

Application of Electrical Phase Selector on Human Relief Stand-By Change-Over Switch

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Abstract: *The human relief stand-by automatic change over switch is a device specifically designed with the purpose of eliminating the frequent manual switching of the central control switch from the Electricity Distribution Company's power source to that of the private or home generating set and back to the Electricity Distribution Company's (EDC) source when power is restored. The uniqueness of this design is its ability to automatically detect when power is restored to the mains supply and returns the loads to this source while turning off the power from the generator set. The present design is such that it would take two different sources simultaneously and also give preference to particular power sources with the unique ability to ensure that there is always power supply to the load as required. This paper also x-ray on the design of its automation in the transfers of the consumer loads to a power source with the best voltage supply source for the case of a three phase source. To ascertain its workability, varieties of test were carried out and the Proteus electronic software was used for its simulation.*

Keywords – Electricity, Power, Proteus, Switch, Voltage

1. Introduction

Generally epileptic power supply or total outage does not promote development to public and private sector as investors do not feel secured in the viability of their business in such countries hence affecting their economic growth. The inconsistency in the availability of this essential utility (EDC), calls for the use of generator as stand-by mode of power supply. As such, a human relief stand-by switch is required to change from one source (EDC) to another (Generator), which is needed to be automated. The human relief stand-by switch designed is to simply monitor, operate and maintain power in every home or institutions. While its principle of operations is based on relays, contactors and overload coil [1].

This project has many units so arranged to carryout sequence of operation by way of monitoring the availability and the quality of EDC supply to either put **ON or OFF** the generator through the various switching circuits, that connects the loads to the available power supply sources, through the contactor coils that closes the contacts of the contactors. The ratings of these contactors depend on the total loads expected to be driven from the supply source. There are also minimal time lags (five seconds each) between each sources to allow for system stability before connecting the loads. The inclusion of power switch 1, is to allow safety maintenance of EDC side while the power switch 2, is to prevent the generator from coming up when its service is not required in the event of power failure from EDC and also to provide for easy maintenance of generator unit. The time lags between the two sources (EDC & Generator switch actuation takes 10secs) to allow for power stability before connecting the loads. This is made possible with the use of Timer-Relays.

In our design, we made use of relays and contactors combination only, which has been observed prior to this research to have not been used. It consists of some relays which serves several purposes. In this mode of operation, when there is any failure from EDC, there is no need to employ personnel to go and changeover the line[6]. The change-over switches automatically start the generator, and as well allowing it attains synchronous speed before connecting it to the end users load. However, when power from the mains source returns, it switches the generator OFF and connects the load to EDC supply. Also when the power phases are not complete or not normal (over or low), the switch picks the phase that is okay and transfer it to the Load for use. This type of automatic changeover switch designed differs from the other (semiconductor controlled switching type) in terms of the type of load transfer or switching panel which is pure relay-contactor switching type [1].

2. Methodology

In the course of this project, due to the following features, these electrical components were put into considerations:

- Relays for the phase selector. [1]
- Relays for the switching between EDC and generator sources.
- Mains contactors that carries the bulk of the load.
- Generator contactor that helps to connect generator to the main Load.
- Two micro switches to put OFF power when not needed and to enhance safe maintenance.

2.1 DESIGN ANALYSIS AND MATERIALS SELECTION

This design is intended to power a total load of 10.56kw

where $\cos\theta$ is the power factor (i.e. 0.8)

$$V = 220v$$

$$P = 10.56kw$$

$$\therefore I = \frac{\text{power}}{V\cos\theta}$$

Using the formula,

$$P = IV\cos\theta$$

Where:

V is phase voltage = 220V

I is Full load current

Cos θ is a power factor = 0.8

P is inducting loads rating = 10.56KW

$$I = 10560 / 220 * 0.8 = 60A$$

2.2 CONTACTOR SELECTION

In choosing the contactors to be used, the running currents would be considered. The full load current of 60A was assumed. At starting, current passes through the Mains or Generator contactor to the load. The contactor to be used will have a rating higher than 60Amps. A contactor of 80Amps will be selected for the Mains and Generator contactors to pave way for future load expansion⁽¹²⁾. From contactor table chart, contactor coil current rating of such amperage (80A) is rated 5A

2.3 RELAY SELECTION:

Relays with the following parameters were used for the design:

D.C rating 10A/12V, coil rating of the relay

A.C rating 5A/220V, coil rating of the relay

2.4 CONDUCTOR SELECTION:

- A standard table (conductor & cable rating) are used for the selection of copper conductors use:
- 10mm² cable will carry 60A of current through the contactors contacts to the loads.
- 1.0mm² cable for the control circuit connection[3,5]

2.5 MEASURING INSTRUMENTS

A suitable scaled 83 x 68mm, voltmeter and ammeter are fitted as standard. It takes the reading of output voltage & current respectively.

