DISTRIBUTION LINE, OPERATION,MAINTENANCE, TROUBLESHOOTING OF APEX FOOTWEAR LIMITED

A Report submitted to the Department of Electrical and Electronic Engineering in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science In Electrical and Electronic Engineering (EEE)

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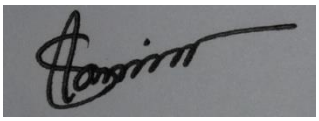
JANUARY 2019

Certification

This is to certify that this project and thesis entitled "**Distribution Operation, Maintenance, Troubleshooting of Apex Footwear Limited**" is done by the following student under my direct supervision and this work has been carried out by him in the Maintenance Department of Apex Footwear Limited under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on ----- January 02,2019.

Signature of the candidates



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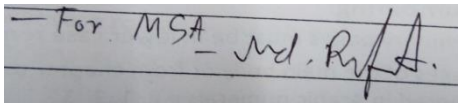

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The project and thesis entitled "**Distribution Operation, Maintenance, Troubleshooting of Apex Footwear Limited**"submitted by **Md. Shamim Reza**, **ID No: 131-33-1376**, Session: Spring 2013 has been accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** on January 02, 2019.

BOARD OF EXAMINERS

Dedicated to

Our Parents

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A
AC Alternating Current (vs. DC)
AVR Automatic Voltage Regulator

B
BDC Bottom Dead Centre
C
CT Current Transformer

D
DC Direct Current (vs. AC)
DVR Digital Voltage Regulator

E
ECM Engine Control Module
EMF Electromotive force
EPG Electric Power Generation
EPTC Electronic Programmable Transmission Control
ET Electric Test
F
Fr Frequency
G
Gen Generator
H
Hz Hertz (cycles per second)
HT High Temperature (cooling water circuit)

K
KHz Kilo Hertz (1000 cycles per second)
KVA Kilo Volt Amperes
KWH Kilo Watt Hours

L
LT Low Temperature (cooling water circuit).
O
OS Operating System

P
PF Power Factor
PCB Printed Circuit Board.

R
RPM Revolutions Per Minute.

ACKNOWLEDGEMENT

At the very beginning, I would like to express my deepest gratitude to the Almighty Allah for giving me the ability and the strength to finish the task successfully within the scheduled time. This report "**Study on Distribution line, Operation, Maintenance, Troubleshooting**" has been prepared to fulfill the requirement of B.Sc. degree. I am very much fortunate that I have received sincere guidance, supervision and co-operation from various persons. I would like to express my heartiest gratitude to my supervisor, **Dr. M. ShamsulAlam,Professor and Dean, Faculty of Engineering, Daffodil International University (DIU)**, for his continuous guidance, encouragement, and patience, and for giving me the opportunity to do this work. His valuable suggestions and strict guidance made it possible to prepare a well-organized report. I would like to thank **Apex Footwear Limited** for giving me the opportunity to work. I would also like to thank my co- supervisor **Quazi Abdullah Al Mohsin (Asst. General Manager-Maintenance),Apex Footwear Limited** for his continuous guidance, encouragement, and patience. I would like to thank**Professor Dr. Pran Kanai Saha, Head, Depart of Electrical & Electronic Engineering, Daffodil International University (DIU) Md.MohammadRafat (MRX) (Lecturer, Depart of Electrical & Electronic Engineering)** for being helpful during the time of my internship. A big thanks to its Engineers whose guidance and training came handy in obtaining the perfect knowledge and experience about the Electrical and Electronic installation, operation and maintenance and it will definitely be useful in my future. On the submission of my internship report on "**Distribution line: (Operation, Maintenance, Troubleshooting)**", I would like to extend my gratitude and sincere thanks toQuazi Abdullah Al Mohsin (Asst. General Manager-Maintenance), for being a source of guidance and inspiration during this period. Their wonderful style of mentoring has surely made my training period a great learning experience. I would also like to thank all staff of Apex Footwear Limitedwhose kindly spared for me much of their precious time in giving me support and information. Finally, my cordial thanks to my parents whose continuous support was a genuine source of motivation behind making this report a fruitful one.

ABSTRACT

During the Field Study period the practical experiences is achieved over the topics related Alternator, High Tension (HT) Panel, Operation of Low Tension (LT) Panel, Power Factor Improvement(PFI) Panel , Change Over, Motor Controlling, The Field Study gives practical knowledge about Apparatus for Molded Case Circuit Breaker, Miniature Circuit Breaker, Three Phase Circuit Breaker, Single Phase Circuit Breaker, Magnetic Conductor, Automatic Transfer Switch, High Rapture Capacity Fuse(HRC) Some Equipment for Instrumentation. There gives practical desiccation on Air circuit Breaker, Vacuum Circuit Breaker, Distribution Board (DB).

Chapter 1
Introduction

1.0 Introduction

Power supply system is the most important sector in an Electrical site and also our country.This report is about the detail description of power supply system and controlling system, Transformer, Diesel Generator, motor and the working procedure of diesel generator & motor overall maintenance and all types of information. The overall process of a Transformer, Diesel Generator and Motor is highlighted here. This report will help anybody who is interested to know about power supply system and Diesel Generator.

1.1 Background

For Bangladesh it has become a great challenge to provide continuous supply of electricity.Study on Power Supply System, Operation and Maintenance of Electrical Machines and Apparatus is most important part an Electrical site. Our country has different power Supply Company such as DESCO, REB, PGCB, DESA. These are power Supplier Company and power supply by 11KV to 0.4KV. Now a day's power supply system is the great challenge.In our country presently only 49% of the total populations have access to electricity, which is very poor comparing with even other developing countries. The main reason for the power crisis is the shortage of supply. Demand is never meet by supply. Generation of power needs to be increased transferred to the desired distribution centers of power. For this reason Bangladesh government is appealing foreign and private investors to invest through vision and policy guideline, making reform and restructure and by giving fiscal incentives.

1.2 Origin of the Report

As a partial fulfillment of Bachelor of Science in Electrical & Electronic Engineering program I have done

this practicum report. My report entitled as **"Sub-station operation, maintenance & troubleshooting".** Basis on this two months duration practical experience I have done this report and I have worked under the instruction of Engr.Quazi Abdullah Al Mohsin, Sr. Executive Service, and various team of Apex Footwear Limited

1.3: Objectives of the Report

1.3.1 Objective

The prime objective of this Project are to extrovert my knowledge to the Power Generation, Supply System, Operation, Maintenance and Motor working procedure, Compressor, Alternator, Control Panel, etc.

1.3.2Specific Objective

- Study on Power Supply System, Operation and Maintenance of Electrical Machines and Apparatus.
- To supply proper Electrical Transmission and Distribution line.
- Study on different types of Limit Switch, Isolator, Fuse, timer, Relay, Circuit breaker, Magnetic contactor, Transformer.
- To study working procedure of Diesel Generator and Transformer.
- To study and working procedure of a motor.
- To determine the process of maintaining, operation and maintenance of a Diesel Generator, Transformer.
- Suggest probable solution of the identified problem.
- Identifying different types of problems of Electrical Machines and Equipment's.

1.4 Significance

In our country the crisis of electricity in national grid is a common problem where in industrial sector the electricity is required for 24 hours. Due to failure of national grid, private industry and owners are using their own power plants & generators combining with national grid to meet the demand of electricity.

1.5 Scope and Opportunities

Like the other countries of the world, the demand for power is increasing day by day in our country. So the significance is higher than any other sector. In the era of globalization power failure has become an acute problem for our country. This report will cover and offer the opportunities to know different types of machinery used in Apex Footwear Limited Diesel Engine, Power Generation and Controlling System of various arising problem during Power generation.

1.6 Thesis outline

Chapter 1 introduces to my thesis.

Chapter 2 describes the distribution system of apex footwear.

Chapter 3 describes the power generation by diesel generator.

Chapter 4 describes the electricity supply system at apex footwear limited.

Chapter 5 describes the protection system at apex footwear limited.

Chapter 6 contains the discussion, conclusion and limitation of the work.

CHAPTER 2
POWER GENERATION BY DIESEL GENERATOR

2.0 Introduction

Generator is the main source for electricity. Every industry needed generator when not a grid supply. There are many generator use for any industry. Generator are,Ship Generator, Perkins generator, diesel generator, Deutz Generator, SDMO Generator etc.

