3-Phase Appliances Protector

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Abstract— Many of our costly appliance require 3 phase ac supply for operation. This circuit does not require a separate indicator lamp for monitoring the availability of the 3phases. 3phase appliance are used in industry on large scale as well as used in farming homes e.x.3 phase motors, 3 phase welding machines failure of any of the phases an cause the application may get damages hence it becomes important to monitor .the availability of the 3 phases supply a switch off the appliance when on or two phases get failed. The power to appliance should resume with the availability of all phases of the supply. Here time delay is added in load supply to avoid surge momentary fluctuations. The 3 phases appliance protector circuit require 3 phases supply , three 12 volt relay, a Timer ICNESS, a 4 pole 230 volt contactor, 3 phase 12 volt transformer relays RL1 and RL2 act as a sensing device for phases Y and B respectively. These relays are connected such that each acts an enabling device for the sub sequent phase. Therefore the combination of the relay forms a logical and gate connected serially.

Key words: Resistor, Capacitor, Transistor, LCD, Relay

I. INTRODUCTION

In India there are so many industries in different fields. For example steel sector, Oil sector, Irrigation etc. All industries have many drives and equipment's like conveyor belts, pumps, Mills etc. All the drives of industries use electrical motors. Most of the electrical motors are designed for three phase, 50Hz (in India) supply. The starting of three phase motors are less expensive than starting of DC motors. Three phase induction motors are very sensitive and get damaged, when they are subjected to Single-phasing. For three phase induction motor, it is necessary that all the phases of supply are present. While it is on load if any one of the fuse goes out, or goes missing, the motor will continue to run with two phases only, but it will start drawing a huge current for the same load. This high current may run the motor unless switched off immediately. Failure of any of the phases makes the appliance prone to erratic functioning and may even lead to failure. Hence it is importance to monitor the availability of the three-phase supply and switch off the appliance in the event of failure of one or two phases. The power to the appliance should resume with the availability of all phases of the supply with certain time delay in order to avoid surges and momentary fluctuations.

A single phasing preventer avoids such a mismatch with this circuit, the motor will not run unless all the three phases are present. In this context we need to design a preventer which prevents these mishaps and protects the costly motor under such conditions. This single phase preventer is very less expensive and protects reliably the motor which is costly.

II. LITERATURE SURVEY

The research work carried out by various researchers in the many industries in different fields. Various researchers have worked in steel sector, Oil sector, Irrigation etc. All industries have many drives and equipment's like conveyor belts, pumps, Mills etc. All the drives of industries use electrical motors. Most of the electrical motors are designed for three phase, 50Hz (in India) supply. The starting of three phase motors are less expensive than starting of DC motors. Three phase induction motors are very sensitive and get damaged, when they are subjected to Single-phasing. For three phase induction motor, it is necessary that all the phases of supply are present. While it is on load if any one of the fuse goes out, or goes missing, the motor will continue to run with two phases only, but it will start drawing a huge current for the same load. This high current may run the motor unless switched off immediately. Failure of any of the phases makes the appliance prone to erratic functioning and may even lead to failure. Hence it is importance to monitor the availability of the three-phase supply and switch off the appliance in the event of failure of one or two phases. The power to the appliance should resume with the availability of all phases of the supply with certain time delay in order to avoid surges and momentary fluctuations.

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with the availability of all phases of the supply with certain time delay .

III. PROPOSED SYSTEM

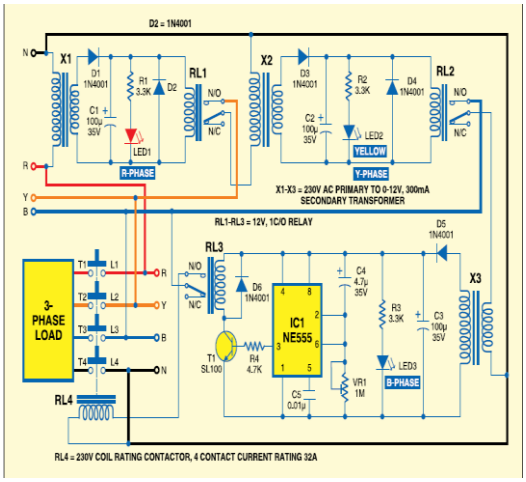

Fig. 1:

IV. CONSTRUCTION

R-phase sensing block senses the availability of R-phase. The output of this block is Y-phase. 230v input from R-phase supply is step down by transformer to 12v AC and this 12v AC is converted to 12v DC to drive relay. This relay after sensing R-phase connects Y-phase to the next block .Y-phase sensing block senses the availability of Y-phase. The output of this block is B-phase. 230v input from Y-phase supply is step down by transformer to 12v AC and this 12v AC is converted to 12v DC to drive relay. This relay after sensing Y-phase connects B-phase to the next block. B-phase sensing block senses the availability of B-phase. 230v input from B-phase supply is step down by transformer to 12v AC and this 12v AC is converted to 12v DC to drive relay. This relay after sensing B-phase gives signal to delay block .Delay block senses the input signal and after four seconds it gives output signal .Contactor connects all the three phases and neutral to load after getting input signal.

