DESIGN, IMPLEMENTATION, AND FABRICATION PARAMETERS OF SWITCHGEAR

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ABSTRACT- This research paper discusses design parameters of switch gear and mentions a method for it designing. The switch gears are mostly and commonly used in electrical systems for protection and switching. This includes utilization, features, key components, and role of switch gear in electrical systems. At the end, detailed proposed design methodology is presented with successful results. Even some production processes have been discussed and the future usefulness of the proposed designing procedure is discussed.

Keywords: Switch Gear, Circuit Breaker, Relay, MCCB, MCB, DOL

I. INTRODUCTION

In an electric power system, switchgear is the combination of electrical disconnect switches, fuses and/or circuit breakers used for controlling, protection, and isolation of electrical equipments. Switchgear is used both to de-energize equipment to allow work to be done and to clear faults in the downstream section of the system. This type of equipment is therefore necessary for the reliability of the electricity supply. Switchgear essentially consists of the switching and the protection sections. The devices used are switches, fuses and circuit breakers, and the relays. The apparatus used for controlling, switching, as well as protection of the electrical circuits and equipment is generally known as switchgear [1].

Fig.1 Circuit Breakers

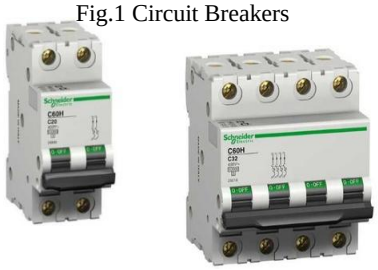

Fig.2 MCCB (Molded Case Circuit Breakers)

In Figure 1, the circuit breakers which are used in switch gear are shown. Their main purpose is switching-that is making or breaking of electric circuit. These are single pole type breakers; these consist of two, three, or even four poles. It depends on the scheme or requirement, which mentions the type as per given load conditions. Molded Case Circuit Breakers (MCCB) are actually designed for circuit protection of low voltage distribution system. And these are good for applications such as main-breakers, and also for protection of branches and feeder circuits [2]. These MCCBs provide overload and short circuit protection for all of circuit elements. They are used in switchboards, in the control panels, and in combination starters, in separate enclosures to meet all the requirements of distribution and power circuits [3].

II. FEATURES

Comprehensive range is 25-1600A in different frame sizes in compact dimensions. And the identical front plate cut out is automatically uniform. The flexibility of mounting comes through the interchangeable line and load connection. It comes with adjustable front accessible thermal and magnetic setting. (Generally the thermal setting for the overload adjustment is from 70% to 100% of the rated current and magnetic setting for the short circuit adjustable 4-10 times or 5-10 times). It is available in single pole, 3 pole and 4 pole with the switched neutral version. It is suitable for switching-disconnections and isolators. In the feature of the trip-free mechanism actually breaker trips internally in case of any fault, even in the case of knob is in turn-on position. Mounting is possible both in vertical or horizontal positions. The complete range of accessories includes under voltage release, auxiliary switches, phase barriers, terminal shrouds, shunt trip, extended terminals, rotary handles, back studs, the enclosure, and an earth leakage relay.

II.I RELAYS

A relay is generally electrically operated switch. Many relays use one electromagnet to mechanically operate the switch, but other various operating principles are also used, e.g. solid-state relays. Relays are used where there is a necessity to control a circuit by low power signal thus achieving full electrical isolation between the control and controlled circuits, or in situations where several circuits are to be controlled by one signal [4]. Initially, the first relays were used in the long distance telegraph circuits as the amplifiers, thus they repeated the incoming signal from one circuit and retransmitted it on the other circuit. Relays were also used extensively in the telephone exchanges and early computers for logical operations.

Fig.3 Relay

III. ROLE OF SWITCH GEAR

The low voltage switches and the rewirable fuses are common in domestic systems. The switch is used to manually open and close the electrical circuit to protect the household appliances from over-electric current and the short circuit faults. In the same way, every electrical circuit those which include voltage electrical power system need proper switching and thus protective devices. But in case of high voltage and extra high voltage systems, these switching and protective schemes become complicated for high fault electric current interruptions in a safe and secure way. In addition, every electrical power system needs measuring so the commercial point of view is crucial, which in turn need the control and regulating arrangement [5]. Therefore, collectively the whole system is called switchgear and the protection of power system. The electrical switchgears have been needed so developed in various forms. Switchgear protection plays a major role in modern power system network, starting from the generation, then the transmission, and finally the distribution end. As a convention, the electric current interruption device or the switching device is generally called circuit breaker in switchgear protection systems. The circuit breaker can be operated manually whenever required. By sensing the abnormality of system, it can also be operated during over electric current and short circuit situation or in other various faults in the system. The protection relay is used to sense the faulty condition of system and the relay is again actuated by the faulty signal usually comes from a current or voltage transformer.

IV. PRACTICAL IMPLEMENTATION

There are two main techniques used for starting a motor.

I. DOL (Direct online starter)
II. Star Delta Starter

IV.I DOL (DIRECT ONLINE STARTER)

To start of induction motors, different starting methods are employed because it draws more starting current during its starting. To prevent the damage to the windings due to the flow of high starting current, different types of starters are employed. The simplest form of the motor starter for the induction motor is direct on line starter. The direct on line motor tarter consists of a MCCB or circuit breaker, and the contactor and one overload relay for protection. In electromagnetic contactor case, it can be opened by the thermal overload relay when fault occurs [6]. Typically speaking, the contactor is controlled by a separate start and stops buttons; while an auxiliary contact on the contactor is generally used across the start button, thus it provides the purpose of a hold in contact. So, it can be said that the contactor is electrically latched closed, and in the meanwhile the motor is operating. Figure 4 shows the logical diagram.