2.1 Power Sources of Apex Footwear Limited

Apex Footwear Limited has Ten Big Generator and Two Big Ship Generator electric power sources. They are:

i) Perkins Generator (500 KVA)
ii) Deutz Generator (500 KVA)
iii) Volvo Generator (450 KVA)
iv) John Deere (250 KVA)
v) SDMO Generator (500 KVA)
vi) Perkins Generator (435 KVA)
vii) Volvo Generator (400KVA)
viii) Perkins Generator (550 KVA)
ix) Deutz Generator (200KVA)
x) SDMO Generator (500KVA)

2.1.1 Ship Generators

There are two big ship generators here, this generator produce huge amount of electricity. This are:

i) Ship Generator- 01 (1170 KVA)
ii) Ship Generator- 02 (1175 KVA)

Here all generator supplies electricity continuously, when there is no Rural Electrification Board (REB) line. All time hall factories run by REB line electricity but electricity has gone, on that time hall factory run by generator. Every day Apex Footwear Limited demand at least 3.5MW electricity. This demand can full fill every day, if this company will continue. Otherwise, the companies some sites are take rest (no electric supply available).

Fig 2.1 Diesel Generator (Perkins)

2.2.1 Specification of Perkins generator

Table 1Specification of Perkins generator

Name	Perkins
Company Location	UK
Model Number	G500
Serial Number	CSGAD0419
Capacity	500 KVA
Power Factor	0.8
Rated Voltage	415/240V
Rated Current	550A
RPM	1500

Rated Frequency	50Hz
Phase	3
Max. Ambient Temp	30°C
Excitation Voltage	35 V

2.3 Ship Generator

The Ship Generator is the most important part in an Electrical Energy. This ship Generator is the big size and can generate huge Electricity. These types of generator available in this company. This Ship Generator is 1170KVA and Maximum load is 1100A current. When, REB line current has gone, On that time this company run by this Generator. This is diesel engine.

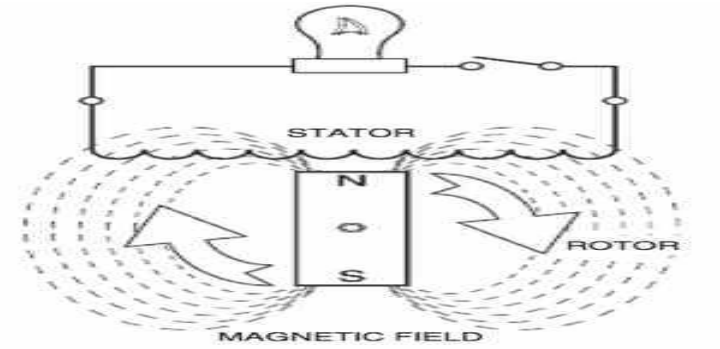
Fig 2.2 Ship Generator

2.3.1 Specification of Ship generator

Table 2 Specification of Ship generator

Name	Ship Generator
Company Location	USA
Machine Model Number	L5794GSI ESM
Machine Serial Number	C-94861/1
Engine Model Number	VHP5904GSID
Engine Serial Number	C-91861-901/1
Fuel	Natural Gas and Diesel
Capacity	1170 KVA
Rated Voltage	415/240 V
Rated Current	1100 A
Power Factor	0.8
Rotation	CCW
Rated Frequency	50Hz
Phase	3
RPM	1200
Weight	25186 kg
Input Voltage	12-36 VDC
EXC Volts	30
EXC Amps	7
Stator connection	Wye
Air inlet Temp. Limit F/°C	100/38

2.4 A Simple AC Generator



2.4.1 Alternator

Alternators operate on the same fundamental principles of electromagnetic induction as D.C. generators. Alternating voltage may be generated by rotating a coil in the magnetic field or by rotating a magnetic field within a stationary coil. The value of the voltage generated depends on-

- The number of turns in the coil.
- Strength of the field.
- The speed at which the coil or magnetic field rotates.

Figure 2.4Generator Alternator Parts

2.4.2 Specification of Perkins Alternator

Table 3:Specification of Perkinsalternator

Capacity	500 KVA
Power Factor	0.8
Rated Voltage	415/240 V
Rated Current	550 A
RPM	1500
Rated Frequency	50 Hz
Phase	3
Temp	30°C
Excitation Voltage	35 V
Excitation Current	3 A

2.4.3 Stationary Components

1. Armature (Main Stator)
2. Field Coil
3. Exciter Field
4. Regulator

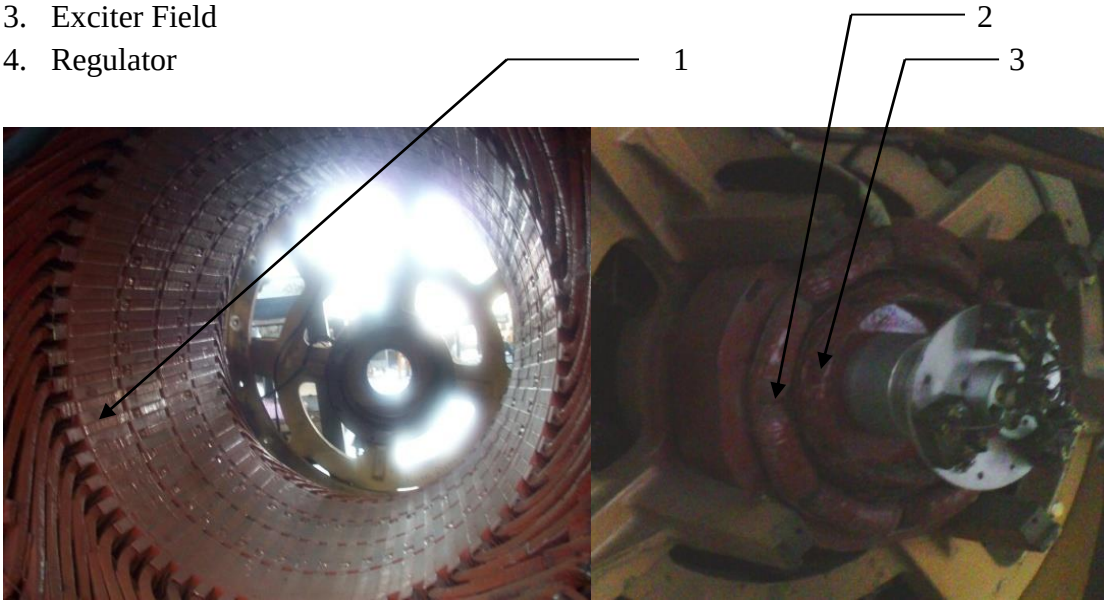
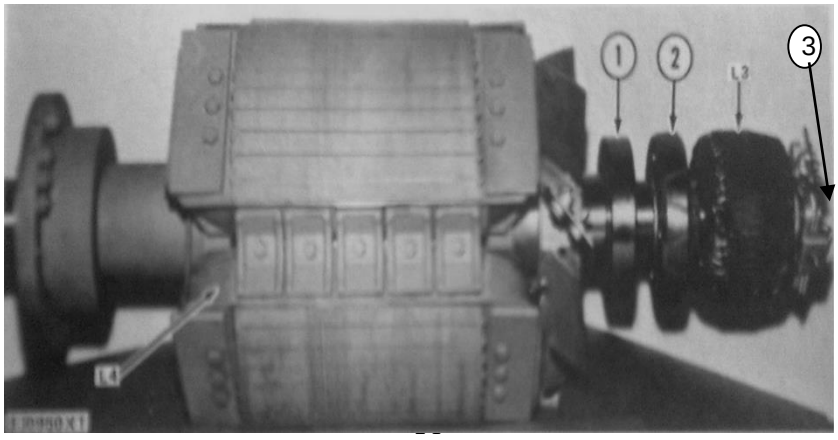


Figure 2.5 Stationary components

(1- Armature (Main Stator), 2- Field Coil, 3- Exciter Field

2.4.4 Rotating Components

1. Main Field (rotor)
2. Exciter Armature
3. Permanent Magnet (PMG)
4. Bridge Rectifier



2.6 Rotating Field Assembly

2.4.5 Main rotor

Figure 2.7 Rotating Field Assembly

The main rotor is the main part of an ac synchronous generator, which rotates because the wires and magnetic field of the ac synchronous generator are arranged so that a torque is developed about the rotor's axis. In some designs, the rotor can act to serve as the armature, across which the input voltage is supplied. The main rotor of ac synchronous generator is a shaft that constructed with the poles. The main rotor is always rotating through the armature field. Then there produce an electromagnetic flux and applied to an external load through the armature.

2.4.6 Pole

AC synchronous generator's poles constructed with the main rotor shaft. The poles are constructed with iron and copper cored insulation. Usually, ac synchronous generators have four poles that are constructed with the rotor shaft. Two of the poles are North Pole and another two poles are South Pole. The four poles are connected in series connection to each other.

