ENGINEERING DRAWING

(NSQF)

2nd YEAR

(For 2 Year Trades)

(As per Revised Syllabus July 2022)

Group 19

Group 19 CTS Trades Covered

Electrician, Wireman, Electroplater, Lift & Escalator Mechanic,
Electrician Power Distribution

Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
GOVERNMENTOF INDIA

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032

Engineering Drawing (NSQF) 2nd Year (For 2 Year Trades)

Group 19 Engineering Trades

As per Revised syllabus July 2022 under CTS

Developed & Published by

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Post Box No.3142
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INDIA
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FOREWORD

The Government of India has set an ambitious target of imparting skills one out of every four Indians, to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of comprising various stakeholder's viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Engineering Drawing 2nd Year (For 2 Year Trades)** NSQF **Group 19 Engineering Trades (Revised 2022)** under CTS will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Director General of Training, Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

ATUL KUMAR TIWARI, *I.A.S.*
Secretary
Ministry of Skill Development & Entrepreneurship,
Government of India.

December 2023
New Delhi - 110 001

PREFACE

The National Instructional Media Institute(NIMI) was set up at Chennai, by the Directorate General of Training, Ministry of skill Development and Entrepreneurship, Government of India, with the technical assistance from the Govt of the Federal Republic of Germany with the prime objective of developing and disseminating instructional Material for various trades as per prescribed syllabus and Craftsman Training Programme(CTS) under NSQF levels.

The Instructional materials are developed and produced in the form of Instructional Media Packages (IMPs), consisting of Trade Theory, Trade Practical, Test and Assignment Book, Instructor Guide and Wall charts. The above material will enable to achieve overall improvement in the standard of training in ITIs.

A national multi-skill programme called SKILL INDIA, was launched by the Government of India, through a Gazette Notification from the Ministry of Finance (Dept of Economic Affairs), Govt of India, dated 27th December 2013, with a view to create opportunities, space and scope for the development of talents of Indian Youth, and to develop those sectors under Skill Development.

The emphasis is to skill the Youth in such a manner to enable them to get employment and also improve Entrepreneurship by providing training, support and guidance for all occupation that were of traditional types. The training programme would be in the lines of International level, so that youths of our Country can get employed within the Country or Overseas employment. The **National Skill Qualification Framework (NSQF)**, anchored at the National Skill Development Agency(NSDA), is a Nationally Integrated Education and competency-based framework, to organize all qualifications according to a series of **levels of Knowledge, Skill and Aptitude.** Under NSQF the learner can acquire the Certification for Competency needed at any level through formal, non-formal or informal learning.

The **Engineering Drawing** 2nd Year (For 2 Year Trades) NSQF Group 19 - Engineering Trades (Revised 2022) under CTS is one of the book developed by the core group members as per the NSQF syllabus.

The **Engineering Drawing** 2nd Year (For 2 Year Trades) NSQF Group 19 - Engineering Trades under (Revised 2022) CTS as per NSQF is the outcome of the collective efforts of experts from Field Institutes of DGT, Champion ITI's for each of the Sectors, and also Media Development Committee **(MDC)** members and Staff of **NIMI.** NIMI wishes that the above material will fulfill to satisfy the long needs of the trainees and instructors and shall help the trainees for their Employability in Vocational Training.

NIMI would like to take this opportunity to convey sincere thanks to all the Members and Media Development Committee (MDC) members.

Chennai - 600 032 **EXECUTIVE DIRECTOR**

ACKNOWLEDGEMENT

The National Instructional Media Institute (NIMI) sincerely acknowledge with thanks the co-operation and contribution of the following Media Developers to bring this IMP for the course **Engineering Drawing 2nd Year (For 2 Year Trades) Group 19 - Engineering Trades** as per NSQF Revised 2022.

MEDIA DEVELOPMENT COMMITTEE MEMBERS

Shri. M. Sangara pandian	-	Training Officer (Retd.) CTI, Govt. of India, Guindy, Chennai - 32.
Shri. G. Sathiamoorthy	-	Jr.Training Officer - SG (Retd.) Govt I.T.I, Trichy, DET - Tamilnadu.
Smt. M.V. Vijayavalli	-	Assistant Training Officer, Govt. I.T.I., Ambattur, DET - Tamilnadu.

NIMI CO-ORDINATORS

Shri. Nirmalya Nath	-	Deputy General Manager, NIMI, Chennai - 32.
Shri. G. Michael Johny	-	Manager, NIMI, Chennai - 32.

NIMI records its appreciation of the **Data Entry, CAD, DTP Operators** for their excellent and devoted services in the process of development of this IMP.

NIMI also acknowledges with thanks, the efforts rendered by all other staff who have contributed for the development of this book.

INTRODUCTION

Theory and procedure along with the related exercises for further practice

This book on theory and procedure along with related exercises contains theoretical information on **2nd Year Engineering drawing** NSQF (For 2 Year Revised syllabus July 2022 Group 19 - Engineering Trades) and procedure of drawing/ sketching different exercise for further practice are also available. Wherever required, BIS specification has been used.

Exercise for further practice

The practice exercise is given with Theory and procedure for 2nd Year book made obsolete as it was felt that, it is very difficult to work in workbook using drawing instruments. It is well known fact that, any drawing is prepared on suitable standard size of drawing sheets only.

The instructor is herewith advised to go through the instructions given below and to follow them in view of imparting much drawing skill in the trainees.

