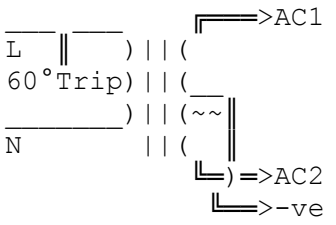
Simple SCR Regulated Charger

By G8MNY (Updated May 13)
(8 Bit ASCII graphics use code page 437 or 850, Terminal Font)

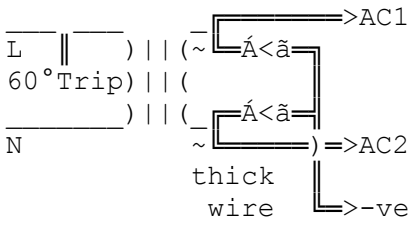
This is a simple self regulating SCR controlled charger. It was made to give 27.5V at 15A for charging a train carriage's 500 AH 24V battery system. It is not suitable for use with electronic equipment that can't operate on hummy supplies! Or due to possible RFI used near Radio Rx equipment!

Using a dual winding transformer (1) or a single one with 2 large diodes so the SCRs form part of a bridge (2), or (3) a single SCR arm following a bridge rectifier.

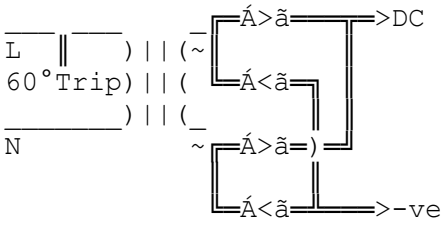
(1)



(2)



(3)

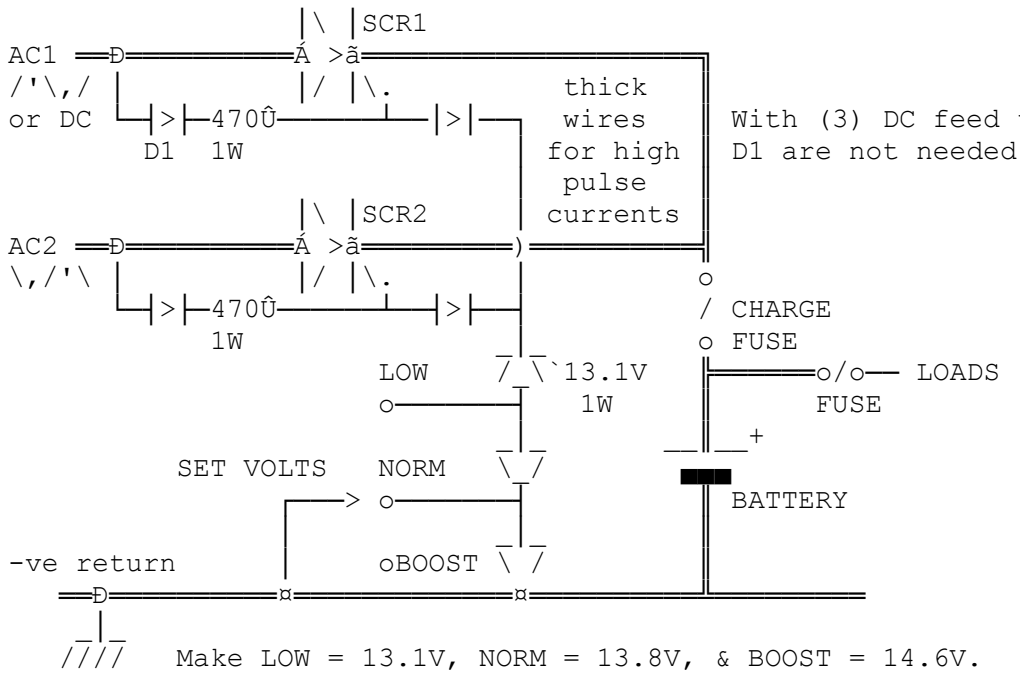


The transformer must deliver an RMS voltage slightly greater than the battery voltage plus diode & wiring losses. If voltage too low, triggering the SCRs can be difficult. Tn that case use an additional 2V winding put around a toroidal or leg of the transformer to feed the trigger circuit can keep the unit working well on low mains (the train PSU had to deal with mains of less than 200V AC at times).

This circuit is very efficient, only the transformer heats up with the high pulse current, & some SCR/diode losses, there is no huge power loss of a dropper/linear type regulator!

For high current battery work fusing can just be "weak" wire links mounted in a safe way not to cause fires etc, but anything to do with batteries needs some fuse protection!