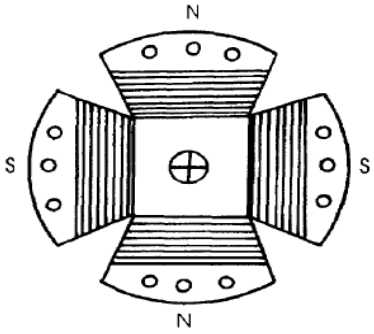


Figure 2.8 Poles (north-south-north-south)

$$\text{rpm} = \frac{120 \times f}{\text{Number of poles}}$$

2.4.7 Coupling

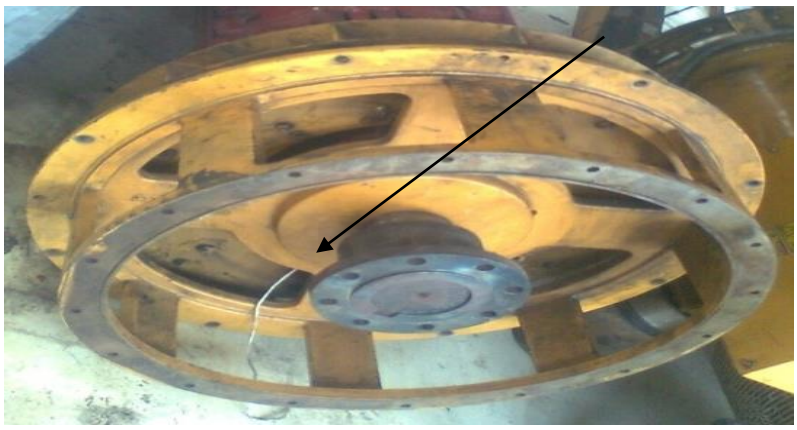


Figure 2.9 Coupling

2.7Basic Component of an Generator Engine

- ENGINE HEAD
- ENGINE BLOCK
- FLY WHEEL
- CRANK SHAFT
- CAM SHAFT
- MAIN BEARING
- BIG-END BEARING
- PISTON
- PISTON RING
- CONNECTING ROD
- LINER
- OIL PUMP
- INJECTOR
- FUEL PUMP
- WATER PUMP
- AC PUMP
- ROKKER ARM
- INTAKE VALVE
- EXHAUST VALVE
- INTAKE MANIFOLD
- EXHAUST MANIFOLD
- CHANGING ALTERNATOR
- TURBO CHARGER
- FILTER
    - LUBE OIL
    - FUEL
    - AIR
- RADIATOR
- FAN

2.7.1 Radiator

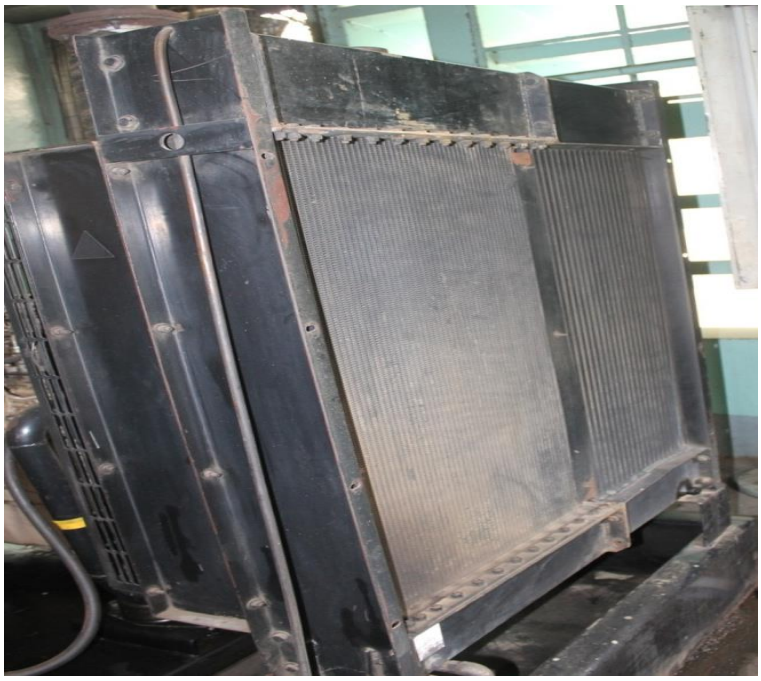


Fig 2.10 Radiator

2.7.2 Starter Systems

Fig 2.11 Starter Systems

CHAPTER 3

ELECTRICITY SUPPLY SYSTEM AT APEX FOOTWEAR LIMITED

3.1 Electric Supply System

The conveyance of electric power from a power station to consumer's premises is known as electric supply system. An electric supply consists of three principal components:

1. Power Station
2. Transmission line
3. Distribution System

The electric supply system can be broadly classified into two parts:

1. D.C or A.C system
2. Overhead or Underground System

Now a day's 3-phase, 3-wire a.c system is usually adopted for generation and transmission of electric power as an economical proposition. However, distribution of electric power is done by 3-phase, 4-wire a.c system. The undergrounding system is more expensive than the overhead system. Therefore, in our country, overhead system is mostly adopted for transmission and distribution of electric power.

3.2Typical a.c Power Supply Scheme

The large network of conductor between the power station and consumers can be broadly divided into two parts:

1. Transmission System
2. Distribution System

Each part can be further sub-divided into two parts:

1. Primary Transmission
2. Secondary Transmission
3. Primary Distribution
4. Secondary Distribution

3.2.1 Generating Station

Therefore, the choice of proper transmission voltage is essentially a question of economics. Generally the primary transmission is carried at 66 KV, 132 KV, 220 KV or 400 KV.

3.2.2 Primary Transmission

The electric power at 132 KV is transmitted by 3-phase, 3-wire overhead system to the outskirts of the city. This terms the primary transmission.

3.2.3 Secondary Transmission

The primary transmission line terminates at the receiving station (RS) which usually lies at the outskirts of the city. At the receiving station, the voltage is reduced of the city.

3.2.4 Primary Distribution

This forms the primary distribution. It may be noted that big consumers are generally supplied power at 11 KV for further handling with their own sub-station.

3.2.5 Secondary Distribution

The electric power from primary distribution line (11 KV) is delivered to distribution sub-station (DS). These sub-station are located near the consumers localities and step down the voltage to 400 V, 3-phase, 4-wire for secondary distribution. The voltage between any two phases is 400 V and between any phase and neural is 230 V. The single-phase residential lighting load is connected between any one phase and neutral, whereas 3-phase, 400 V motor load is connected across 3-phase lines directly.

3.2.6 Sub-Station of Apex Footwear Limited

Sub-station is the assembly of apparatus used to change some characteristics (e.g. voltage, a.c. to d.c., frequency, power factor etc) of electric supply. Apex Footwear Limited has a Sub-station. They use a transformer to step down the voltage of REB line from 11 kV to 415V.

3.3.1 Transformer

Masco Industries Limited uses a step down transformer to step down the voltage of DESA line from 11 kV to 415V. It does so with corresponding increase in current but without changing in frequency. The transformer is consists of two coils – Primary and Secondary coil. The coils are electrically separated but magnetically linked through a path of low reluctance

3.3.2 Specification of Transformer

Table 4:Specification of Transformer

Transformation ratio	11kV/415V
KVA	1500 KVA
Load Max	2178.75 A
Power factor	0.8
Frequency	50Hz
Phase	3

Figure 3.1 :11000/415V, 3-Phase distribution transformer

3.3.3 Three Phase Transformer

They use three single phase transformer which make a bank and produce three phase supply

3.3.4 Working Procedure of a T.

Figure 3.2 Transformer Structure

3.3.5 Parts of the Transformer

- L. V. Winding
- H. V. Winding
- Oil level indicator
- Conservator
- Breather
- Drain coke
- Transformer oil
- Earth point
- Temperature gauge
- Buchholz relay
- Low –voltage bushing
- High-voltage bushing
- Thermo-meter
- Carriage
- Expulsion vent

