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DESIGN AND DEVELOPMENT OF AUTOMATIC MAINS FAILURE PANEL FOR DIESEL GENERATOR

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Abstract --Electricity is an essential commodity in our day to day life, electricity forms the basics of any developing country or a developed country. Electricity is required in Domestic, industrial and commercial purposes. Thus, electricity is very important. Failure in electricity supply or interruption in the supply has many adverse effect on Electrical equipments and Control systems. The purpose of this project is to design and build a system that is called Automatic Main Failure (AMF) System which can automatically allow switching from Mains power supply to a battery as backup power supply. Depending upon the Control unit ,[1] there are three main types of AMF units 1) by using Microcontroller in AFM unit itself, 2) by using PLC (Programmable Logic Control) programming for control action & 3) with the help of Relay Machanism .In this paper a Relay based system is discribed for control action. Elements which are used they are voltage sensor(PFD), Overload Relay and Air Circuit Breaker. The system is continously monitoring the voltage level from the mains. If the voltage is dropped below the allowed level, this system will switch the Load to Generator(Auxillaury supply) and switch back to the Mains when the voltage is back to nominal required normal level.An interlocking of both the ACB is done to avoid any mal operation of switching of ACB. Some delay is also introdused in the system to avoid the transient condition fault in witch the source will not have to shift .Continouty of supply to load is achieved with the help of AMF unit.

Keywords: Phase Failure Detector; Overload Relay; Air Circuit Breaker; Battery Charger; Delay Timer; MCB, Bus bar .

I. INTRODUCTION

Automatic Main Failure (AMF) System is a system which can automatically transfer the switch from Mains power supply to Auxiliary when anomaly such voltage drop, over-voltage and outage or blackout is occurred at the main power & any Power Quality problem regarding the supply will also cause the system to operate. [2]AMF continuously monitor the level of voltage and the output is given to the Control Circuit. Feedback from the Overload relay, Low voltage monitoring relay will generate the signal for both the ACB to be operates corresponding and switch the supply accordingly.

A. Objectives.

The objectives of this project is to:

i) Design a system that allows switching from mains power to backup power when anomaly is detected.
ii) Design an automatic system using Relay Operating Control system.

TABLE 1. Main Components and their Specification used in the system.

Component List	Ratings
Phase Failure Detector	415-440 VAC
Overload Relay	440V ,6 Amp
Air Circuit Breaker	415V,800 Amp
Battery charger	24 V DC 10 Amp
Delay Timer(ON delay)	240VAC
Single Pole MCB	230/400V , 16 Amp

B. Problem Statement

i. A device will not operate efficiently due to the voltage drop
ii. A device may damage due to overvoltage
iii. Time Consuming, to switch the source manually.

II. FUNCTIONAL DETAIL

A. Phase Failure Detector.

It is an electro mechanical device used in power system engineering to protect a load from damage due to failure in any of the phases supplying power to the load. It automatically cuts off the load from supply if one of the individual phase becomes faulty. A phase failure detector is particularly important component in many assembly plants using the mains power supply. A significant reduction in value due to uneven load conditions will cause serious problems.

Phase Failure Detector will operate in following conditions;

i) Unbalanced Voltage
ii) Single Phase or Phase loss
iii) Overload Condition
iv) Power Outage
v) Phase Reversal

It monitor both Generator as well as Mains side parameter. Any above mentioned condition will cause PFD to operate & give signal to ACB as well as control signal is generated

B. Overload Relay

A thermal Overload relay is used for monitoring the over load in the system. Which causes the over current flow from supply side to the load side.

This overcurrent will responsible for many damage that will occur in the system. Equipment fail to operate, life time of electrical machine will get reduced, and mal operation of other connected unit etc. are the main impact of this overload or current to the system.

Thermal Overload relay is a bimetallic strip having different thermal properties like the melting or binding temperature of one strip will be less than that of other. In case overload, this high inrush current flowing through the relay will cause the one strip to be milt & relay contacts will get closed this gives the signal to control unit

As per given feedback signal from thermal overload relay ACB & other control signal generated.