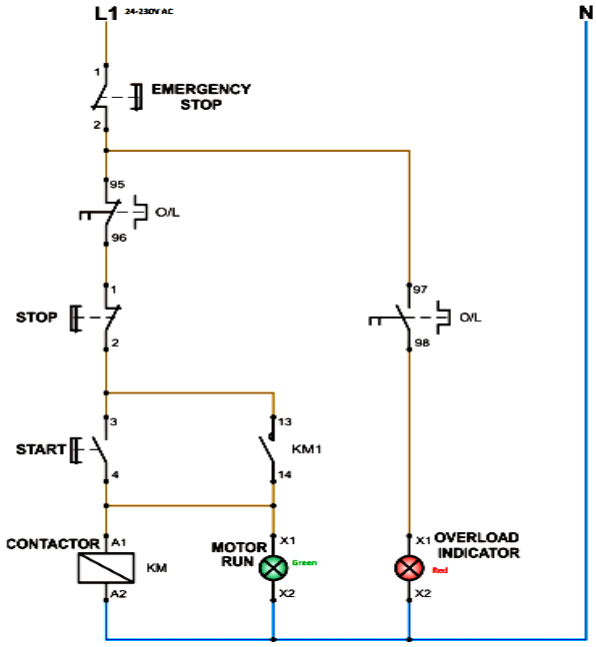

Fig.4. DOL (Direct online starter)

IV.II STAR DELTA STARTER

In dual starter, the motor terminals are directly connected to the power supply. Thus, the motor is subjected to the full voltage of the power supply. As a result, motor experiences a high starting current flow through it. But this type of starting is suitable for small motors below 5hp (horse power) or 3.75 kW. And the reduced voltage starters are carried through the motors which are above 5hp. As a matter of fact, dual motor starters are mostly available for the motors having rating less than 150kW power on 400V and for the motors less than 1MW power on 6.6 kV specifications. The supply reliability and the reserve power generation ensure the usage of reduced voltage or the not reduced starting current of an induction motor. The voltage across the motor is needed to be reduced. So, this can be done by star delta starter Variable Frequency Drive (VFD) used extensively for the speed control also serves this purpose [6]. Furthermore, in dual starter, the motor is directly fed from the line and in star-delta starter, and then motor is started initially from star and later while being in running from the delta. Both the starting current and starting torque are reduced in this method. In order to use this starting method, the motor should be delta connected during a normal run. Here, he received starting current is almost 30% of the starting current in case of direct on line start (DOL); and the starting torque is reduced to about 25% of the torque available at DOL start.

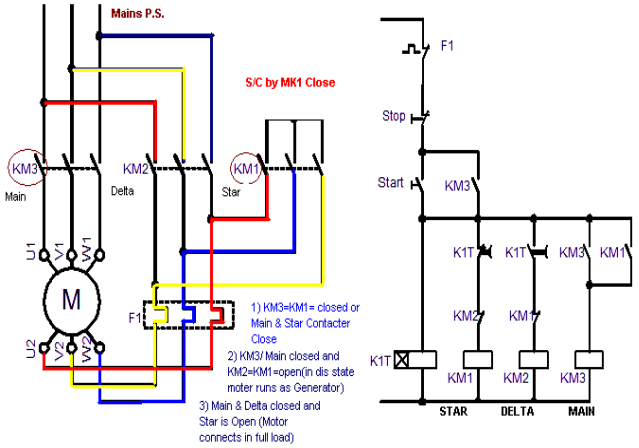

Fig.5.Star Delta Starter

V. MANUFACTURING PROCESS

Designing is mostly done in CAD (Computer Aided Design) and switchboard design software.

Metal processing is done in the metal processing shops installed with the state-of-the-art CNC (Computer Numerically Controlled) machines. Furthermore, high quality electro galvanized steel sheets are used for high standard product manufacturing.

In paint shop, the pretreatment and the high precision payoff of the sheet-steel are followed by the powder coating. Additionally, the salt spray tests of the coated parts are done in independent laboratories.

All the assembly lines are fully equipped with all the necessary equipments and tools. Mostly the work tables are provided with the required pneumatic tools.

To ensure high level conductivity, a high quality of 99.99% pure tinned copper is mostly used. All the conducting parts are fabricated strictly after viewing the designs generated by engineering design department.

VI. CONCLUSION

Switchgear has a proven record of reliability, the performance failures are rare. But there are precautions that should be taken to ensure the safety of personnel working with or in the vicinity of switchgear manufacturing. The older types of switchgear have been proven deficient in some areas with time. This together with changing system fault levels and poor maintenance can lead to high safety risks to the personnel working on aged switchgear installations. This risk can be largely eliminated by performing system studies followed by remedial actions such as retrofitting aged installations with the modern circuit breakers, the high speed protection systems, remote switching or fianally the internal arc fault feature. Switchgear using stored energy mechanism when fitted with remote electrical closing does not require the operator to be present during the close or open operations; the risk to human life is thus further reduced. Most circuit breakers manufactured currently are of the stored energy type.

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