Automatic Phase Detector in Three Phase Supply

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Abstract- Power failure is a common problem. It hampers the production of industry, construction work of new plants and buildings. It can be overcome by using a backup power supply such as a generator. But it is cost effective and also time consuming as certain time is required to switch on the generator manually. It is often noticed that power interruption in distribution system is about 70% for single phase faults while other two phases are in normal condition. Thus, in any commercial or domestic power supply system where 3 phases available, an automatic phase selector system is required for uninterrupted power to critical loads in the event of power failure in any phase. There is no requirement of backup power supply in that case. Also, there is no time consumption as the phase is changed automatically within a few seconds. The main aim of this paper is to present the real idea of an automatic phase switch for 220V to 240V alternating current. Although, there are many designs that can perform almost similar functions like, single phase change-over switches, two phase automatic transfer switch and three phase automatic change-over switch, but this model is about an automatic phase switchover (phase selector) which is designed for only three phase A.C input power to single phase output applications.

Keywords- *Automatic phase detector, power failure, single phase load, Three phase supply, Electromagnetic Relays, Battery.*

I. INTRODUCTION

Most companies, industrial, commercial and even domestic are dependent on public power supply which has erratic supply such as phase failure, phase imbalances or total power failure due to one or more technical problem in power generation, transmission or distribution. If all the three phases are available, there is need for automation of phase change during phase failure or total power failure in any of three phases in order to safe guard consumer appliances from epileptic power supply.

In most cases, many manufacturing companies, whether they are domestic or industrial, which employ single phase equipment for its operation sometimes experience challenges during failures in power supply. Much time would be required in the process of manual change over. This means that time and the process required for the phase change may cause serious damages to machines and even the products. Hence, there is need for automatic phase switching system.

A single phase public utility prepaid meter is operated with a single-phase power supply unit. If there is a phase failure from the public utility power supply, the prepaid meter will stop working until the phase is manually changed to an active phase. So a person needs to be present always to make the changes at any point in time. To overcome this problem automatic system is required.

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II. BLOCK DIAGRAM REPRESENTATION

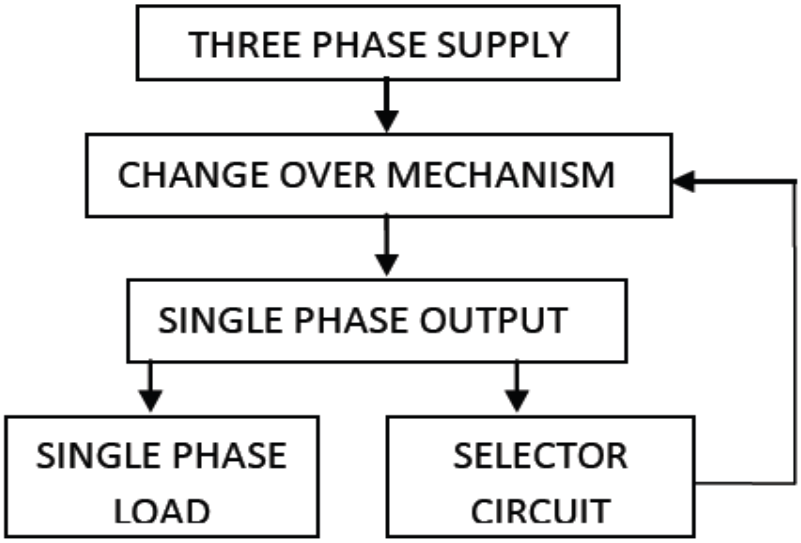

Figure 1. Block Diagram of Representation.

According to the block diagram the three-phase supply is given to the changeover mechanism. The Changeover mechanism consists of a conductor and a gear motor (12 V). The conductor is in touch with any of the three phases. The conductor is connected with the gear motor in such a way that if the motor moves the conductor can also move from one phase to another phase. The single-phase output is first stepped down and rectified. After that it is fed to the selector circuit. This circuit selects one active phase and sends the signal to the changeover mechanism which gives the single-phase output connected to the load**.** There actually is no such thing as 2 phase. Only single phase (As most/all residential services), or three phase (primarily in commercial/industrial) is Available.

When a normal three phase motor 'loses a phase' (blown fuses, open winding, bad contactor, etc...) while running, the motor continues running due the flux produced by the other two phases known as ‘single phasing’. This operation of motor draws more current in other two phases, causes burning of winding. While it probably will not operate very long, the motor would over heat, and loose speed rapidly, and they will sometimes make noise. To avoid single phasing simple method is to simply disconnect the motor. When one phase of the three-phase supply is not provided by the supplier a virtual phase is created by the disconnection of particular phase from supply and inclusion of capacitor which provides phase displacement.

It is to compensate the loss of phase by providing the third phase from the supply. This is done by phase shifting one of the phases of the healthy phase and giving it to disconnected phase. This is the main method of this project. The 230v single phase ac supply is given to the input for the transformer primary and this voltage is stepped down to 12v. The output from the transformer secondary is given to the bridge rectifier. The bridge rectifier will convert the given ac supply into dc.

