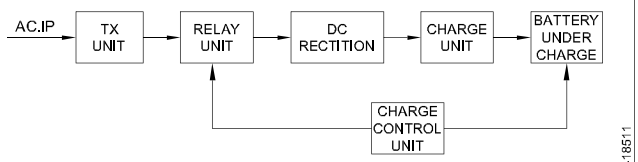
A simplified block diagram of battery charger is explained to understand the function of battery charger. (Fig 1)

Fig 1



BLOCK DIAGRAM OF BATTERY CHARGER

Transformer

The mains transformer primary is connected through auto transformer and the supply to auto transformer controlled through relays. The automatic charge control supply is always present at the primary of charge control unit transformer.

Relay unit

The relay unit supplies the DC rectifier input supply to the required DC input to the battery for charging. This relay unit also cut-off the rectifier input AC in case of the battery is fully charged.

DC rectifier

This rectifier unit always is a full wave bridge rectifier to handle heavy charging current. High current metal rectifiers are found mostly used in this circuit, but high current capacity semi conductor diode are in use.

Charging unit

This indicates the charging current taken by the battery and it is controlled by ON-OFF switches. A test switch is provided to test the charging condition of the battery.

Battery section

The battery under charger is always to kept in a well ventilated room and also open the vent plug for easy evaporation of exhausted gases from cells.

Charge control unit

Once the battery fully charged; then the DC supply to battery to be cut-off automatically. The voltage sensing circuit enables the control unit to trip the AC input to the rectifier unit thereby stop the charging voltage.

Constant voltage

This type of charging method using series regulators is suitable for the SMF batteries but not useful in automobile and tubular lead acid batteries.

Constant current

This charging method using shunt regulators, is useful for automobile and tubular /Industrial lead acid batteries, but it can damage the SMF batteries by overcharging them.

Constant voltage and constant current

This charging method contains more advantages .This method is suitable for automobile and tubular /Industrial lead acid batteries and also for SMF batteries.

This method provide regulated charging to improve the battery life.

Charging operation of battery

When the mains A.C is available, the mains supply is connected to 0-240V taping of auto transformer through a relay.

The transformer works on step down which has 0-240 V, taping at the primary and 12-0-12 V at the secondary.

The voltage at the secondary is used to charge the batteries connected.

Trickle charging

In an inverter, when the mains A.C is available the battery get charged. After the battery is fully charged the charger is cut-off. After the battery get fully charged if the charger is not cut off then the battery will get damaged.

Trickle charging is a special charging method used to keep the battery constantly in full charge position by keeping the battery charged constantly.

This method of charging is slightly different from the normal charging method.

For trickle charging 100^{th} part of the normal charging current is provided to the battery.