3.3.6 Transformer Components Description

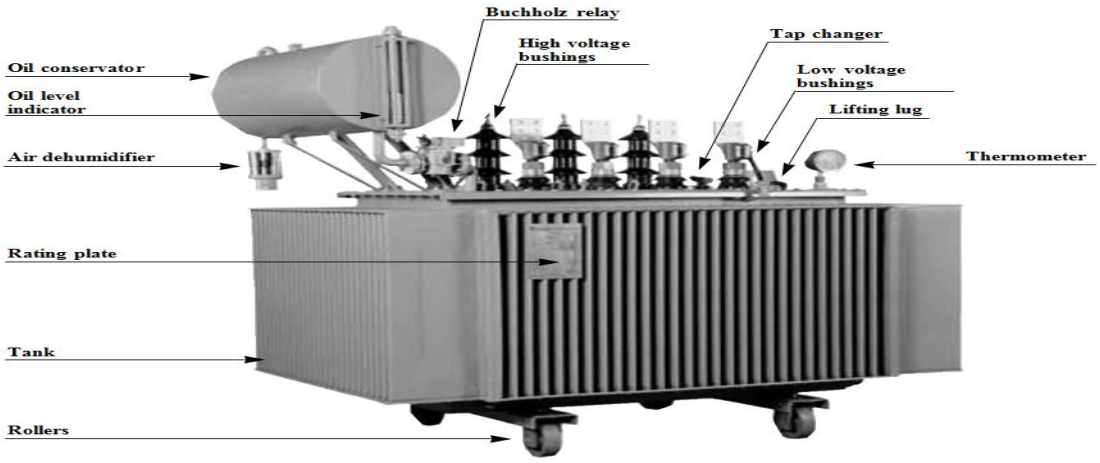


Figure 3.3 Oil-immersed Transformer

3.3.8 Tap Changer

The applying medium voltage to the primary winding of transformer is not stable and depends upon the transformer position in the distribution network. Therefore, taken the primary voltageas granted, the tap changer is used in order to keep the secondary voltage of the transformer as stable as possible.

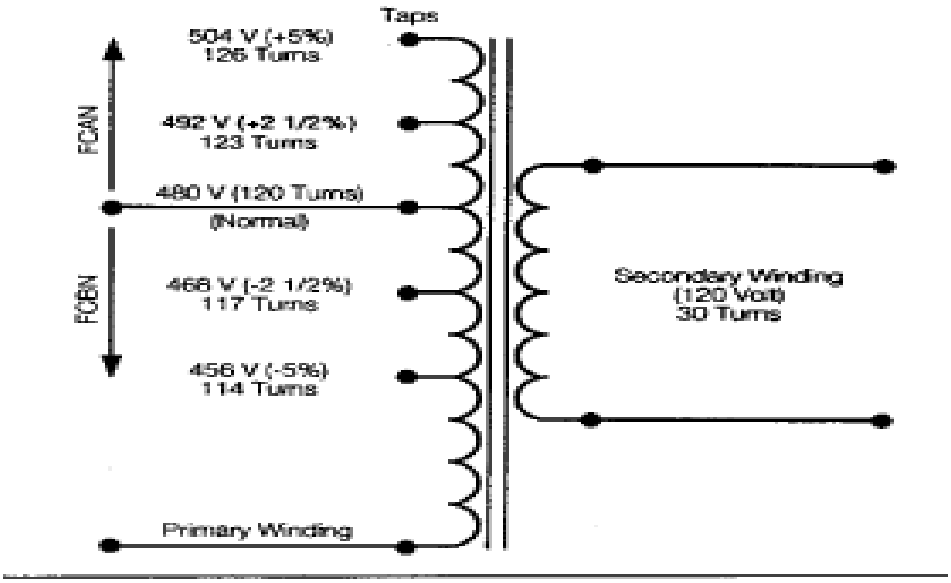


Figure 3.4 Tap Changer

Other Designs may have the high voltage winding wound inside, side-by-side or sandwiched between layers of the low voltage winding to meet special requirements. As stated previously, the voltage transformation is a function of the turn's ratio. It may be desirable to change the ratio in order to get rated output voltage when the incoming voltage is slightly different than the normal voltage.

3.3.9 Buchholz Relay

strong oil flux to the oil conservator after short-circuit or internal fault. Moreover, the Buchholz relay provides protection from oil leakage.

Figure 3.5Buchholz Relay

3.3.10 Oil Conservator

Fig 3.6 Oil Conservator

3.3.11 Dehydrating Breather

a) The dehydrating breather should be regularly checked for color of desiccant. When the majority of gel becomes saturated, the same shall be replaced or reactivated.

b) Oil in the oil seal, if used, should be maintained up to the level marked on the cup.

Figure 3.7 Breather

3.3.12 Protection of Transformer

Transformers are a critical and expensive component of the power system. Due to the long lead time for repair of and replacement of transformers, a major goal of transformer protection is limiting the damage to a faulted transformer. Some protection functions, such as over excitation protection and temperature-based protection may aid this goal by identifying

The following protection should be taken

- Over/Under Voltage Protection
- Earth fault Protection
- Buch Holz Relay
- Short Circuit
- Oil Temperature/Pressure
- Oil Level

- Surge Oil Protector
- Pressure Regulating Valve
- Winding Temperature

3.3.13 Current Transformer

A current transformer (CT) is an electric device that produces an alternating current (AC) in its secondary which is proportional to the AC current in its primary.

Figure3.8 Image of current transformer

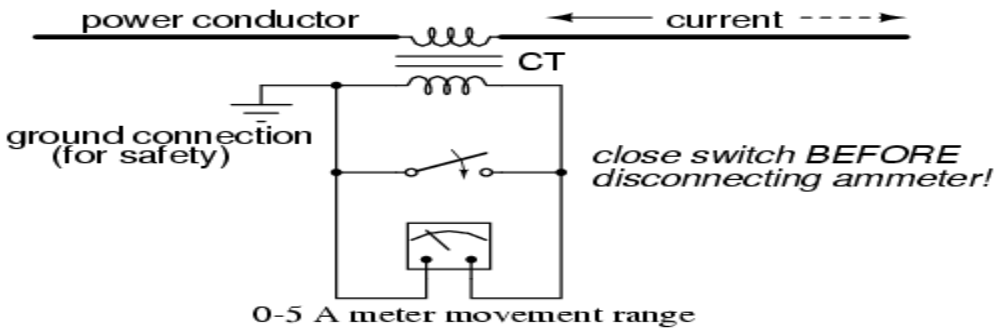


Figure 3.9 Circuit diagram of CT

3.3.14 Potential Transformer

Voltage transformers (VT), also called potential transformers (PT), are a parallel connected type of instrument transformer. They are designed to present negligible load to the supply being measured and have an accurate voltage ratio and phase relationship to enable accurate secondary connected metering.

Figure3.10 Image of Potential Transformer

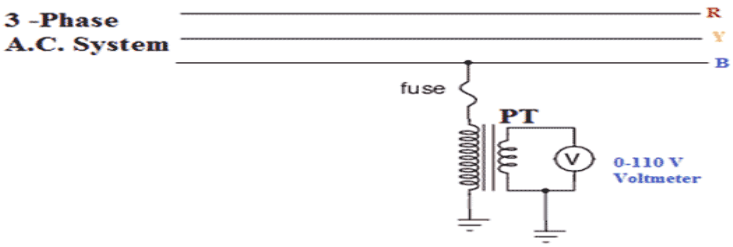


Figure3.11 Circuit diagram of PT

3.3.15 Specification of CT and PT

Table 5 Specification of CT and PT

Current Transformer(CT)		Potential Transformer	
Rated voltage	11KV	Rated voltage	11KV
High voltage	12KV	High voltage	12KV
CT Ratio	300-150/1A	PT Ratio	11000/110V
Accuracy	0.5	Accuracy	0.5
Frequency	50Hz	Frequency	50Hz

3.4 Power Factor Improvement

Improving the power factor means reducing the angle of lag between supply voltage and supply current. In order to improve power factor, some devices taking leading power factor should be connected in parallel with load. Power factor can be improved by the following equipment:

a) Static capacitor
b) Synchronous condenser

3.4.1 Static Capacitor

The power factor can be improved by connecting capacitor in parallel with the equipment operating at lagging power factor. The capacitor draws a leading current and partly or completely neutralizes the lagging reactive component of load current. This raises the power factor of the load. For three phase loads, the capacitor can be connected in delta or star. Apex Footwear Limited uses capacitor 20 capacitor bank for power factor improvement. Each capacitor bank contains 3 delta connected capacitors.