Acquiring the above said ability and doing small drawings is not a simple task. These books will provide a good platform for achieving the said skills.

Time allotment - 2nd Year : 40 Hrs

Sl. No.	Topic	Exercise No.	Time Allotment
1	Reading of Electrical Sign and Symbols	2.1.01 - 2.1.04	4
2	Sketches of Electrical components	2.2.05 - 2.2.07	6
3	Reading of Wiring, Layout and Earthing Diagram	2.3.08 - 2.3.10	10
4	Drawing of Electrical circuit diagram	2.4.11	10
5	Drawing of Block diagram of Instruments & equipment of trades	2.5.12	10
			40 Hrs

Instructions to the Instructors

It is suggested to get the drawing prepared on A4/A3 sheets preferably on only one side. If separate table and chair facility is available for every trainee then it is preferred to use A3 sheets and if the drawing hall is provided with desks then A4 sheets may be used. However while preparing bigger drawings on A4 sheets suitable reduction scale to be used or multiple sheets may be used for detailed and assembly drawings.

First the border and the title block to be drawn only for the first sheet of the chapter. Eg. for conical sections only first sheet will have the title block whereas the rest of the sheets of that chapter will have only borders.

Serial number of sheet and total no. of sheets to be mentioned on each sheet.

The completed sheet to be punched and filled in a box file/ suitable files and preserved by the trainees carefully after the approval of instructor, VP and Principal of the Institute.

The file may be referred by the authority before granting the internal marks at the end of the Year.

CONTENTS

Exercise No.	Topic of the Exercise	Page No.
	Reading of Electrical Sign and Symbols	
2.1.01	Reading of electrical sign and symbols	1
2.1.02	Wiring symbols	5
2.1.03	Symbols pertaining to contactor and machines	7
2.1.04	Graphic symbols for transformer	18
	Sketches of Electrical components	
2.2.05	Sketches of electrical components	20
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2.2.07	Sketches of transformer components	28
	Reading of Wiring, Layout and Earthing Diagram	
2.3.08	Reading of electrical wiring diagram and layout diagram	30
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2.3.10	Drawing the schematic diagram of plate earthing	34
	Drawing of Electrical circuit diagram	
2.4.11	Drawing of electrical circuit diagram	35
	Drawing of Block diagram of Instruments & equipment of trades	
2.5.12	Drawing of block diagram of instruments & equipment of trades	37

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

- **Read and apply engineering drawing for different application in the field of work.**

SYLLABUS

2nd Year **Group 19 - Revised syllabus July 2022** **Duration: 2 Year**

2 Year Engineering trades under CTS

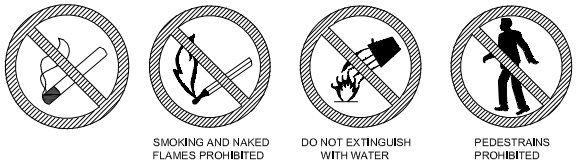
CTS Trades Covered: Electrician, Wireman, Electroplater, Lift & Escalator Mechanic, Electrician Power Distribution

S.no.	Syllabus	Time in Hrs
1	Reading of Electrical Sign and Symbols	4
2	Sketches of Electrical components	6
3	Reading of Electrical wiring diagram and Layout diagram Reading of Electrical earthing diagram Drawing the schematic diagram of plate and pipe earthing.	10
4	Drawing of Electrical circuit diagram	10
5	Drawing of Block diagram of Instruments & equipment of trades	10
	Total	**40**

Reading of electrical sign and symbols

Reading of Electrical Signs

a) Prohibition signs



Shape	Circular.
Colour	Red border and crossbar. Black symbol on white background.
Meaning	Shows what must not be done.
Example	No smoking and naked flames

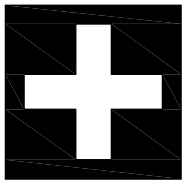
b) Mandatory signs

Shape	Circular.
Colour	White symbol on blue background.
Meaning	Shows what must not be done.
Example	Wear hand protection.

c) Warning signs

Shape	Triangular.
Colour	Yellow background with black border and symbols.
Meaning	Warns of hazard or danger.
Example	Caution, risk of electric shock.

d) Information signs



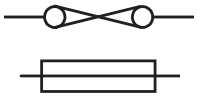
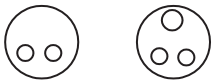
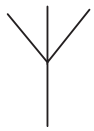
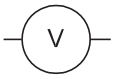
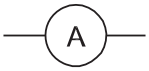
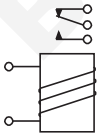
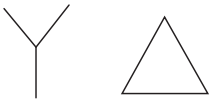
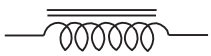
FIRST AID POINT

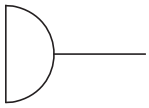
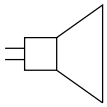
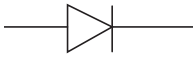
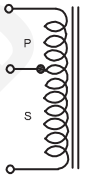
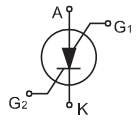
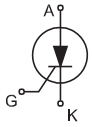
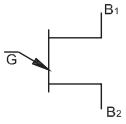
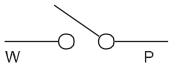
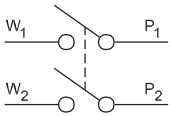
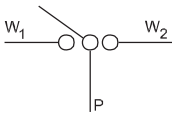
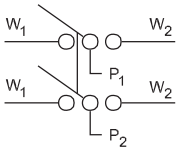
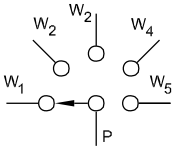
Shape	Square or oblong
Colour	White symbols on green background.
Meaning	Indicates or gives information of safety provision/First aid
Example	Caution, risk of electric shock.