The output of the rectifier would have ripples, to reduce the ripple the output is passes through the filter circuit. Then the filtered output is given as the input for the voltage regulator, this will produce the constant 5v dc.

A voltage regulator is designed to automatically maintain a constant voltage level. If the output voltage is too low (perhaps due to input voltage reducing or load current increasing), the regulation element is commanded, up to a point, to produce a higher output voltage–by dropping less of the input voltage (for linear series regulators and buck switching regulators), or to draw input current for longer periods (boost-type switching regulators); if the output voltage is too high, the regulation element will normally be commanded to produce a lower voltage.

IV. CIRCUIT DIAGRAM

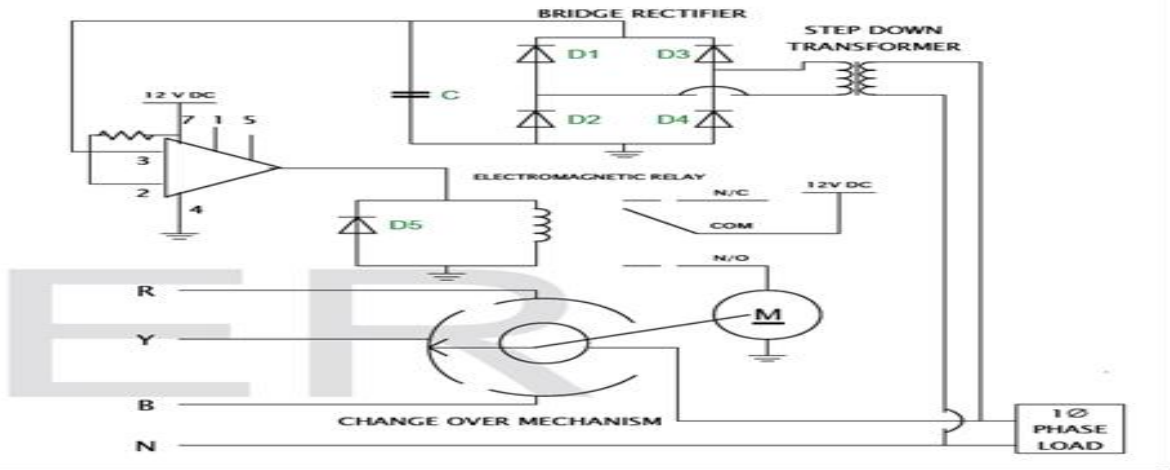

Figure 2. Circuit Diagram of Project

V. OPERATION

Automatic phase selector is applicable for a single-phase load. When a three-phase supply is fed to this system, it compares the voltages of each phase and active phase appears across the output. As a results an active phase is automatically selected among the three phases (R, Y, B) when one of those phases is absent. That active phase is connected to the load. Automatic phase selector consists of a selector circuit & a changeover mechanism. Selector circuit compares the voltage of each phase.The changeover mechanism consists of a gear motor and one conductor. When any of the phases is absent, it gives the signal to the changeover mechanism through electromagnetic relay. The gear motor starts to rotate until the conductor reaches to the next phase. As per the circuit diagram three phase supply is given to the changeover mechanism and the single-phase output is taken out for supplying a single-phase load. One part of this output is stepped down by a 220V/12V step down transformer. After that it is rectified by bridge rectifier and filtered by capacitor. After filtration, the signal is given to pin no 3 of op-amp (IC 741), pin no 3 is already connected to a 12V DC supply. If the connected phase is active, the output of op-amp is zero.

But whenever that phase is absent the output of op-amp becomes 1. The output signal is fed to an electromagnetic relay. The relay coil becomes energized and the connection changes from N/C to N/O. Thus, the motor start to rotate and the carbon brush connected to the rotor shaft through an insulating material reaches to the next phase. If the next phase is active, the output of the op-amp becomes 0 again and the load can get supply from that phase as the carbon brush is in contact with that active phase. But in case if that phase is also absent, the rotor shaft with the carbon brush again reaches to the next phase. In this way, we can get single phase supply continuously in spite of absence of any phase.

VI. RESULTS

Table 1 Result of operation

R PHASE	Y PHASE	B PHASE	OP-AMP OUTPUT	SELECTED PHASE
Active	Active	Active	0	Any of three (say Y)
Active	Absent	Active	1	R
Active	Active	Absent	1	R
Absent	Active	Active	1	Y
Absent	Absent	Absent	1	None

VII. CONCLUSION

According to the result it is seen that we get the desired output from the auto phase selector. Automatically it is selecting the active phase when the connected phase is absent. The only problem is when all the three phases are not active, the motor continues to rotate and will not stop until we switch off the 12V supply of the motor manually. This problem can be overcome by implementing a timer circuit which will automatically switch off the power supply of the motor after a certain time. But our main objective is to select an active phase automatically to save the time and without hampering the work. This objective is satisfied successfully here.

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