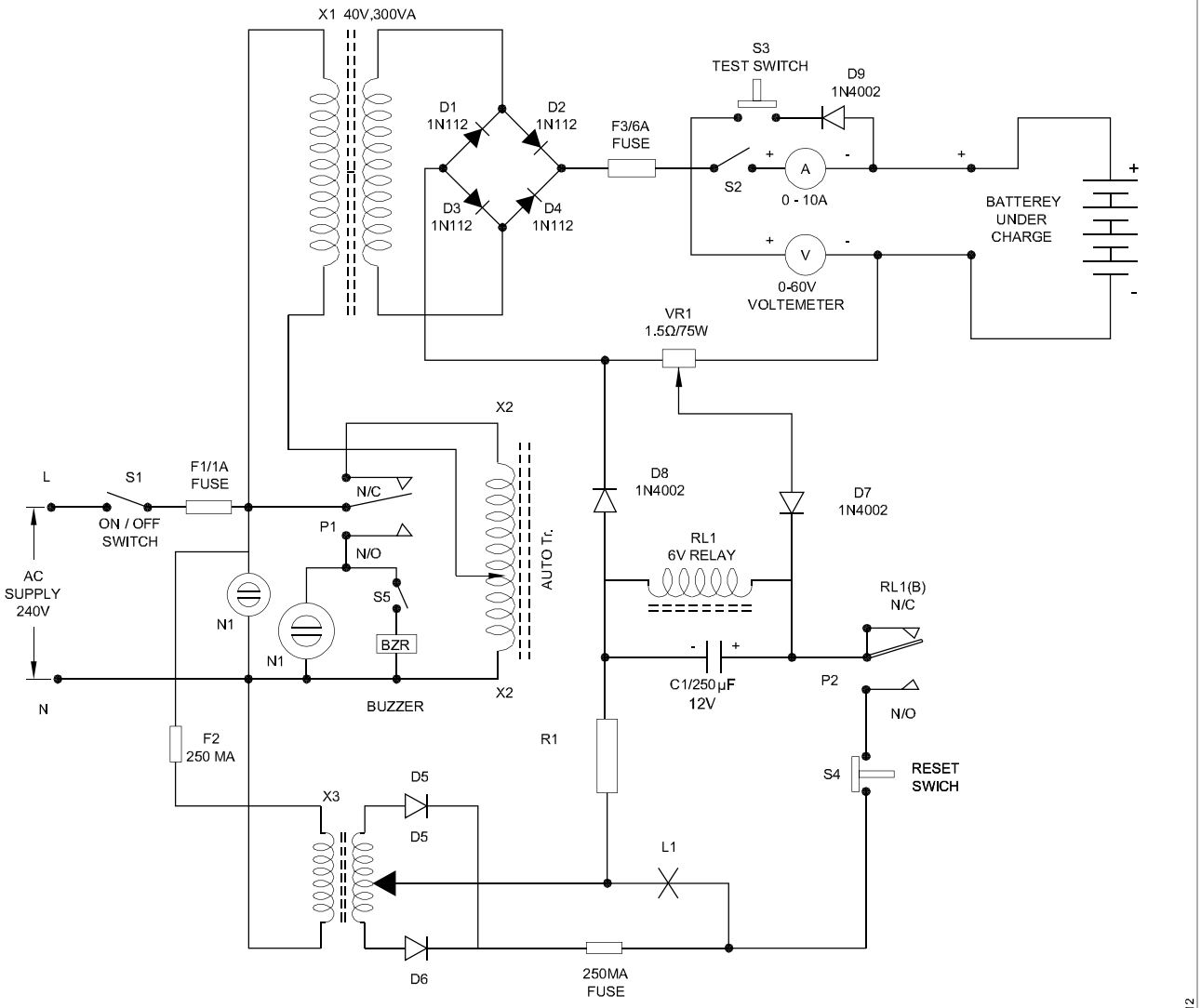
A Simple battery charger

The charger can charge 6V,12Vand 24V battery at Suitable current rate. This circuit has many protection built in it to protect the battery from overcharge and reverse polarity etc.

The charger consist of an auto transformer $X_{2,}$ (Fig 2) for supplying constant current and voltage.

A charger transformer 'X_1' is connected to the auto transformer and the secondary of the X_1 (Fig 2)is rectified through full wave bridge rectifier and supplied to the battery under charger through. Ammeter voltmeter and a potentiometer (Fig 2)

Fig 2



AUTOMATIC BATTERY CHARGER

A step down transformer X_3 is used to keep cut off relay is energised condition when the mains AC supply is cut off to the charger circuit. Relay RL_1 used to cut off the AC mains supply to the charger circuit. Pole P_1 of relay RL_1 is connected to AC mains supply and pole P_2 is connected to cut off circuit.

Relay is energised by the centre tapping of potentiometer, which is set such that, the current in the charger circuit exceeds then it is energised and poles P_1 & P_2 are connected to normally opened (NO)pin, switching 'Off' A/C mains supply to the circuit.

The test switch S_3 is connected to check battery polarity, reset switch S_4 is used to reset the charger, when any fault occurs. Then the charger is cut off and the Switch 'S_1' is mains ON/OFF switch.

A fully charged lead acid battery must be 2.1 volt/cell during on charge.It will increase upto 2.7V/cell.The voltage of a battery is multiple of the number of cells.

In discharged condition the voltage is 1.8V/cell,it should not be further discharged in this condition as it may permanently damage the cell.

E.g A 100AH (ampere hour)battery requires (100 AH/ 10Hr=10 Amp) 10 Amp. Charging current for 10 hours for fully charged. To get complete discharge at the rate of 5Amps will require 20 Hrs.

The fully discharged battery requires about 11/2 times more to get charged .If the battery is in dead (or)not in use for long time even in normal changing current is passed. These dead batteries require higher charge voltage to start the charging current.

Checking of battery

Acid level and specific gravity of electrolyte, will indicate the condition of battery whether it requires charging or not.

The hydro meter is used for checking the acid level in a battery .The scale in marked in the hydrometer from 1100 to 1300.when it is inserted in the battery, the reading

i) 1100-1150 -indicates battery is down

ii) 1200-1250- indicates battery is o.k.

iii) 1250-1300 indicates excess acid

Voltage testing

By using high rate discharge tester, the voltage the each cell must be 2.1V, If it indicates below than 1.8V, then it shows the battery is in fully discharged. It is still below 1.8V.Then the battery becomes dead condition.

Never connect the high rate discharge tester for long duration while checking voltage, it will load the battery heavily and the cell, will discharge.

If the electrolytic level down in the container shell of the battery, top up with distilled water. Never add electrolyte prepared separately to the battery.