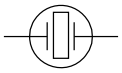
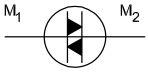
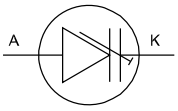
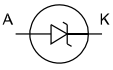
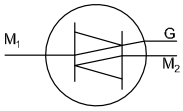
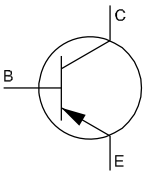
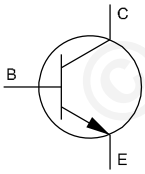
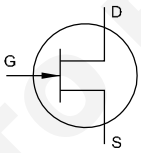
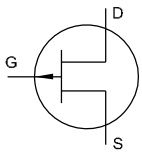
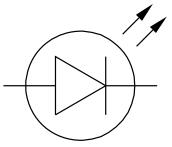
Reading of Electrical Symbols

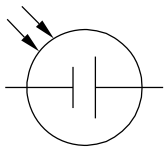
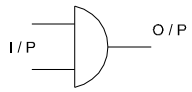
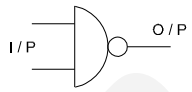
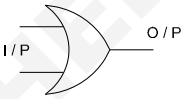
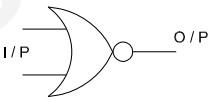
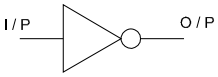
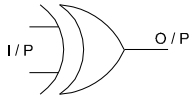
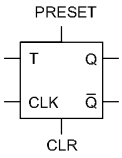
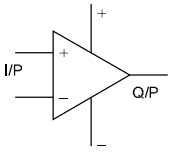
S.No.	Description	Symbol
1	D.C.	
2	A.C.	
3	Positive	
4	Negative	
5	Single Phase A.C. 50 Hz	1Ø 50 Hz
6	Three Phase A.C., 50 Hz	3Ø 50 Hz
7	A.C. / D.C.	
8	Earth	
9	Cell	+ -
10	Battery	+ -

S.No.	Description	Symbol
11	Single pole single throw switch	
12	Push-button switch	
13	Energy meter	Kwh
14	Alternator	A
15	Generator	+ G -
16	D.C. Motor	+ M -
17	A.C.Motor Single phase	M
18	Capacitor: Fixed, variable	
19	Electrolytic Capacitor	- +
20	Two-way switch	

S.No.	Description	Symbol
21	Fuse: ordinary catridge	
22	Socket 2 pin, 3 pin	
23	Aerial / Antenna	
24	Voltmeter	
25	Ammeter	
26	Ohm Meter	
27	Watt Meter	
28	Lamp	
29	Relay	
30	Buzzer	
31	Connections: star, Delta	
32	Choke	
33	Transformers	

S.No.	Description	Symbol
34	Carbon microphone	
35	Loudspeaker	
36	Diode	
37	Auto transformer	
38	Silicon Bilateral switch (SBS)	
39	SCR	
40	UJT	
41	SPS T switch	
42	DPS T switch	
43	SPD T switch	
44	DPD T switch	
45	Single Pole 5 way rotary switch	

S.No.	Description	Symbol
46	Piezoelectric crystal	
47	Diac	
48	Varactor diode	
49	Zener diode	
50	TRIAC	
51	PNP transistor	
52	NPN transistor	
53	FET N-channel	
54	FET P-channel	
55	LED diode	

S.No.	Description	Symbol
56	Photo voltaic cell	
57	AND Gate	
58	NAND Gate	
59	OR Gate	
60	NOR Gate	
61	NOT Gate	
62	EX-OR Gate	
63	T Flip-Flop	
64	Operational amplifier	
65	Analog multimeter	

Wiring symbols

Table 1

Graphical symbols used for electrical installation in a building: It is common practice to indicate the electrical fittings in architectural diagrams, building plans etc. by graphical symbols.

The B.I.S. symbols used in the wiring are given here.

ITEMS	SYMBOLS
I Wiring	
1 General wiring	
2 Wiring on the surface	
3 Wiring under the surface	
4 Wiring in conduit	
a Conduit on the surface	
b Conduit concealed	
The type of conduit may be indicated, if necessary.	
5 Wiring going upwards	
6 Wiring going downwards	
7 Wiring passing vertically through a room	
II Fuse-boards	
1 Lighting circuit fuse-boards	
a Main fuse-board without switches	
b Main fuse-board with switches	
c Distribution fuse-board without switches	
d Distribution fuse-board with switches	
2 Power circuit fuse-boards	
a Main fuse-board without switches	

ITEMS	SYMBOLS
b Main fuse-board with switches	
c Distribution fuse-board without switches	
d Distribution fuse-board with switches	
SYMBOLS	
III Switches and switch outlets	
a Single pole	
b Two-pole	
c Three-pole	
2 Single pole pull-switch	
3 Multi-position switch	
4 Two-way switch	
5 Intermediate switch	
6 Pendent switch	
7 Push-button or bell-push	
IV Socket outlets	
1 Socket outlet, 6A	
2 Socket outlet, 16A	
3 Combined switch and socket outlet, 6A	
4 Combined switch and socket outlet, 16A	
5 Interlocking switch and socket outlet, 6A	
6 Interlocking switch and socket outlet 16A	