Table 6 Specification ofStatic Capacitor

Total capacitor bank	20
Capacitors per bank	3
Connection	Delta
Voltage	440V, 415V, 400V
Current	28A, 26A, 25 A
Frequency	50Hz

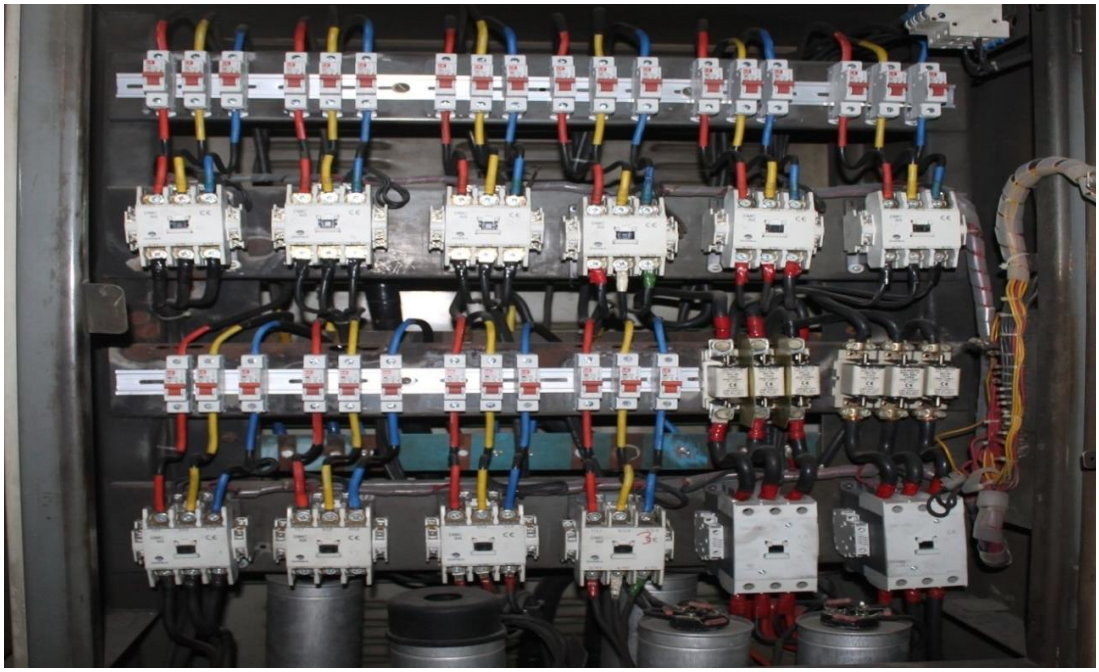


Figure 3.12 PFI plant of Apex Footwear Limited

Table 7 Specification of PFI panel

Single Phase circuit breaker	20A,25A,32A
HRC fuse	50A,100A,150A
Magnetic conductor	110V,220V
Capacitor	25KVAR,50KVAR,100KVAR

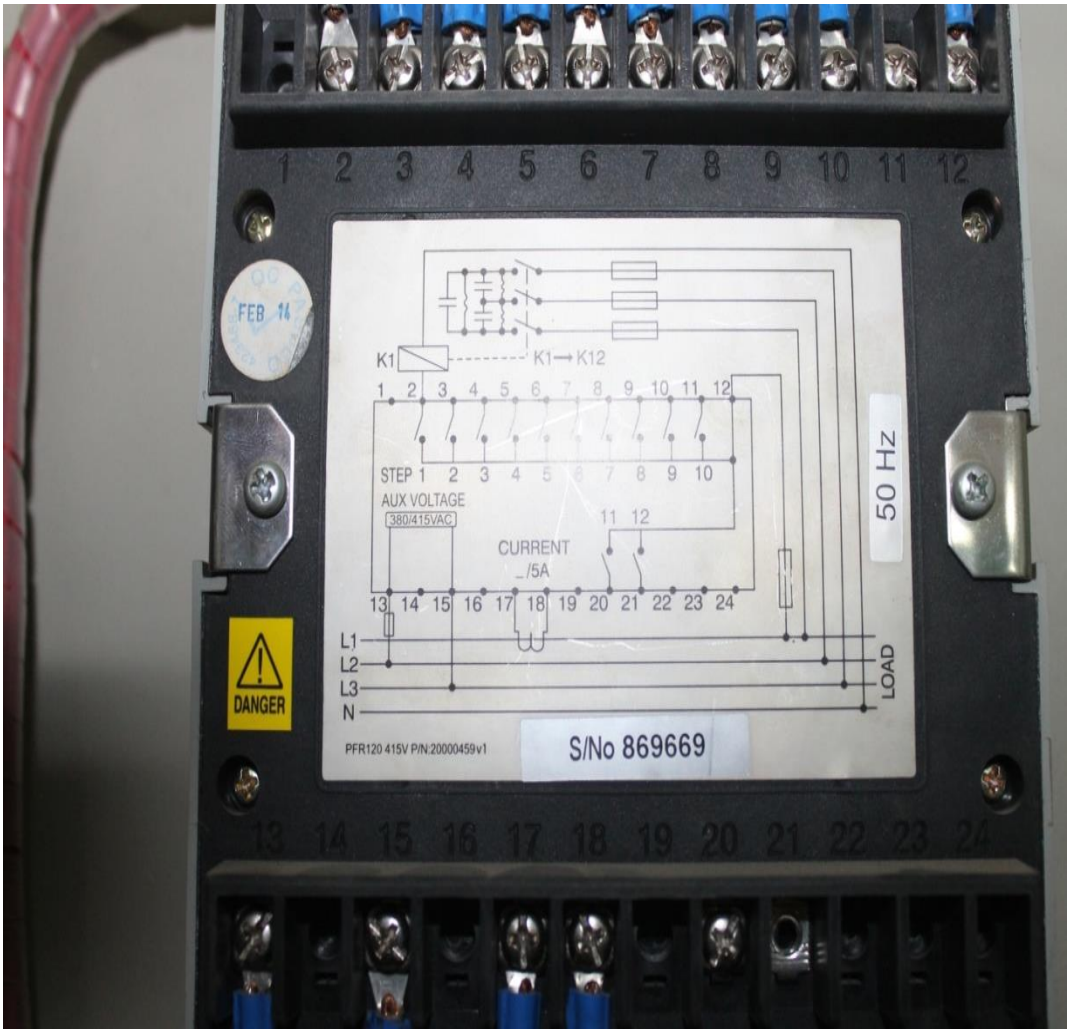


Figure 3.13 PFI Control Circuit

CHAPTER 4

PROTECTION SYSTEM OF APEX FOOTWEAR LIMITED

4.0 Introduction

In any industrial machine have one or one more protecting device. There are need to control the machine by different protecting device. So we need to know as will about the apparatus for protecting device. Protecting device are

4.1 Switchgear

The term switchgear, used in association with the electric power system, or grid, refers to the combination of electrical disconnections fuses and circuit breakers used to isolate electrical equipments. Switchgear is used both to de-energize equipment to allow work to be done and to clear faults downstream. “The apparatus used for switching, controlling and protecting electrical circuits and equipments is known as switchgear”

In power system consisting of generator, transformer, transmission and distribution circuit, it is inevitable that sooner or later failure will occur somewhere in the system. When failure occurs on any part of the system, it must be quickly detected and disconnected from the system. The detection of fault and disconnection of faulty section or apparatus can be achieved by using fuse or relays in conjunction with circuit breaker. only. For high voltage circuit, relays and circuit breakers are employed to serve the desired function of automatic protective gear. The relays detect the fault and supply information to the circuit breaker which performs the function of circuit interruption.