V. WORKING

The availability of phase R energies relay RL1 and its normally opened (N/O) contacts close to connected phases Y TO the input of transformer X2. The availability of phases Y energies relay RL2 and its contacts closed to contact phase B to the input of transformer X3, thus applying a triggering input to timer ICNESSS (ICI) . The delay timer is built around NESS. It triggers only when all the phases (R,Y AND B) are available it provides a delay of approximately 4 seconds , which energies relay RL3 and its N/O contacts closed to contact the line to the energizing coil of 4 pole contactors relay RL4 contactor RL4 closed to ensure the availability of the 3 phase supply to the applications.

VI. LIST OF COMPONENTS

- Transformer
- Relay
- Miniature circuit breaker (MCB)
- Contactor
- Resistor
- Capacitor
- Semiconductor diode
- Light emitting diode
- Transistor
- Integrated circuit(IC).

VII. COMPONENTS DISCRIPTION

A. *Step-down Transformer*

This transformer is used to decrease the secondary (output) voltage in proportion to primary (input) voltage. In this transformer the number of primary winding is greater than the number of secondary winding and the secondary voltage is given by

$$Vs = Vp/Np*Ns$$

B. *Construction of Step-down Transformer*

The simple elements of transformer having mutual inductance are the laminated steel core. In all types of transformers the core is constructed of transformer sheet laminations to provide a continuous magnetic path with minimum air gap. The steel used is of high silicon content. The laminations are being insulated from each other by light vet of plate varnish or by an oxide layer on the surface. The thickness of the laminations varies from 0.35 mm for a frequency of 50cls to 0.5 mm for a frequency of 25cls. It is seen that the joints in the alternate layers are staggered in order to avoid the presence of narrow air gaps right through the cross section of the core. Here, we have been used step down transformer.

C. *Relay*

An electromagnetic relay is basically a switch operated by magnetic force. This magnetic force is generated by flow of current through a coil in the relay. The relay opens or closes a circuit when current through the coil is started or stopped.

D. *Construction of Relay*

- A relay basically consists of four parts,
- An electro-magnet made of a coil and a magnetic circuit.
- A movable armature
- A set of contacts and
- A frame to mount all these components.

As you can see in the figure, a relay contains a core surrounded by a coil. This core and coil assembly is mounted on a metal frame. On top of this coil/core assembly, an armature attached to a “return spring” is located; this “return spring” keeps the armature in tension by pulling it downward. This downward pull of armature by the spring makes “armature contact arm” to touch a terminal known as “top contact”. When current flows through the relay coil, the coil is energized and when the force of attraction of electromagnet generated in the coil is sufficient to overcome the opposition of the tension of “return spring”, the armature and the “armature contact arm”, is pulled downwards. This makes the “armature contact arm” to touch another terminal known as “bottom contact”. Controlling a circuit with the relay is shown in detail in the figure 5. As you can in this figure, the relay circuit has no direct electrical connection with the circuit being controlled.

Current in the relay circuit will energize the electromagnet of the relay and pull the armature down from the "top contact" to the "bottom contact". When the armature contact arm touches the "bottom contact", the circuit being driven by the relay becomes complete, and the current start to flow from the pole to the "bottom contact" and into the circuit. This will glow the lamp in our example circuit. When the relay circuit is de-energized by switching off the switch and cutting supply to the relay, the electro-magnet will lose its magnetism. This will make the return spring to pull the armature, once again, back to the "top contact" position. This movement of armature will also remove the "armature contact arm" from the "bottom contact" and open the lamp circuit, which in turn off the lamp. In a relay the armature is not allowed to touch the core of coil, as this may make the armature to stick to the core because of remnant magnetism in the core. As small gap is left between the armature and the core, when the "armature contact arm" touches the "bottom contact". Sometimes a small rivet of non-magnetic material such as brass is fixed on top of core, so that the armature does not touch the core .Generally relays are made for voltages6, 12, 18, 24, 48,110,240v AC or DC. Here, we have been used a SPST (Single Pole Single Throw).