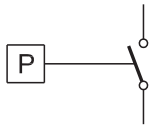
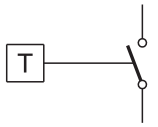
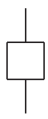
ITEMS	SYMBOLS
V Lamps	
1 Lamp or outlet for lamp	
Group of three 40 W lamps	3x40 W
2 Lamp mounted on a wall or light bracket	
3 Lamp mounted on ceiling	
4 Counterweight lamp fixture	
5 Chain lamp fixture	
6 Red lamp fixture	
SYMBOLS	
7 Lamp fixture with built-in switch	
8 Lamp fed from variable voltage supply	
9 Emergency lamp	
10 Panic lamp	
11 Bulk-head lamp	
12 Water tight light fitting	WT
13 Battern lamp-holder (Mounted on the wall)	BH
14 Projector	
15 Spot light	
16 Flood light	
17 Fluorescent lamp	
Group of three 40W fluorescent lamps	3x40 W

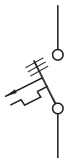
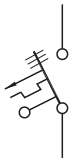
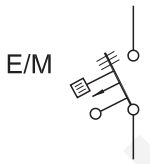
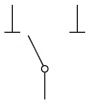
ITEMS	SYMBOLS
VI Electrical appliances	
1 General	
If necessary, use designation to specify	
2 Heater	
SYMBOLS	
VII Bells, buzzers and sirens	
1 Bell	
2 Buzzer	
3 Siren	
4 Horn or hooter	
5 Indicator 9 at `N' insert number of ways)	N
VIII Fans	
1 Ceiling fan	
2 Bracket fan	
3 Exhaust fan	
4 Fan regulator	
IX Telecommunication apparatus	
1 Aerial	
2 Loudspeaker	
3 Radio receiving set	
4 Television receiving set	
X Earthing	
1 Earth point	

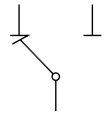
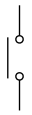
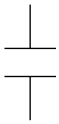
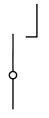
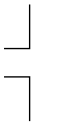
Symbols pertaining to contactor and machines

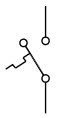
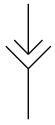
The table given below contains most of the important symbols used by an electrician. However, you are advised to refer the quoted B.I.S. standards for further additional information.

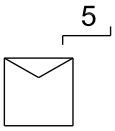
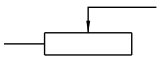
TABLE

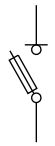
S.No.	BIS Code No.	Description	Symbol
	BIS 2032 (Part XXV)-1980		
	9	**Switch gear, accessories**	
1	9.1	Switch, general symbol	
2	9.1.1	Alternate symbol for switch.	
3	9.2	Three-pole switch, single line representation.	
4	9.2.1	Alternate symbol for three-pole switch, single line representation.	
5	9.3	Pressure switch	
6	9.4	Thermostat	
7	9.5	Circuit-breaker	
8	9.5.1	Alternate symbol of circuit-breaker. **The rectangle of symbol 9.5 should contain some indication to circuit-breaker is concerned.**	
9	9.5.2	Alternate symbol for circuit breaker.	

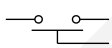
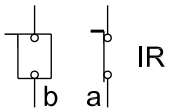
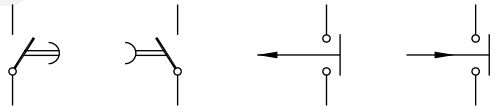
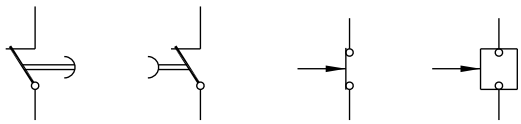
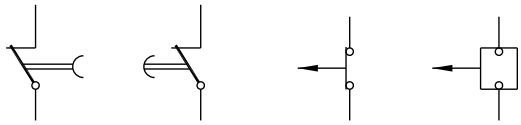
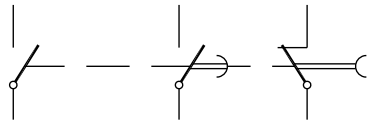
S.No.	BIS Code No.	Description	Symbol
10	9.5.3	Circuit-breaker with short circuit under voltage and thermal overload releases.	
11	9.5.4	Hand-operated circuit-breaker with short circuit, thermal overload protection and no-volt tripping.	
12	9.5.5	Motor - solenoid operated air circuit-breaker with short circuit and no-volt tripping (triple pole).	
13	9.6	Change over contact, break before make. **The fixed contacts may be placed at any angle except at 60°. In order to facilitate the work of the draughtsman, the contacts may be arranged differently.**	
14	9.7	Two-way contact with neutral position	
15	9.8	Make-before-break contact.	
16	9.9	Contactor, normally open.	
17	9.9.1	Contactor, normally closed.	
18	9.10	Push-button with normally open contact.	
19	9.10.1	Push-button with normally closed contact.	
20	9.11	Isolator.	
21	9.12	Two-way isolator with interruption of circuit.	