4.2 Circuit Breakers

A circuit breaker is an automatically operated electricalswitch designed to protect an electrical circuit from damage caused by overload or short circuit A circuit breaker is so designed that it can be operated

manually under normal condition and automatically under fault condition. Masco Industries Limited uses the following circuit breakers:

4.2.1 VacuumCircuit Breaker (VCB)

Table 8 Specification of vacuum circuit breaker VCB

Origin	Germany
Frequency	50Hz
Voltage	11kV
Normal current	650A
Short circuit breaking current	20kA
Duration of short circuit	3 sec
Lightning impulse withstand voltage	75kV
Operating sequence	0-3MIN-CO
Operating voltage	3MIN-CO
	220V

Figure 4.1 Vacuum circuit breaker (VCB)

4.2.2 Air Circuit Breaker (ACB)

Apex Footwear Limited uses ACB to disconnect REB supply and to connect power supply from Generator and Ship Generator. ACB is used as medium voltage circuit breaker. The air circuit breaker comprises the following features:

Table 9 Specification of air circuit breaker (ACB)

Origin	Korea
Poles	4
Frequency	50/60Hz
Voltage	660V
Current	2000A
Ambient Temperature	40^0C
Interrupt Capacity	
Voltage	Current
660VAC	35kA
220-500VAC	65kA
Short time current:	
1 sec	50kA
3 sec	45kA

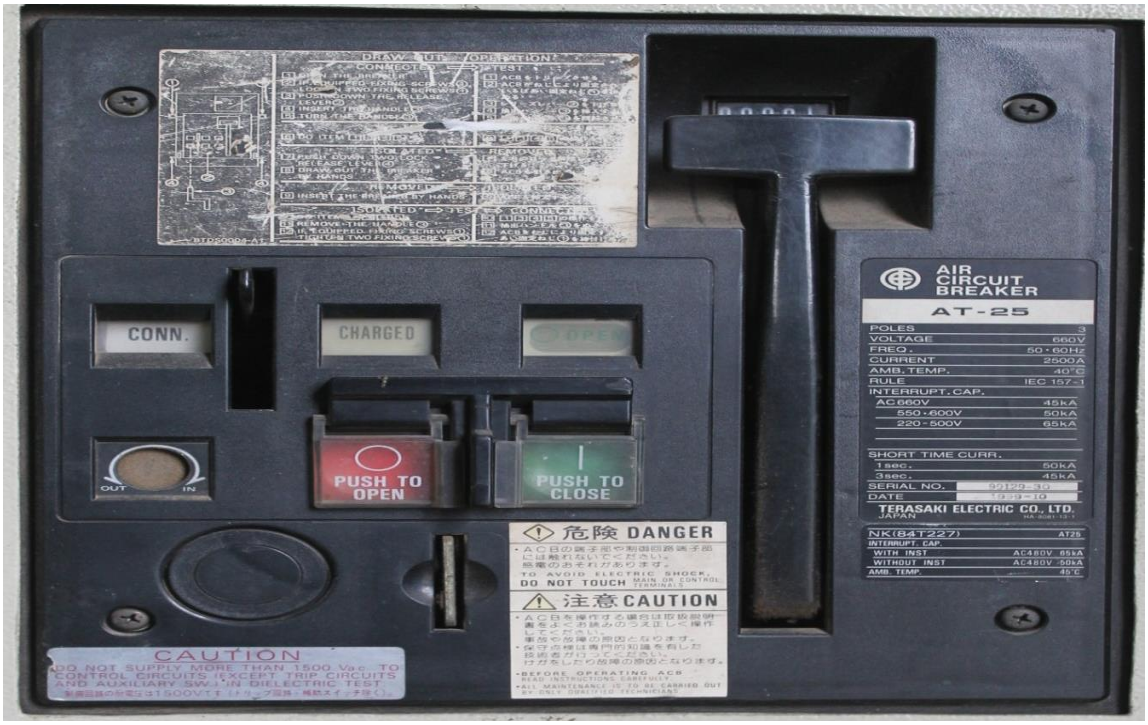


Figure 4.2 Air circuit breaker (ACB)

4.2.3 Molded Case Circuit Breaker (MCCB)

Molded case circuit breaker (MCCB) is a low voltage circuit breaker. It is normally mounted into a low-voltage switchboard or a purpose-designed panel board. It comprises the following features:

- All parts housed within a plastic molded housing made in two halves
- An electronic or thermal/electromagnetic trip sensing system to operate through the tripping mechanism and open the circuit breaker under overload or fault conditions

MCCB used in Apex Footwear Limited have the following specifications:

Table 10 Specification of molded case circuit breaker(MCCB)

Origin	China
Poles	3
Frequency	50/60Hz
Ambient Temperature	40^0C
Rated Voltage	Rated Current
AC 600V	10kA
AC 480/500V	14kA
AC 415/460V	25kA
AC 220/240 V	50kA
DC 250V	15kA
DC 125V	20kA

Figure 4.3 Molded case circuit breaker (MCCB)

4.2.4 Miniature Circuit Breaker (MCB)

Apex Footwear Limited uses MCB for the protection of their low voltage instruments.

Table 11 Specification of miniature circuit breaker (MCB)

Brand	Schneider
Origin	China
Poles	1P, 1P+N, 2P, 3P, 4P
Frequency	50/60Hz
Ambient Temperature	40^0C
Current Rating	0.5 - 100A
Voltage Rating	220/415V AC

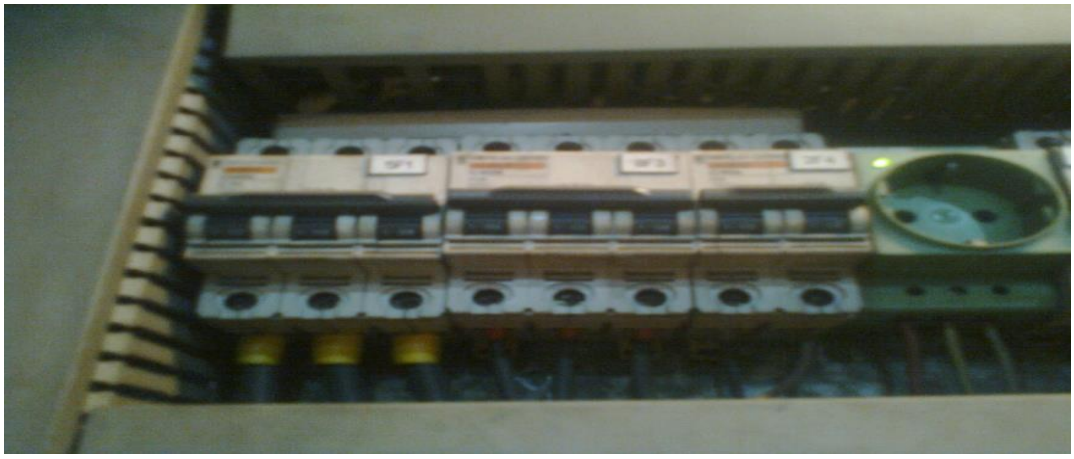


Figure 4.4: Miniature circuit Breaker (MCB)

4.3 Relay

Brand	OMRON
Origin	Indonesia
Voltage	250V AC / 28V DC
Current	10A (NO), 5A (NC)
Frequency	50/60Hz
Brand	Schneider
Origin	China
Voltage	230V AC
Current	3A
Frequency	50/60Hz

Figure 4.5: Relays

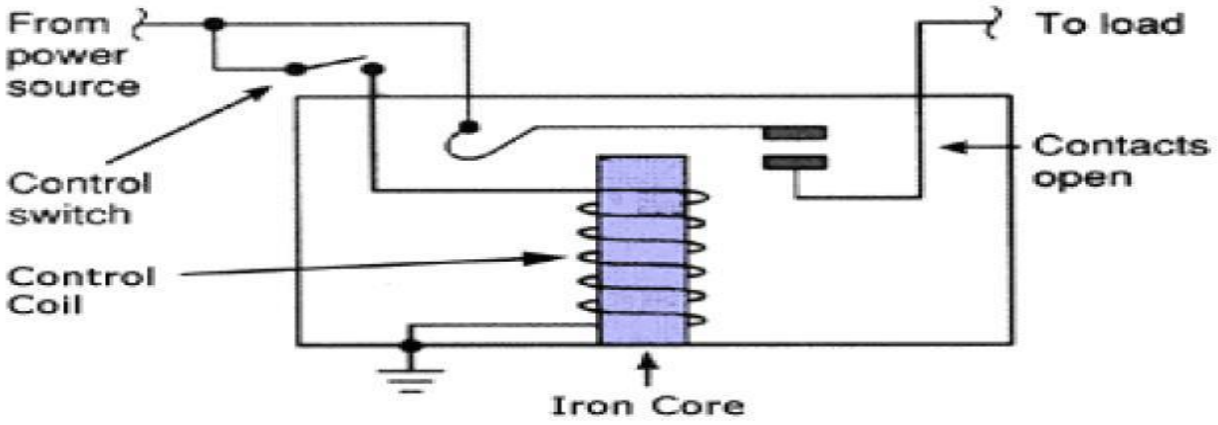


Figure 4.6: Relay Control Circuit

Relays are used because-

- Relays can switch AC and DC, transistors can only switch DC.
- Relays can switch higher voltages than standard transistors.
- Relays are often a better choice for switching large currents (> 5A).
- Relays can switch many contacts at once.