E. Miniature Circuit Breaker (MCB)

Fig. 2:

MCB is also called as Miniature circuit breaker. MCB is a device which is make or break the circuit at faulty condition .It is the main component of protective circuit. Which is used in our project because our main purpose is protect device from short circuit or any other faulty condition. It is trip on when voltage surge over voltage in circuit

F. Contactor

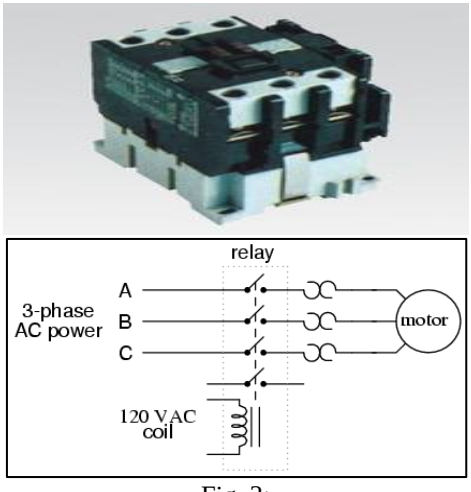

Fig. 3:

A contactor is an electrically controlled switch used for switching a power circuit, similar to relay except with higher amperage ratings. A contactor is controlled by a circuit which has a very low power level than the switched circuit. Contactors come in many forms with varying capacities and features. Unlike a circuit breaker, a contactor is not intended to interrupt a short circuit current. Contactors range having a breaking current of several amps and 24 V DC to thousands of amps and many kilovolts. The physical size of contactors ranges from a device small enough to pick up with one hand, to large devices approximately a meter (yard) on a side. Contactors are used to control electric motors, lighting, heating, capacitor banks, and other electrical loads.

G. Resistor

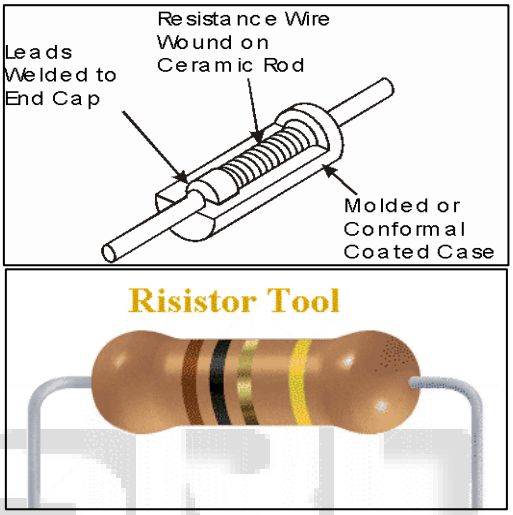

Fig. 4:

Resistors are the circuit elements having the function of introducing electrical resistance into the circuit. It is probably the most common component in all kinds of electronic equipment. It opposes the flow of current through it. There are different types of resistors. The resistors are grouped into three categories:

- Fixed resistors
- Variable resistor as potential
- Rheostat

A fixed resistor is a two terminal resistor whose electrical resistance is constant A rheostat is a resistor that can be changes in resistance value without opening the circuit to make adjustment .A potentiometer is an adjustable resistor with three terminals, one at each end of the resistive element and the third movable along its lengths. Here, we have been used fixed as well as variable resistor.

H. Capacitor

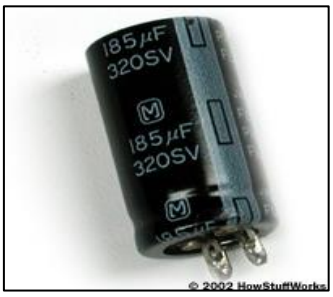

Fig. 5:

Capacitors are electronic components which have the ability of storing electrical energy. Basically, all capacitor consist of two parallel facing conductive surfaces separated by an insulating material called the dielectric. When connected to a voltage source, a momentary charging current deposits charge on the plates, establishing an electric field. Energy is stored in this field and may be returned by discharging the capacitor through a load. Capacitor may be defined as the amount of charge required to create a unit potential difference between its plates. The unit in which the capacitance is measured is a farad. Thus the capacity is a ratio of charge to potential.

I. Rectifier

An electronic device consisting semiconductor diode which converts AC supply into DC supply is called semiconductor diode Rectifier. There are mainly two types of rectifier:

1) Half wave rectifier
2) Full wave rectifier

1) Half wave rectifier

As the name indicates this type of rectifier makes rectification during the positive half cycle of AC supply. It means no current is conducted during negative half cycle of AC supply.

2) Full wave rectifier

As the name indicates this type of rectifier makes rectification of AC for both half cycle. It is activated by using at least two diodes. Here we have to use half wave rectifier.