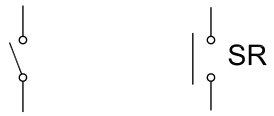
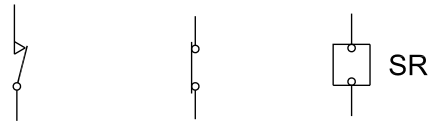
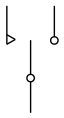
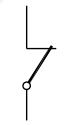
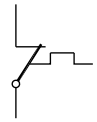
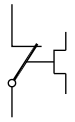
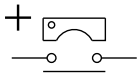
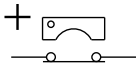
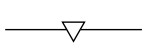
S.No.	BIS Code No.	Description	Symbol
22	9.13	Two-way isolator without interruption of circuit.	
23	9.14	Make contact, general symbol.	
24	9.14.1	Alternate symbol for make contact, general symbol.	
25	9.14.2	Alternate symbol for make-contact.	
26	9.14.3	Alternate symbol for make-contact.	
27	9.14.4	Alternate symbol for make-contact.	
28	9.14.5	Alternate symbol for make-contact.	
29	9.14.6	Alternate symbol for make-contact.	
30	9.14.7	Alternate symbol for make-contact.	
31	9.14.8	Alternate symbol for make-contact.	
32	9.15	Break-contact, general symbol.	

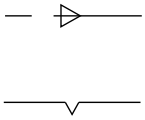
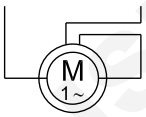
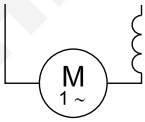
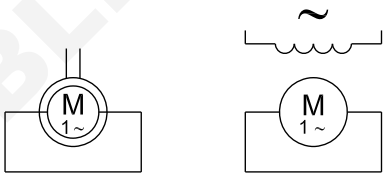
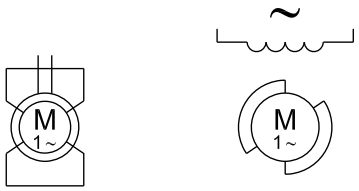
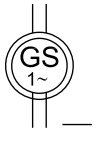
S.No.	BIS Code No.	Description	Symbol
33	9.15.1	Alternate symbol for break-contact.	
34	9.15.2	Alternate symbol for break-contact.	
35	9.15.3	Alternate symbol for break-contact.	
36	9.15.4	Alternate symbol for break-contact.	
37	9.15.5	Alternate symbol for break-contact.	
38	9.16	Thermal overload contact.	
39	9.17	Socket (female).	
40	9.17.1	Alternate symbol for socket (female).	
41	9.17.2	Socket with switch.	
42	9.18	Plug (male).	
43	9.18.1	Alternate symbol for plug (male).	
44	9.19	Plug and socket (male and female).	
45	9.19.1	Alternate symbol for plug and socket (male and female).	

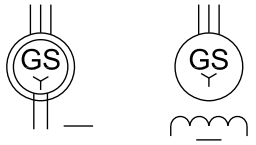
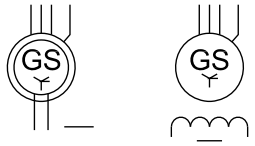
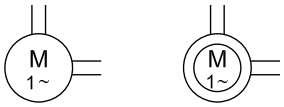
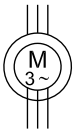
S.No.	BIS Code No.	Description	Symbol
46	9.20	Starter, general symbol.	
47	9.21	Starter by steps (Example: 5 steps).	
48	9.22	Star-delta starter.	
59	9.23	Auto-transformer starter.	
50	9.24	Pole-changing starter (Example, 8/4 poles).	
51	9.25	Rheostatic starter.	
52	9.26	Direct on-line starter.	
53	9.27	Sliding contact, general symbol.	
54	9.27.1	Resistor with moving contact, general symbol.	
55	9.28	Combined control panel for two motors (multiple speed and reversible).	
56	9.29	Fuse.	
57	9.29.1	Alternate symbol for fuse.	
58	9.29.2	Alternate symbol for fuse where supply side is indicated by a thick line.	

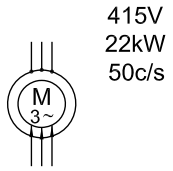
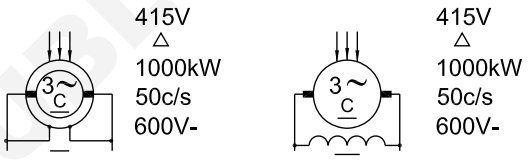
S.No.	BIS Code No.	Description	Symbol
59	9.29.3	Alternate symbol for fuse where supply side is indicated by a thick line.	
60	9.30	Isolating fuse-switch, switching on load.	
62	9.31	Isolating fuse-switch.	
	BIS 2032 Part(XXV11) 1932	**Contactors**	
	3.2	**Qualifying symbols**	
63	3.2.1	Contactor function.	
64	3.2.2	Circuit-breaker function.	
65	3.2.3	Disconnector (isolator) function.	
66	3.2.4	Switch-disconnector (isolator switch) function.	
67	3.2.5	Automatic release function.	
68	3.2.6	Delayed action. Convention - delayed action in direction of movement from the arc towards its centre. **This symbol must be linked by a doubleline to the symbol of the device, the action of which is delayed.**	
69	3.2.6.1	Delayed action convention - delayed action in the direction of movement of the arrow mark.	
70	3.2.7	Non-spring return (stay put) function. **The symbols shown above may be used to indicate spring-return and stay-put contacts. When this convention is invoked, its use should be appropriately referenced. These symbols should not be used together with the qualifying symbols Nos. 3.1 to 3.4.**	 