4.4 Magnetic Contactor

A magnetic contactor is an electrically controlled switch used for switching a power circuit, similar to a relay except with higher current ratings. A contactor is controlled by a circuit which has a much lower power level than the switched circuit

Masco Industries Limited uses magnetic contactor for motor controlling such as star-delta starter, motor forward-reverse controlling, and DOL starter. They use the following magnetic contactor:

Table 13 Specification of magnetic conductor

Origin	Korea			
Company	Sangwon Electric Co. LTD			
Serial No	5-3-5082			
V AC	220	440	550	690
KW	15	22	30	30
A	55	50	43	28
Origin	Korea			
Company	DONG A E.D. Co. LTD			
Serial No	HB02002-006			
V AC	220	440	550	
KW	15	22	30	
A	55	50	43	

Figure 4.7 Image of Magnetic Conductor

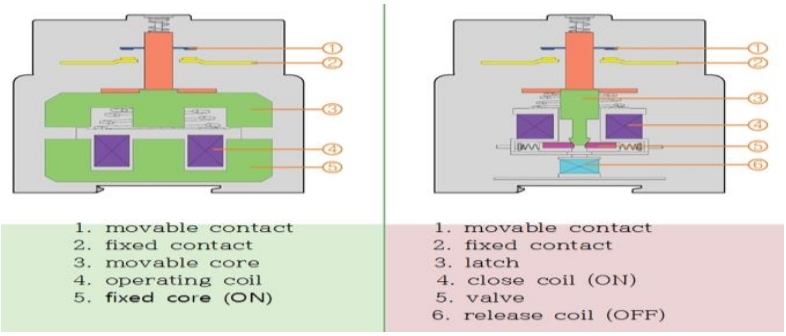


Figure 4.8 Magnetic Conductor

4.5 Timer

A timer is an electromechanical device used for automatically timing process or an observed event. Most of the timers are based on an accurate clock (electric or spring driven) that opens or closes contacts at predetermined instants. The basic diagram of timer is almost same with relay except the timer has a timer IC. Timers are mainly two types-

i. On-delay timer
ii. Off-delay timer

Masco Industries Limited uses on-delay timer. They use timer for motor controlling specially on star-delta starter. In star-delta starter, there are two magnetic contactors- first one connects the motor in star connection and the second one connects the motor in delta connection. A timer is used to control the magnetic contactors. A predetermined time value is set on the timer. At first the timer activates the first magnetic contactor to run the motor in star connection. After passing the present value of time, the timer activates the second magnetic contactor and run the motor in delta connection. For this purpose Apex Footwear Limited use the following timer-

Table 14 Specification of Timer

Brand	OMRON

Model	H3BA
Origin	Japan
Source	200/220/250V AC
Contact	5A,250VAC
Frequency	50/60Hz

4.5.1 Fuse

A fuse is a short pitch of metal, inserted in the circuit, which melts when excessive current flows thought it i.e. Fuse is a simplest current interrupting devices for protection from excessive current. It is used for overload and or short circuit protection in medium voltage (into 650v) and low voltage (up to 400v) installations.

Fuse Characteristic

HRC (High Rupturing Capacitor) Fuse

In electronics and electrical engineering a fuse (short for fusible link) is a type of sacrificial over current protection device. It's essential component is a metal wire or strip that melts when too much current flows, which interrupts the circuit in which it is connected. Short circuit, overload or device failure is often the reason for excessive current

Figure 4.10 HRC Fuse

The fuse element is made of zinc, copper, silver, aluminum, or alloys to provide stable and predictable characteristics. The fuse ideally would carry its rated current indefinitely, and melt quickly on a small excess. The element must not be damaged by minor harmless surges of current, and must not oxidize or change its behavior after possibly years of service.

4.6 Alarm Situation

Protection devices which generate alarms are divided into two basic groups

- Direct protection devices
- PLC initiated and calculated protection signals

Direct protection device e.g. temperature and pressure switches protection relays etc. generates alarm information directly to operator station through PLC.PLC initiated protection signals are normally calculated from an analog measurement or concluded from several signals or situation from the process.

4.6.1 Silencing and Acknowledgement of Alarm

The plant is equipped with voice based alarm device located in the control room. The audible alarm device is used to inform operator that a new alarm is received in the operator's station.The alarm bell is acknowledged/ silenced from the operator's station.

Fig 4.11 Alarm

4.6.2 Settlement of Fault in Switchgear

- The breaker whose operating mechanism refuses to trip is forbidden to put into operation.
- Treatment when SF_6 breaker rejects to close
- Check whether selecting switch position is right;

- Check whether fuse for control and indication is blown;
- Check whether signal indicator light is burned;
- Check whether operating power voltage is normal.
- Check whether closing circuit is opened;
- Check whether breaker locking signal is sent out;
- Check whether low oil pressure signal is given.
- The overhauling person should be informed to settle if reason e, f or g cause to refuse breaker closing.

Connecting line in both sides of a Disconnect or should not loosen and change color; its operating mechanism should be flexible and reliable.

CHAPTER 5

ANALYSIS

5.1 Relay tripping calculation

Current setting of relay

The current setting of relay is expressed in percentage ratio of relay pick up current to rated secondary current of CT.

That means, $Current\ setting = \frac{\text{Pick up current}}{\text{Rated secondary current of CT}} \times 100\%$

Plug setting multiplier of relay

Plug setting multiplier of relay is referred as ratio of fault current in the relay to its pick up current.

That means,$PSM = \frac{\text{Fault current in relay coil}}{\text{Pick up current}}$

Time setting multiplier of relay: The adjustment of travelling distance of an electromechanical relay is commonly known as time setting. This adjustment is commonly known as time setting multiplier of relay.

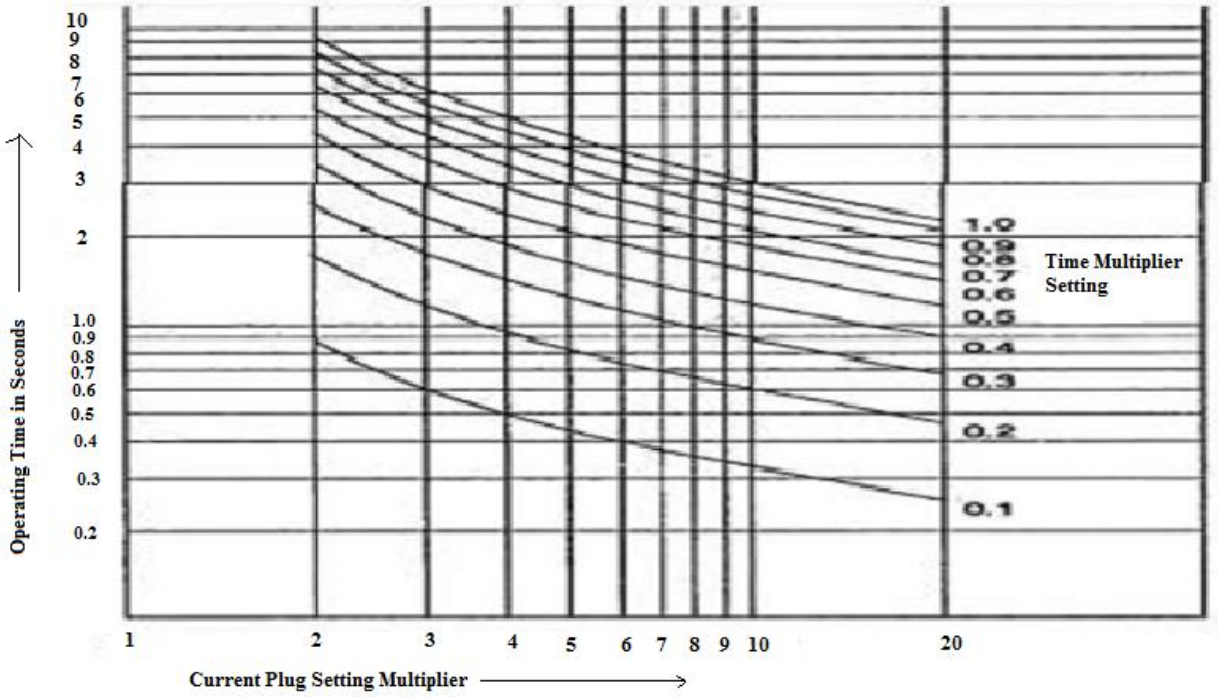


Fig 5.1 Curve of plug setting multiplier and time setting multiplier

1. Here

Relay has a current setting 210%

The primary of relay is connected to secondary of C.T ratio 300/1 A.

Relay fault current 6300A

Calculate P.S.M first.

Fault current in relay coil =actual fault current × C.T ratio

= 6300÷300

=21A

Current setting = 210% =2.1

P.S.M = (21÷2.1) =10

Plug setting multiplier (P.S.M) = 10

The actual operation time 3 seconds when time setting multiplier (T.M.S) 1.0 of the curve.