2.6 CIRCUIT BREAKERS & MCB SWITCH:

Circuit breakers are protective components used to isolate or disconnect a faulty electrical component or circuit from the supply at a very short time without causing damage to the equipment. It is a mechanical switching device capable of making and breaking current under normal & abnormal circuit conditions. Circuit breakers have both short-circuited and overload protective devices [3,7]. The rating is 80A, 220V. The MCB switch is operated manually, by powering it OFF when the operation of generator is not required. Its rating is 15A, 220V.

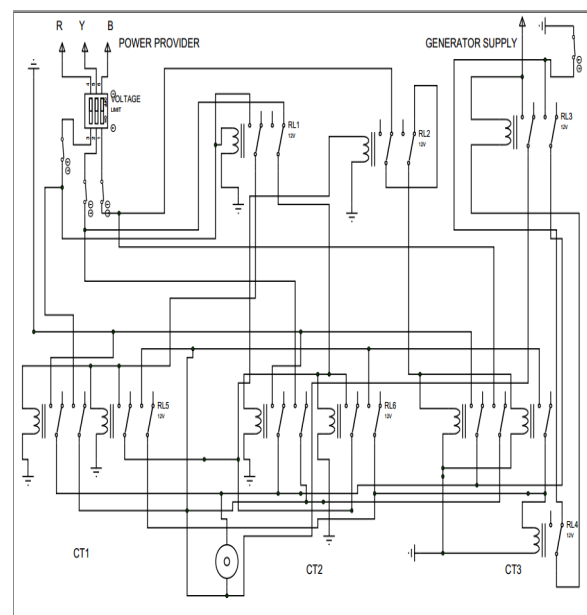


Fig 1: Human relief Stand-By Change over switch (Single Phase).



Fig 2: Human relief Stand-By Changeover switch (Single Phase)

Hence, the automatic changeover switch that is designed and constructed is an improvement on what had been previously done. The present design is such that it can take two different sources simultaneously and also give preference to the power sources with the unique ability to ensure that there is always power supply to the load as required.

2.7 FEATURES OF GENERATOR USED

The automatic change-over switch can be used in any place where alternative power is needed to complement the main power supply. In this project, a generating set is used as an alternative power supply. Thus, it is very important to note the necessary peripherals to be used with the automatic change-over switch.

(a) The generator must have electrical 'start and stop' facility.

(b) The generator's battery has to be in good condition always for kick started Generators.

(c) The inter-connecting cables must be in good order

2.8 INDICATION LAMP:

These components work with single phase voltages. Their operating voltage should be 220V

3. Result and Discussion Conclusion

This product having being designed was specifically made to operate on a single phase power supply, the standby power supply sources must have an effective ON and OFF key and must have an efficient battery to enhance its self-starting. The

connecting wires must be electrically sound and the contactors and relays used must be well sized to meet their current rating requirement for an effective operation. During design some levels of tolerance were made to enhance future expansion, this maximum rating must not be exceeded to avert total system breakdown. A phase selector was incorporated as a modification to ensure availability of power supply to the user from any of the lines that has power.

The normally open and close of the relay were checkmated with the aid of a digital meter to avoid wrong connection of the relay contacts. The output of the power supply unit which powers the relays was tested. The system was tested with public supply sources and Generator. A single filament electric bulb was used as Load for the testing. When the public supply source is ON, the system on its own puts the Generator off while keeping the load on. When the source of public supply sources is OFF the system then starts the generator source and connects the load to it, this takes a few seconds.

4. Conclusion

The advantage of this design is uniqueness of the use of relays and contactors combination, it is said to have the following advantages:

- It automatically connects your home/office/factory to your Generator whenever public supply fails.
- It automatically changes from Generator mode to EDC mode when public power supply is Restored.
- It can switch high voltages.
- It automatically STARTS your Generator when public power supply fails. (No need to go out in the rain or dead of night to start your Generator).
- It automatically turns OFF your Generator as soon as EDC is restored (no need to go out late in the middle of the night to turn off your Generator).
- It can be used to interchange load between various types of power sources including wind turbine/mill, inverter, solar power unit, two or more separate generators, EDC etc.
- Any type of Generator can use it.
- It uses components that are always readily available in the market (no need of any importation or order from outside the country).
- It can select a single phase from the three phase available
- It has control over low and high voltages from the supply.

- It is very flexible.

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6. References

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