J. LED (Light Emitting Diode)

Fig. 6:

LED is a semiconductor optical illuminating device. It operates on a very low voltage (1.2v to 2.4v) for lighting of LED. It requires minimum 10mA forward supply. LED's are available basically in three colors i.e. RED, GREEN, And YELLOW. These are available in different sizes according to the diameter i.e. 1mm, 2mm, 4mm, 8mm etc. These can be operated at different voltages by connecting a series resistance e.g. to operate on 6v, it requires 330 OHMS resistance in series.

K. Transistor

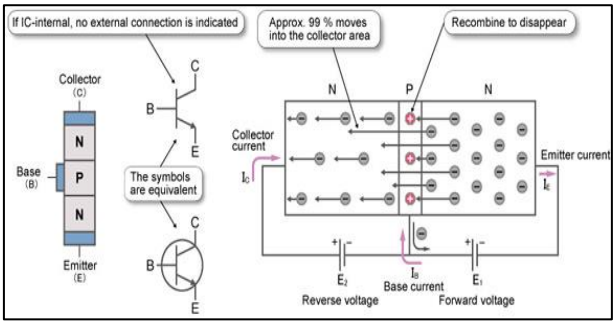

Fig. 7:

Transistor is also known as thermistors. Thermistor is the general name given to the family of semiconductor devices having four or three p-n junctions. In the field of control engineering, variable speed drives, illumination controllers (dimmers), temperature regulators etc. are some of the important aspects of study & research. In our project, we are concerned with the use of thermistors as a Relay Driver. In olden times, when thermistors was not in use or before its development for use in control systems methods like 'WARD LEONARD SYSTEM' were in use, but it was soon discarded as it has several disadvantages. Slowly WARD LEONARD system was replaced by magnetic amplifiers but they were also inaccurate & slow in response. Another problem with the magnetic amplifier was the largeness of its size.

L. Integrated circuit (I.C.)

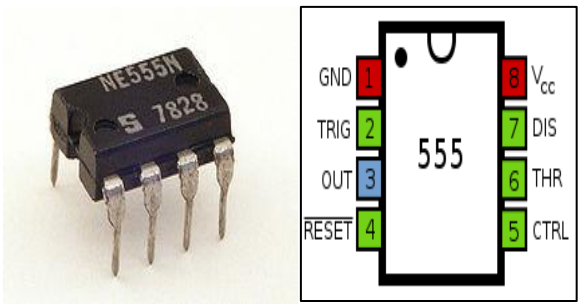

Fig. 8:

An integrated circuit consists of a single-crystal chip of silicon, typically of 1mm by 1mm area, containing both active (transistors etc.) and passive (resistors, capacitors, diodes etc.) elements and their interconnections. As it name directly indicates, integrated circuit is an integrated or condensed from of an electronic circuit. Integrated circuits are produced by the same processes used to fabricate individual transistors and diodes i.e. introducing impurities of known amount and type at required points on the p-type or n-type silicon or germanium substrate and interconnecting various points by thin metallic layers or wires. The basic structure of an integrated circuit consists of four distinct layers of materials. Fig 1 shows a p-type substrate. All the active and passive components are built within the (2) layer, using the series of diffusion steps. The (3) layer is of SiO_2 and it selects where the n-type impurities (2) layer will be injected. Finally (4) layer added to supply the necessary interconnections between components. The chips are so small so as to be used as it is and so they are kept in standard packages and connections to them are made by the help of fine metallic wires, as shown in fig .

VIII. Future Expansion

1) In industry where many machines work in same manner to form an unique object or product. It is possible to work on this machines.
2) In chemical industry this will work in process cycle where a number of process instruments work together for single final process/product.

IX. Conclusion

The test system considered in the project is worked out for the best protection for the 3- phase appliance in absence of any of the phase. The main objective of this prospective

protector is to maintain the efficiency of the appliance which is used for 3- phase supply. The 4-pole contactor locking assures the presence of all the 3-phases. Remaining three relays placed for all the three phases show there working with a hissing sound and glowing LED'S. Due to any erratic action taking place there will be absence of any o the phase results in the un-locking of the 4- pole contactor with an rapid fast off sound. The 555 timer which we used in the destination tip of the circuit provides the time delay for each phase which would be around 4sec as the timer working in a stable mode. For review time delay from the 555 timer we need to connect an variable resistor due to that time delay can subjected and maximum is up to 4 sec. A transistor is placed in need of a switch which is used for getting the output in the third phase. Using this protector scheme would be useful to protector the appliance and at the same time it would reduce the frequent money lending in fault occurrence or failure of the appliance.

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