S.No.	BIS Code No.	Description	Symbol
71	3.2.8	Hand reset.	
72	3.3.7	Contact with two makes.	
73	3.3.8	Contact with two breaks.	
74	3.3.9	Three-point contact.	
75	3.3.10	Make contact-hand reset.	
76	3.3.11	Break contact-hand reset.	
77	3.3.19	Make-contact delayed when operating.	
78	3.3.20	Break-contact delayed when operating.	
79	3.3.21	Break-contact delayed when releasing.	
80	3.3.22	Make-contact delayed when operating and releasing.	
81	3.3.23	Contact assembly with one make-contact not delayed. One make contact delayed when operating and one break-contact delayed when releasing.	
82	3.3.24	Make-contact with spring return.	

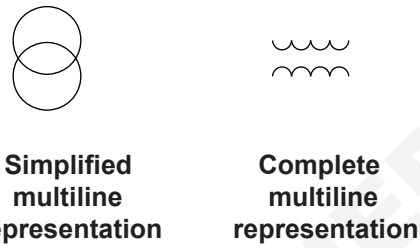
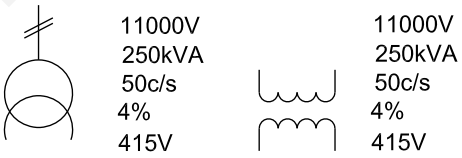
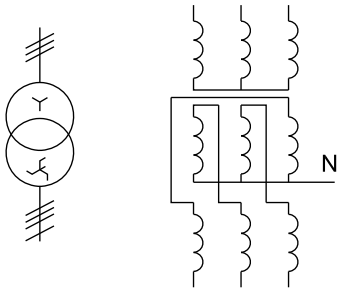
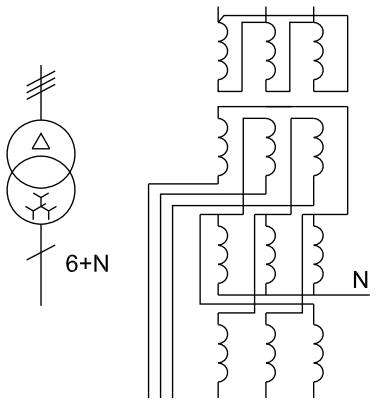
S.No.	BIS Code No.	Description	Symbol
83	3.3.25	Make-contact without spring return (stay-put)	
84	3.3.26	Break-contact with spring return.	
85	3.3.27	Two-way contact with centre off position with spring. Return from the left-hand position but not from the right hand one (stay-put).	
86	3.3.28	Temperature-sensitive make-contact. **May be replaced by the value of the operating temperature conditions.**	
87	3.3.29	Temperature sensitive break-contact. **May be replaced by the value of the operating temperature conditons.**	
88	3.3.30	Self-operating thermal-break contact. **It is important to distinguish between a contact as shown and a contact of a thermal relay, which in detached representation is shown in the example below.**	
		Example: Break contact of a thermal relay.	
89	3.3.32	Blow-out magnetic make-contact.	
90	3.3.33	Blow-out magnetic break-contact.	
	BIS:2032 (PART VII) 1974	**Mechanical controls**	
91	8.4	**Mechanical interlock**	

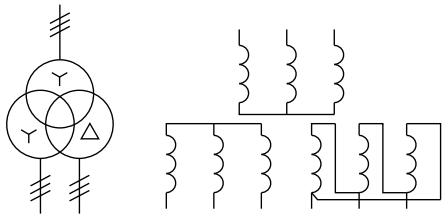
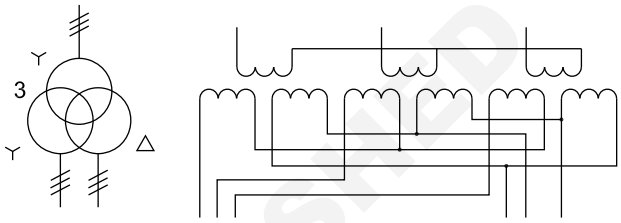
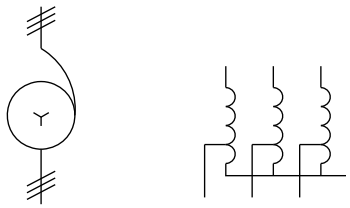
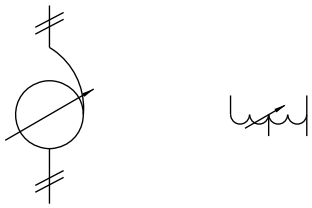
S.No.	BIS Code No.	Description	Symbol
92	8.5	Reset a Automatic reset b Non-automatic reset **These symbols should be used only if it is essential to indicate the type of reset.**	
93	BIS:2032 (Part IV) 1964 4.3.2	**Classification** AC motor, general symbol.	
	4.4	Alternating current Commutator machines.	**Simplified multiline representation**  **Complete multiline representation** 
94	4.4.1	AC series motor, single phase.	
95 96	4.4.2 4.4.3	Repulsion motor, single phase. AC series motor, single phase, Deri type.	
97	4.5 4.5.1	**Synchronous machines** Synchronous generator, general symbol.	
98	4.5.2	Synchronous motor - general symbol.	
99	4.5.3	Permanent magnet synchronous generator (GS) or synchronous motor (MS), three-phase.	
100	4.5.4	Synchronous generator (GS) or synchronous motor (MS) single-phase.	**Simplified multiline representation**  **Complete multiline representation** 