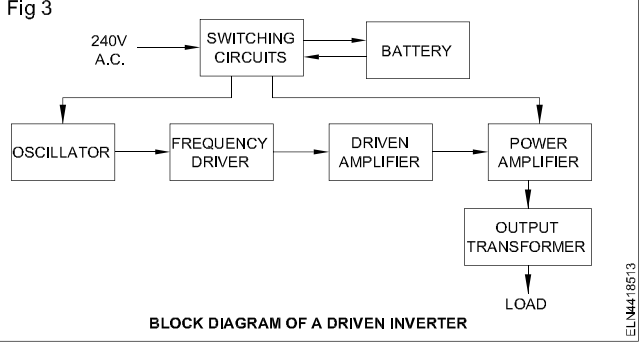
In a lead acid battery the electrolyte level of the battery should be checked and maintained every 15 days in summer season.

Inverter

It is an electronic device, which converts a D.C potential (voltages) normally derived from a lead-acid battery into a stepped-up AC potential (voltage) which is similar to the domestic AC voltage.

Locating the fault and troubleshooting of an inverters which provide sine wave outputs or the use of PWM(Pulse Width Modulation) technology is very difficult. (Fig 3)

Fig 3



BLOCK DIAGRAM OF A DRIVEN INVERTER

Switching circuits

It is the input stage of a inverter. This circuits supplying the power to further stages and connected to battery. The DC supply of battery in this supplies to the switching circuits for various needs.

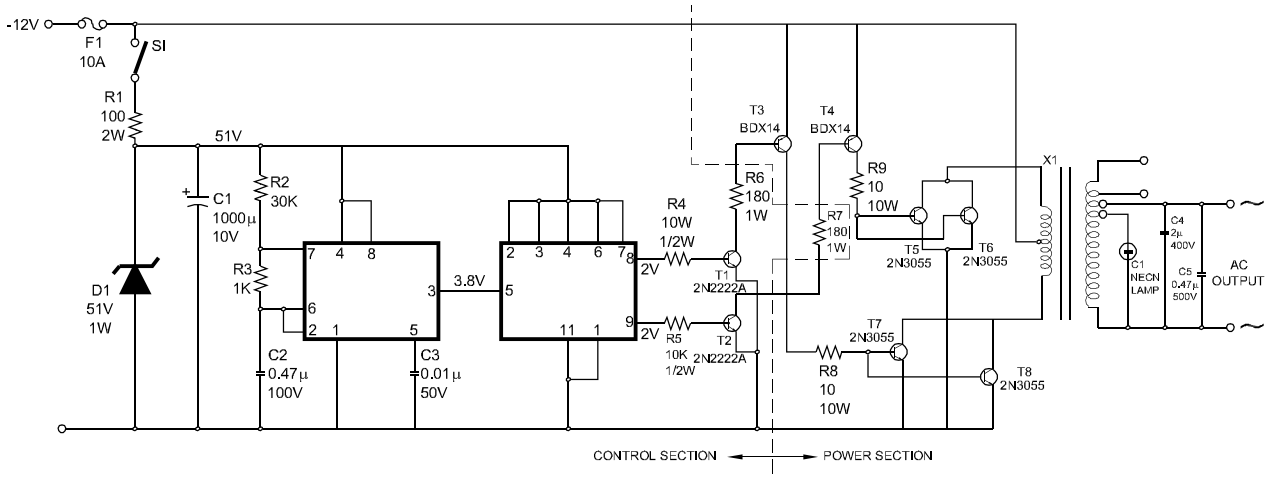
Oscillator

It is an electronic circuit which generates the oscillating pulses either through an IC circuit or a transistorized circuit. This oscillations are the production of alternate pulse of positive and negative (ground) voltage peaks of a battery and at a specified frequency (No.of positive peaks per second). These are generally in the form of square waves and the inverters are called square wave inverters.

The complete circuit diagram of a static 50Hz static inverter is in Fig 4.

The oscillator section of the inverter used a IC circuit to produce control signal frequency to the control and driner section. The received oscillating frequency is amplified to a high current level using power transistor or MOSFET.IC 7473(JK Flip type) used to power amplification and control the frequency to the driver transistors T1 and T2 driving the power transistor to the required level as in the Fig 4.

Fig 4



COMPELETE CIRCUIT DIAGRAM OF 50Hz STATIC INVERTER

The two parallel connected power transistor T5, T6 and T7, T8 are connected to the output transformer which is used to step up the low level AC from the amplifies stage into the specified level.

The transformer secondary is supplied the required level of AC 240V. The generation of the oscillations due to which the process of voltage induction is able to take place across the windings of the transformer.

The inverter does not produce any power and the power produced by DC source. The inverter requires a relatively stable power source capable of supplying of enough current for the intended power demands of the system.

An inverter can produce square wave, modified sine wave, pulsed sine wave, pulse width modulated wave (PWM) or sine wave depending on circuit design.

The inverters more than three stages are more complex and expensive. Most of the electric devices are working with pure sine wave and AC motors directly operated on non-sinusoidal power may produce extra heat, and have different speed-torque characteristics.