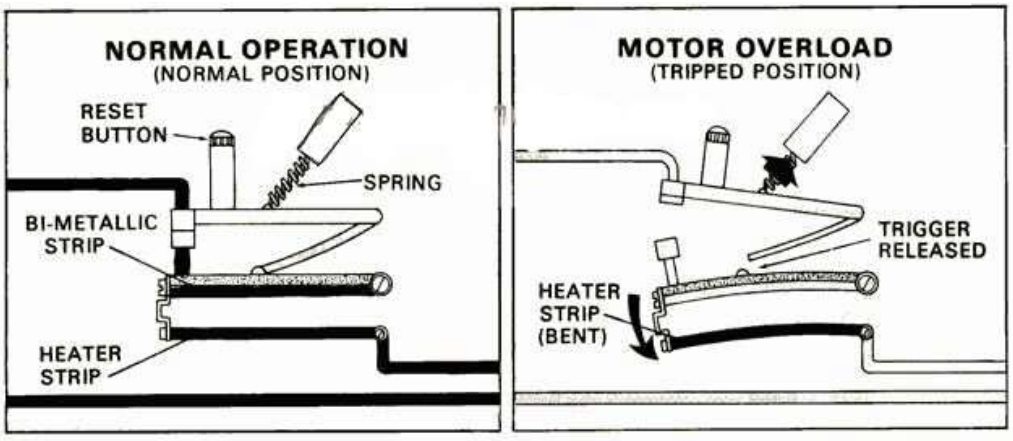

Fig. 1 : Overload Relay

C. Air Circuit Breaker

Air circuit breaker is a device used to provide Overcurrent and short circuit protection for circuits ranging from 800Amps to 10000 Amps. Air circuit breakers are usually used in low voltage applications below 450 volts. ACB prevents the re-establishment of arcing after current zero by creating a situation where in the contact gap will withstand the system recovery voltage .For interrupting arc it creates an arc voltage in excess of the supply voltage.

[3]There are three main methods by which this arc voltage get reduced.

i) *By cooling the Arc plasma*
Medium between the contactors of ACB has high temperature during the Arc reformation due to which free electrons are radially developed by collision, to avoid this a cooling system is provided in-between.

ii) *By lengthening the Arc path*
As the length of Arc is increased, it require more voltage to restrike Arc between the contactors. Metallic strip tangential to contactor are used to increase the length of Arc.

iii) *By Splitting of Arc into 'n' no. series*
A series of non-conducting fringes are present above the Arc area .This causes the Arc to split in no. of small Arc directed upward resulting to avoid the reformation of Arc

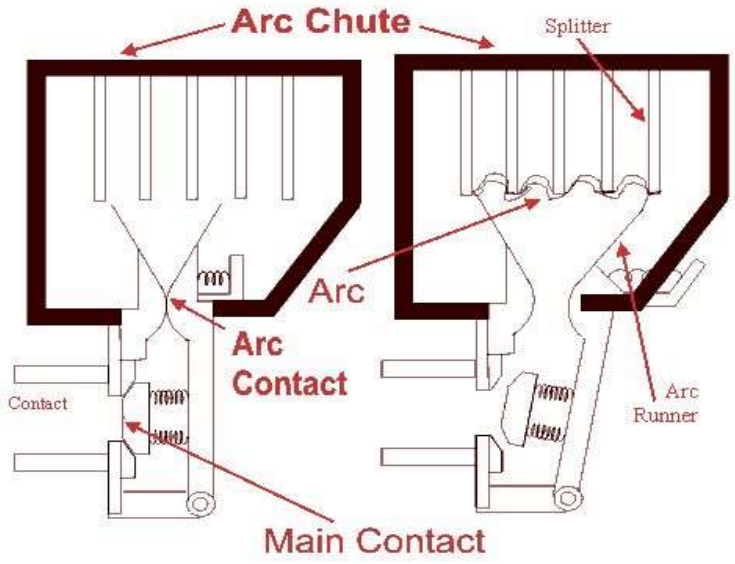

Fig. 2 : Air Circuit Breaker

An interlocking of both ACB is done to avoid the unconditional or fault occurs in the control signal generated .Both the ACB will operate one after another. If any fault occurs in the one ACB then other ACB will not operate

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D. Delay Timer

It is a device which is used to add a delay in operation.There are two types of timer, ON delay timer & OFF delay timer. In ON delay timer, when time has expired the contacts close until voltage removed. In OFF delay timer, control input for opening of contacts cause timer to start &contacts will not be operates until the time out .On delay timer used to avoid transient fault operation.