2. Here

Relay has a current setting 200%

The primary of relay is connected to secondary of C.T ratio 100/1 A.

Relay fault current 1000A

Calculate P.S.M first.

Fault current in relay coil =actual fault current × C.T ratio

= 1000÷100

=10A

Current setting =200% = 2

P.S.M = (10÷2) = 5

Plug setting multiplier (P.S.M) = 5

The actual operation time 2 seconds when time setting multiplier (T.M.S) 0.5 of the curve.

3. Here

Relay has a current setting 150%

The primary of relay is connected to secondary of C.T ratio 100/1 A.

Relay fault current 1000A

Calculate P.S.M first.

Fault current in relay coil =actual fault current × C.T ratio

= 1000÷100

= 10A

Current setting =150% =1.5

P.S.M = (10÷1.5) = 6.67

Plug setting multiplier (P.S.M) = 6.67

When time setting multiplier (T.S.M) 0.1 of the curve than the actual operation time 0.3 seconds.

5.2 Power distribution system

The main function of an electrical power distribution system is to provide power to individual section premises. Distribution of electric powerto different section is done with much low voltage level.

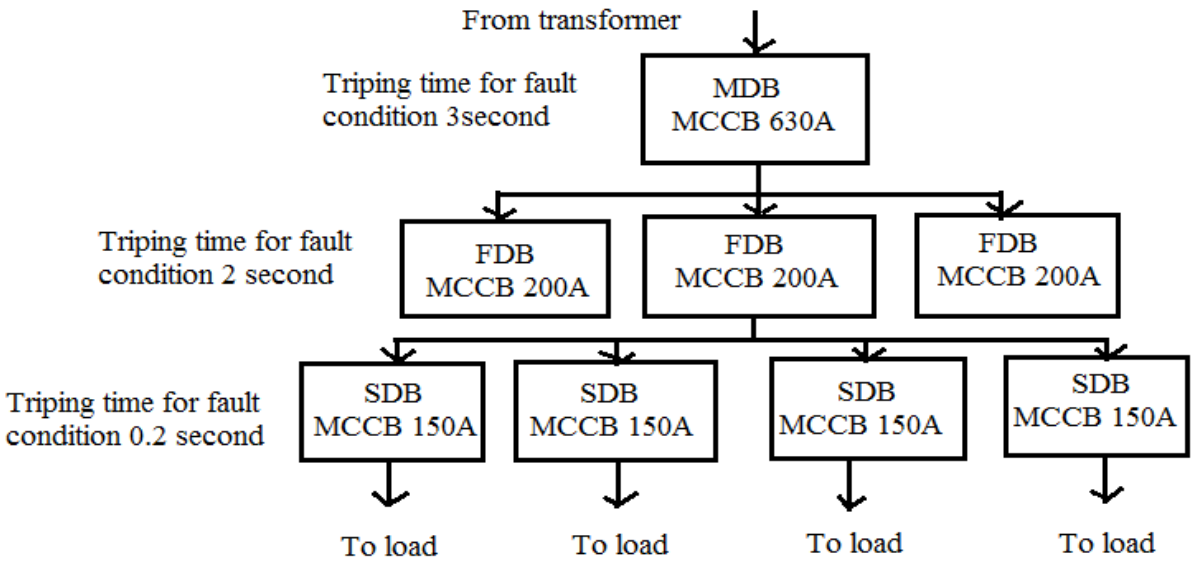


Fig 5.2 Block diagram of distribution system

5.3Impotent rules for load calculation system

- $I = \frac{W}{V} Amp$
- $V = \frac{W}{I} volt$
- $W = V * I$

Here,

I=1 Amp

V=100 v

W=I*V

=1*100w

=100w

How to find KVA an electrical device

$$KVA = \frac{KW}{P.F}$$

Here,

P, F=0.80 to 0.90

5.4 Load calculation system against main MDB

Total load in swing section = 950 kW

Total machines in swing section = 200

100 Machines are = 6 kW

= 6*100 kW

= 600 kW

50 Machines are = 4 kW

= 4*50 kW

= 200 kW

50 Machines are = 3 kW

=3*50 kW

= 150 kW

Total current in swing section = 630 A

Total machines in swing section = 200

100 Machines are = 4 A

= 4*100 A

= 400 A

50 Machines are = 2 A

= 2*50 A

= 100 A

50 Machines are = 2.60 A

= 2.60*50 A

= 130 A

Section power demand energy is 950 kW

Two type of machine are use in this floor

1. Single phase
2. Three phase

5.5 AC machine power calculation rules

Single phase and Three phase machine power

Kilovolt-Amperes (KVA):

$$\text{KVA}(1\Phi) = \frac{Voltage * Amperes}{1000}$$

$$\text{KVA}(3\Phi) = \frac{Voltage * Amperes * 1.73}{1000}$$

Kilowatts (KW):

$$\text{KW}(1\Phi) = \frac{Voltage * Amperes * P.F}{1000}$$

$$\text{KW}(3\Phi) = \frac{Voltage * Amperes * P.F * 1.73}{1000}$$

5.6 3Φ motor power calculation

Kilovolt-Amperes (KVA):

$$\text{KVA}(3\Phi) = \frac{Voltage * Amperes * 1.73}{1000}$$

$$= \frac{380 * 5 * 1.73}{1000}$$

$$= 3.287 \text{ KVA}$$

Kilowatts (KW):

$$\text{KW}(3\Phi) = \frac{Voltage * Amperes * P.F * 1.73}{1000}$$

$$= \frac{380 * 5 * .80 * 1.73}{1000}$$

$$= 2.6296 \text{ kW}$$

5.7 1Φ motor power calculation

Kilovolt-Amperes (KVA):

$$\text{KVA}(1\Phi) = \frac{Voltage * Amperes}{1000}$$

$$= \frac{230 * 1.5}{1000}$$

$$= 3.45 \text{ KVA}$$

Kilowatts (KW):

$$\mathrm{KW}(1\Phi) = \frac{Voltage * Amperes * P.F}{1000}$$
$$= \frac{230 * 1.5 * .80}{1000}$$
$$= 0.276 \text{ kW}$$

5.8 Transformer efficiency calculation

- **Calculate the efficiency of a 500W transformer, which reduces the 230 AC voltage to 24 V. For the calculations, assume the resistances of the primary and secondary windings as 0.05 Ohm and 0.01 Ohm, respectively. The losses in the transformer core Pc = 70mW.**

I would think given the question that the answer would be:

P = VI ∴ I = P/V

For the primary: 500/230 = 2.27 Amps

For the secondary: 500/24 = 20.83 Amps

Copper loss for primary: 2.272 x 0.05 = 0.258

Copper loss for secondary: 20.832 x 0.01 = 4.34 W

Total Copper Loss: 0.258 + 4.34 = 4.598 W

Total loss including core loss: 4.598 + 0.07 = 4.668 W

Total efficiency = (500-4.668)/500 = 0.9907 = 99.07% efficient.

CHAPTER 6

DISCUSSION AND CONCLUSION

6.1 Conclusion

Power is needed for any kind of production. For profitable production, power should be properly used. Masco Industries Limited uses power from DESA as well as produces power by their gas generators. They supply power from control room to different loads. For controlling power they use different circuit breakers and relays. For their industrial automation part, they use relay, magnetic contactor, timer, variable frequency inverter, sensor and PLC. Proper uses and maintenances of these equipment have made their production profitable and are leading the company to forward.

6.2 Future Scope

This report will cover and offer the opportunities to know different types of machinery used in Apex Footwear Limited Diesel Engine, Power Generation and Controlling System of various arising problem during Power generation. I can learn a lot from here, such as sub-station, protection, switch gears,bus bar, and power factor improvement and about their operation. Those who come here they are about the real knowledge will. In future how goes to Apex Footwear limited they learn about substation, alternator, high tension panel (HT), low tension panel(LT), power factor improvement(PFI), bus bar and power generator.

6.3 Limitations

Though I have given utmost effort to prepare this report still there are some limitations of the study. The main constrain of the study was the insufficiency of primary data. As an intern of a private organization, maintain some norms and regulations of the company. So, it has been very difficult for me to get overall picture of demand of business and service system in various sectors.

This report is also have some limitations such like I cannot get the soft copy of the document from the computers of Company for having confidential. So, I lost some data. Therefore, it was not possible to present a complete report like- statistics, financial involvement etc. regarding the topic or the opportunity. During the report, it had to be taken care of the report does not contain any company confidential information and harm the organization in their strategic intelligences.

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