For recharging 12V batteries use 14.5V DC setting, for floating (infinite charge rate) use 13.8V, with sealed/gel lead acid types use 13.5V MAX!

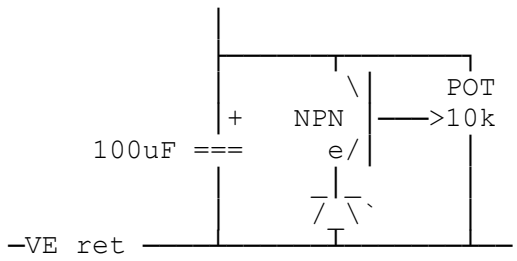


GATE DRIVE POWER
The SCRs gates are actually pulse driven as they only see current for a short time when the battery voltage is below the zener voltage, until the SCR fires (turns on). Then the AC voltage input will be reduced to that of the battery turning off the gate drive. This is important as SCR gate dissipation is quite limited, even on large current SCRs. The gate Rs (470) should experimented with to make sure there is good triggering for your SCRs, a general rule is to make them 1/2 to 1/4 of the value that just triggers the gate OK.

FIRING PROBLEMS
In practice this circuit generally produces a sort of phase firing, as the battery voltage ends up as a saw tooth dropping blow the zener voltage some time in the next half cycle. But if the SCRs fire unevenly sometimes due to inductance problems in the transformer, severe transformer heating can result due to DC satuation of the core, resulting in a very low inductance across the mains. So a "resetting thermal trip" is recommended on the transformer, just in case it gets unduly hot.

SIMPLE VOLTAGE CONTROL
The output voltage can be adjusted in 0.6V steps by the use of diodes in series with the zener.

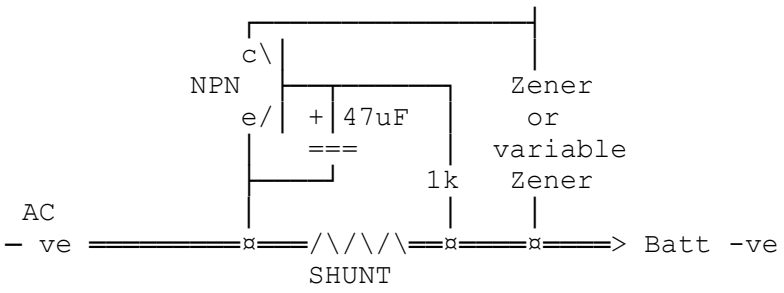
VARIABLE VOLTAGE CONTROL
The Zener can be a virtual one for voltage adjustment...



The Zener can be 5—10V (12V system). The transistors is an NPN. Set the voltage

pot so that the Zener action is 1V higher than the required Battery voltage. The transistor can be either an NPN as here, or the circuit can be inverted & a PNP used.

CURRENT LIMITING
This can be added to either zener circuit..

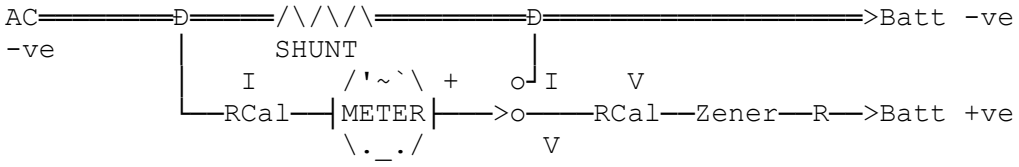


The transistor is a NPN. Make the shunt resistor (thick wire link e.g. 10-30cm of coat hanger wire bolted in place as it will get hot!) so at the maximum current wanted it drops 0.6V, enough to make the NPN conduct, & hence reduce the zener voltage & thereby limit the current. The 1k & 47uF filtering is needed so that the average current is controlled not the high peak current.

If the output is shorted this current limit may not be very effective depending on the trigger threshold of the SCR etc. but it will reduce the otherwise very high current!

Note: if the shunt is put on the supply side of zener, the voltage loss across it will not affect the output voltage, but if it is put on the battery side it will be reduced.

METERING
The Meter can be almost anything from 100uA to 1A movement for current monitoring, provided it needs less than 0.6V drop, using the same current limiter shunt. If a sensitive meter is used a switch can be provided to measure either voltage or current.



Leaving the I RCal preset in line on voltage measurement will produce a small error, but simplifies wiring. Calibrate the V & I meter scales with external meter, adjust suitable presets for full scale. In the voltage case an additional fixed series R (e.g. 1k) can stop meter accidents! Also a 10V zener in series can give a more useful offset scale e.g. 10-15V.

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73 De John, G8MNY @ GB7CIP