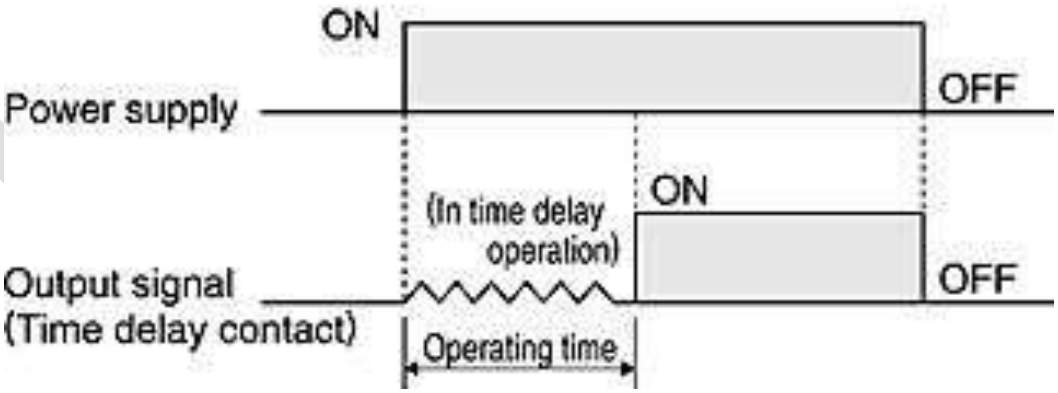

Fig. 3 : Delay time

III. OVERALL SYSTEM DESIGN

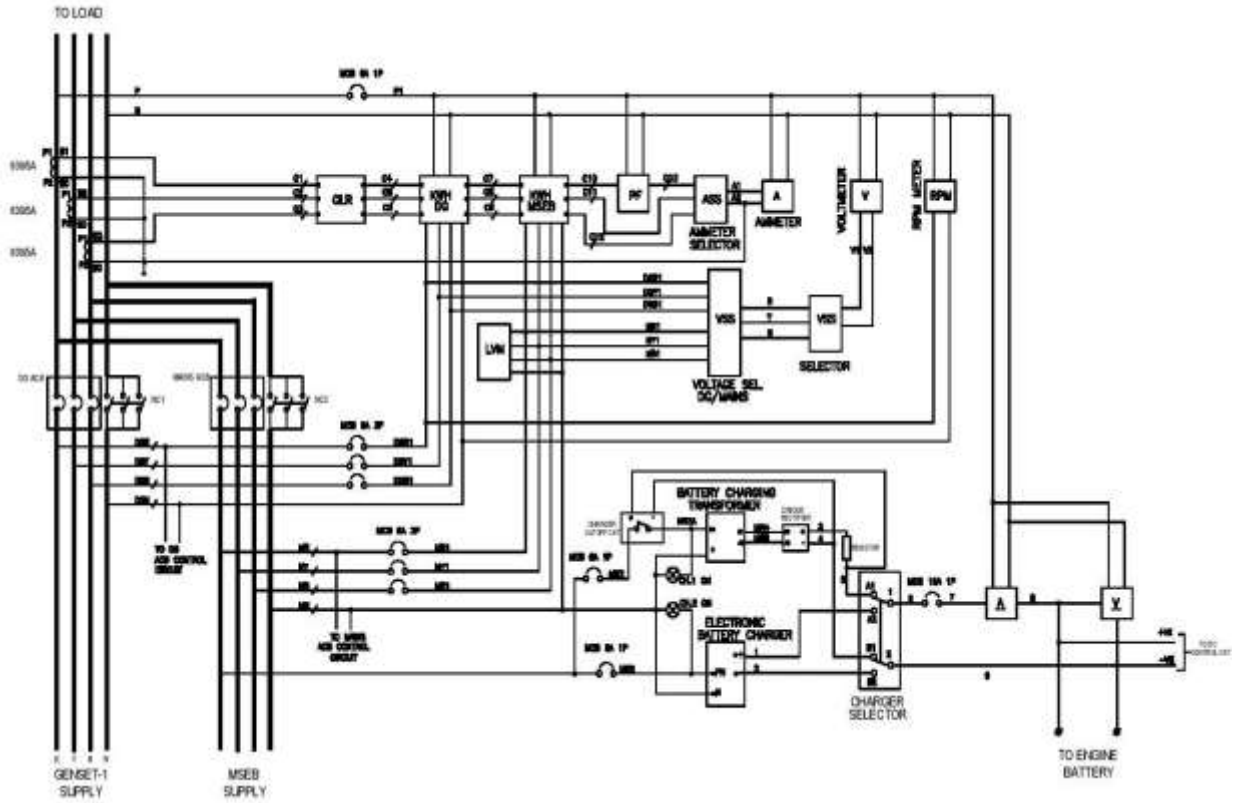

Fig. 4 : Line diagram

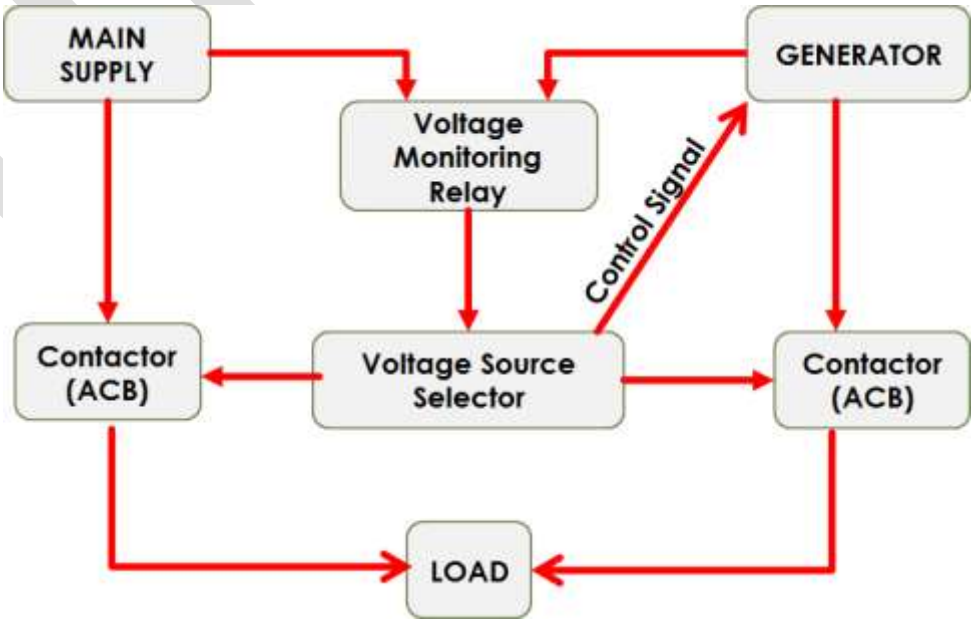

Fig. 5 : Block diagram

Above fig. 5 of block diagram represents the function of AMF panel. Each block represent the main part of panel. Power from mains supply is continuously monitored by PFD with the help of relay unit. It gives signal to the ACB for its operation / protection. When fault occurs in the mains supply PFD detects the fault and disconnect the mains supply form the load side by tripping the ACB. Generator will start automatically. When generator runs at rated RPM & frequency then the ACB (DG) will operate & supply is given to the load form the generator. A delay is introduced in the system to avoid the transient fault condition.

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IV. DESIGN CONSIDERATIONS

In the designing of AMF panel for 250 KVA load, Active power & Maximum Rated current are calculated to determine rating of contactor to be used as well as cable size.(Assume PF=0.8 & Balanced Load)[1]

$$\text{Active power P} = \text{Apparent Power} \times \text{Power Factor}$$

$$\text{Active power P} = 250 \times 10^3 \times 0.8$$

$$\text{Active power P} = 200\text{kW}$$

$$\text{Power} = 3\, I_P V_P \cos\emptyset$$

$$I_P = \frac{\text{Power}}{3\, V_P \cos\emptyset}$$

$$I_P = \frac{200 \times 10^3}{3 \times 240 \times 0.8} = 347.22 \text{ Amp}$$

(Tolerance of 25%)

$$\text{Maximum Fault Current} = I_P + (0.25 \times I_P)$$

$$\text{Maximum Fault Current} = 347.2 + (0.25 \times 347.22) = 434.025\ Amp$$

Required Cable should carry a current of at least == 434.025 x 1.5 = 651.03 Amp

Bus bar size for 800 Amp = 7×75 mm

(IEC 60439 – 2: 2000)

Each control equipment are selected as per the above current rating of system. Connection Diagram of panel is made & final wiring of equipment are carried out after mounting of each

V. CONCLUSION

Auto mains failure panel with generator starting/shut down facility has been designed to help man reduce the stress and loss of time associated with the starting and shutting down of the alternative sources of supply (generator)

It will automatically switch the source when the voltage is lower than required value. And supply of electricity is obtained.

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