S.No.	BIS Code No.	Description	Symbol
101	4.5.5	Synchronous generator (GS) or synchronous motor (MS) three-phase, star-connected, neutral not brought out.	
102	4.5.6	Synchronous generator (GS) or synchronous motor (MS) three-phase star-connected with neutral brought out.	
	4.6	**Induction machines** **In symbols 4.6.1 to 4.6.9 groups of conductors may be placed in another manner than generally shown below. For example, symbol 4.6.6.**	
103	4.6.1	Induction motor, with short-circuited rotor, general symbol.	
104	4.6.2	Induction motor, with wound rotor, general symbol.	
105	4.6.3	Induction motor, single phase, squirrel-cage.	
106	4.6.4	Induction motor, single phase, squirrel cage, leads of split-phase brought out.	
107	4.6.5	Induction motor, three-phase, squirrel-cage.	**Simplified multiline representation** **Complete multiline representation** 
108	4.6.6	Induction motor, three-phase, squirrel cage, both leads of each phase brought out.	
109	4.6.7	Induction motor, three-phase, with wound rotor.	

S.No.	BIS Code No.	Description	Symbol
110	4.6.8	Induction motor, three-phase, star-connected, with automatic starter in the rotor.	
111	4.6.9	Symbol showing terminals, brushes and numerical data. Example : Induction motor, three-phase, with wound rotor 415V, 22 kW, 50 c/s.	
112	4.7 4.7.1	**Synchronous converters.** Synchronous converter, general symbol.	
113	4.7.2	Three-phase synchronous converter, shunt excited.	
114	4.7.3	Symbol showing terminals, brushes and numerical data. *Example* : Three-phase synchronous converter, shunt excited 600 V, 1000 kW, 50 c/s.	

Graphic symbols for transformer

S.No.	BIS Code No.	Description	Symbol
	5.1	**General symbols**	
115	5.1.1	Transformer with two separate windings.	 **Simplified multiline representation** **Complete multiline representation**
116	5.1.2	Transformer with three separate windings.	
117	5.1.3	Auto-transformers	
	5.2	**Transformers with two or three Windings.**	
118	5.2.1	Single-phase transformer with two separate windings.	
119	5.2.2	Three-phase transformer with two separate windings. Connection: star zig-zag.	
120	5.2.3	Three-phase transformer with two separate windings. Connection: delta 6-phase fork.	

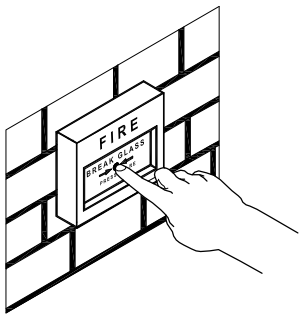
S.No.	BIS Code No.	Description	Symbol
121	5.2.4	Three-phase transformer with three separate windings. Connection: star, star-delta.	 **Simplified multiline representation** **Complete multiline representation**
122	5.2.5	Three-phase bank of single-phase transformers with three separate windings. Connection: star, star-delta.	
	5.3	**Auto-transformers**	
123	5.3.1	Auto-transformer, single-phase.	
124	5.3.2	Auto-transformer, three-phase. Connection:star.	
125	5.3.3	Single-phase auto-transformer with continuous voltage regulation.	

Sketches of electrical components

Fire alarm:

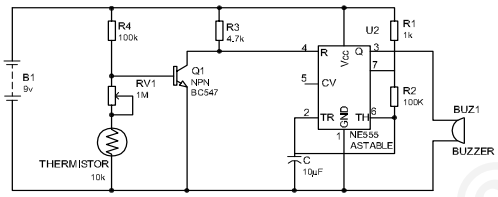
A fire alarm system has a number of devices working together to detect and warn people through visual and audio appliances when smoke, fire, carbon monoxide or other emergencies are present. **These alarms may be activated automatically from smoke, heat detectors also activated via manual fire alarm activation.** (Fig 1 & 2).

Fig 1



EDNEL220511

Fig 2



CIRCUIT DIAGRAM OF FIRE ALARM

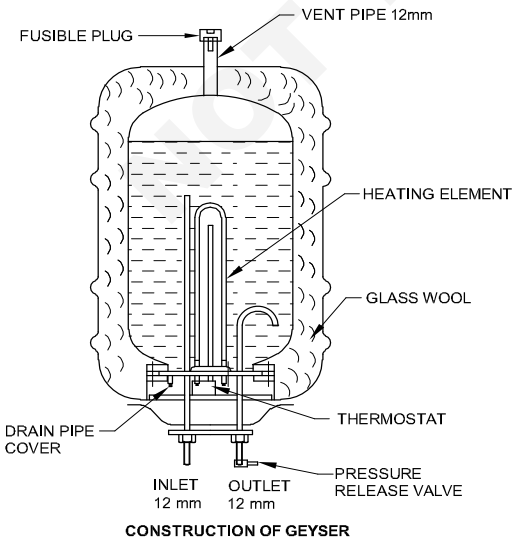
EDNEL220512

Geyser

It is an electric water heater which heats and maintains the temperature of the water stored in it.

