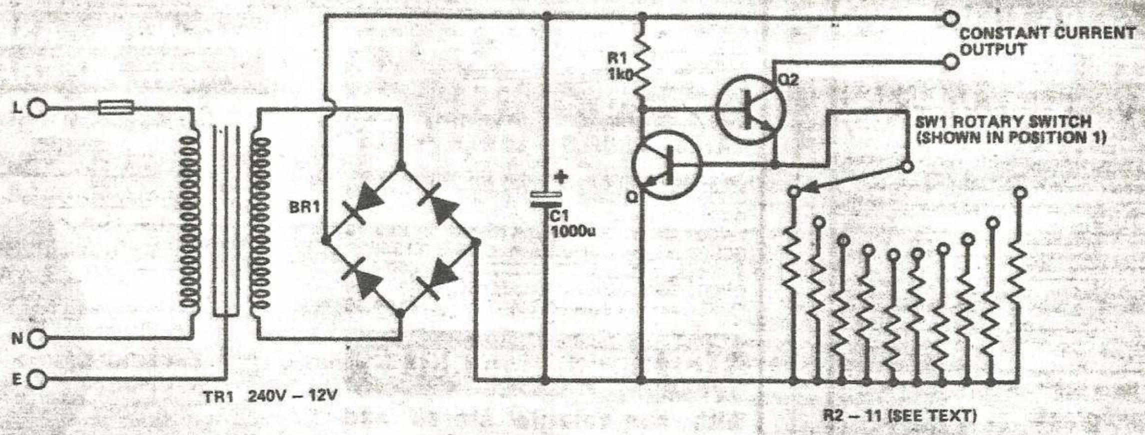


Fig 3. Circuit diagram for the ETI Charger. Resistor values are given in the text for the charger resistors.

per hour, therefore enabling them to be constantly trickle charged and kept at full capacity day and night. If the cells are partially discharged on connection they will take up to 16 hours to reach full capacity.

PP3 and PAP9 type nicads can also be charged but only one at a time, unlike the lower voltage types.

ETI

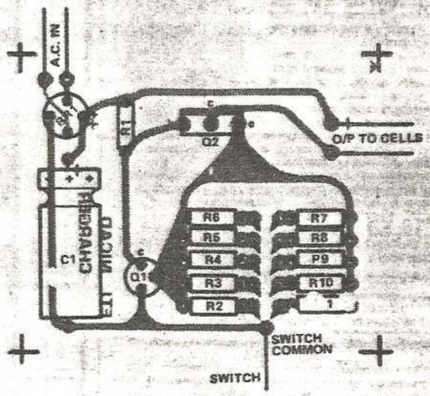


Fig. 4. Component overlay for the Ni-Cd Charger design.

D. 300mA – 2R2

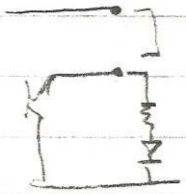
C 250mA – 2R2 + 0.47R

~~[illegible]~~ mA –

AAA ~~[illegible]~~ mA –

AA 40 ~~[illegible]~~ mA

17mA



D	300mA	2R2	Dummy LOAD ~~[illegible]~~
C	250mA	2R2 +.47R.	24R
AA	40mA	15R.	150R.
AAA	20mA	33R.	300R.
PP9	100mA	6R. = 15R//12R	60R
PP3.	9mA	100R = 82R.	1K. ~~[illegible]~~
			1K.

SWITCH POSITIONS