Stabiliser, battery charger, emergency light, inverter and UPS

Objectives: At the end of this lesson you shall be able to
- **state the general precaution to carryout for preventive maintenance**
- **explain the steps to follow the break down maintenance**
- **service the voltage stabilizer, emergency light, battery charger, inverter and UPS**
- **analyse the trouble shooting chart and find the problem/ repair the equipment.**

Use of flow chart and troubleshooting charts for fault location : The circuit diagram is in Fig 1 is given for your reference. The working of the mains cord, fuse, relay contacts, windings of the auto-transformer etc. can easily be ascertained by using a test lamp and/or a series lamp or by a voltmeter for checking the electronic circuit and relay coil winding. A multimeter in appropriate range is a must to localise the fault. A series lamp or test lamp should not be used to test these as they are liable to spoil while testing.

Method of trouble shooting : Referring to Fig 1, we find that the absence of control voltage from S_1, S_2 or DC voltages will make both the relays inoperative, and, hence, will be in the off position resulting in higher output voltage than input voltage with boost indication. The same result also occurs when both transistors are open.

When both the transistors are short i.e. collector to emitter is short or both zener diodes are short the relays are energised and the output voltage will be lower than input voltage.

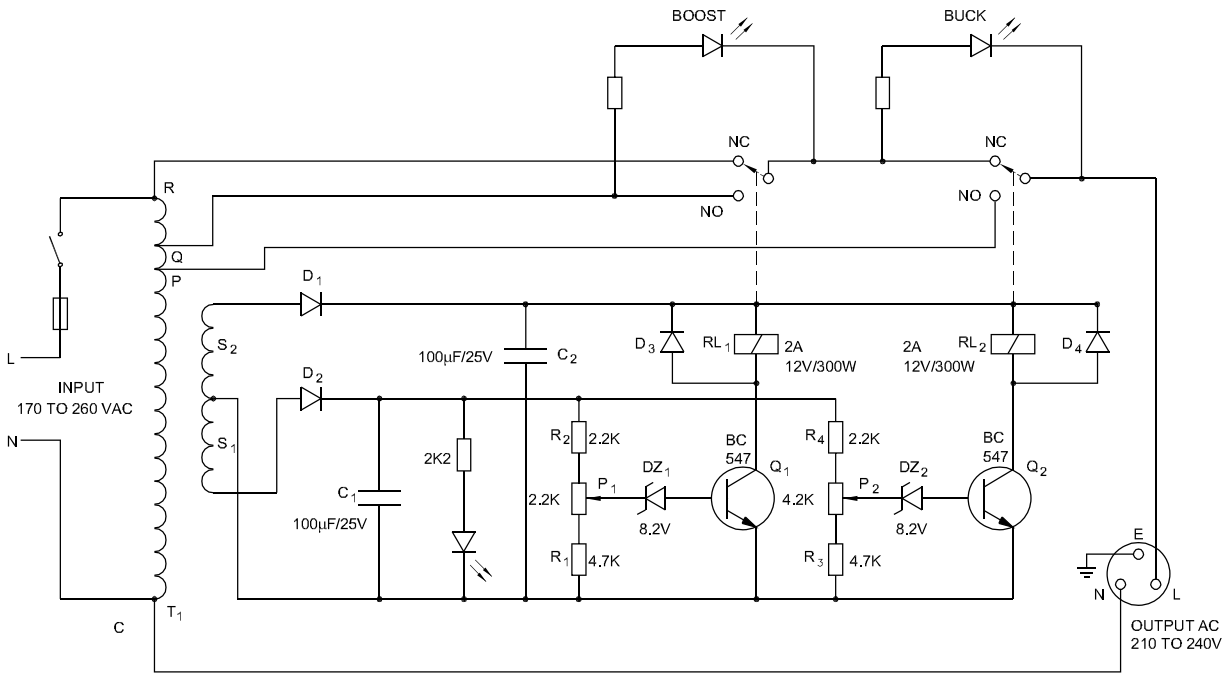
When one of the relay circuit is only not operating that particular function will be absent i.e. either back or boost function will be absent.

When a component mounted on PCB is suspected to be defective, first ascertain from all possible tests with in the circuit and then remove the component from PCB only when it is absolutely necessary. Even removing components for testing should be done as rarely as possible.

While removing the components from PCB, the component position with respect to the PCB, the terminal connections and hook up wire connections should be noted to enable the electrician to reconnect the component properly. When replacing the components procure the component of the same specification or equivalent so that the performance of the equipment is not affected after repair.

Troubleshooting chart given in Table 1 illustrates the problem, section to be suspected possible cause and action required for a stepped automatic voltage stabilizer.

Fig 1



TYPICAL CIRCUIT DIAGRAM OF A STABILZER

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