There are several types of water heaters. The most usual one is the geyser, which is more efficient as the hot water can be directly drawn through a tap at different points. (Fig 3)

Fig 3

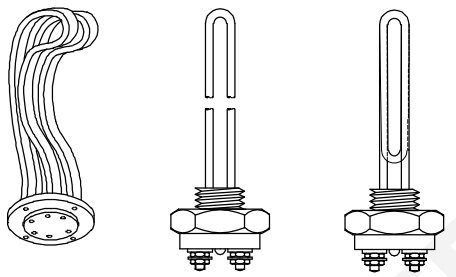


CONSTRUCTION OF GEYSER

EDNEL220513

Fig 4 shows a few shapes of heating elements.

Fig 4

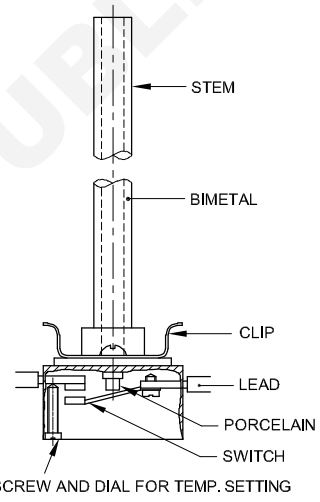


DIFFERENT SHAPES OF HEATING ELEMENTS

EDNEL220514

Thermostats: Thermostats are used in water heaters to control the current to the heating elements and thereby regulate and maintain the water temperature between 32°C to 88°C. (Fig 5)

Fig 5



A TYPICAL TERMOSTAT USED IN WATER HEATER

EDNEL220515

A fusible plug is fitted on the top of the unit to protect the inner tank to release the excess pressure that may be developed due to failure of the thermostat.

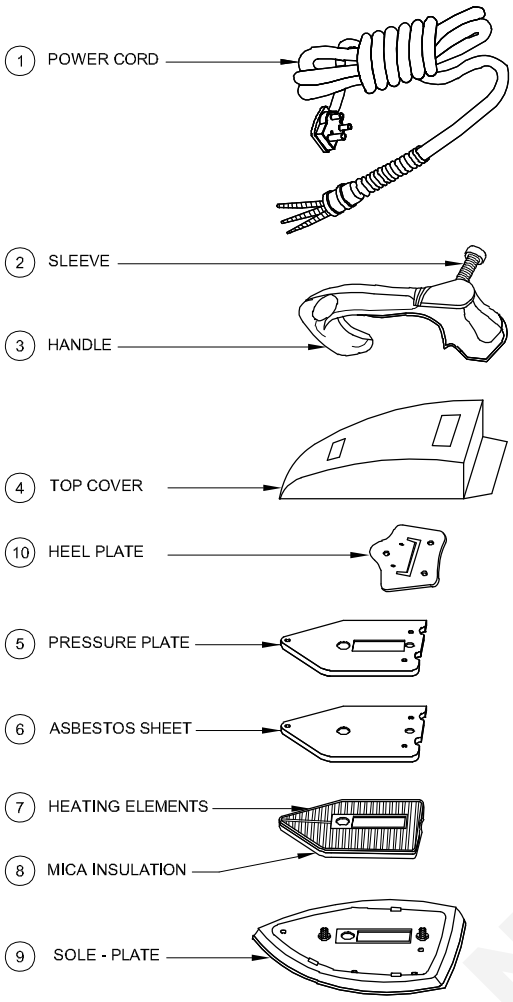
NON AUTOMATIC ELECTRIC IRON

Electric Iron:

An electric iron is a heating device in which the heat is concentrated on a smooth, flat, bottom surface which is applied to the fabrics to be ironed. (Fig 6)

Figure 7 shows the four possible parts of the circuit which may be defective. This is an electric diagram of the simple non-automatic type of iron and does not show other non-electrical parts such as the handle cover and sole-plate.

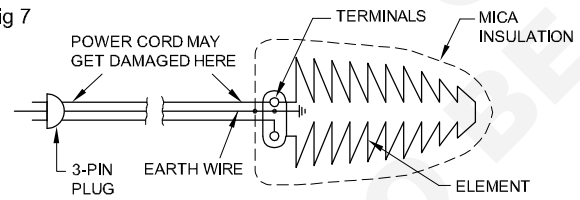
Fig 6



PARTS OF AN ELECTRIC IRON

EDNEL220516

Fig 7



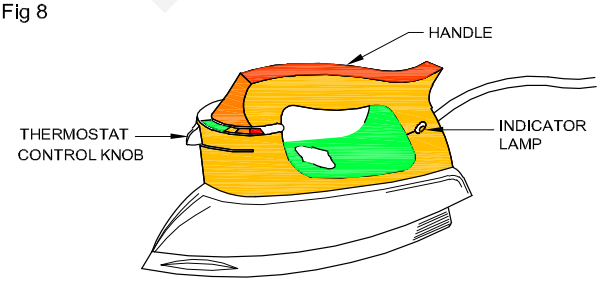
CIRCUIT OF AN ELECTRIC IRON

EDNEL220517

Automatic electric iron

The difference between an automatic iron and the ordinary (non-automatic) iron is that the automatic type has a thermostatic device to regulate the temperature. The other parts are more or less the same in both the types of irons. (Fig 8)

Fig 8



AUTOMATIC ELECTRIC IRON

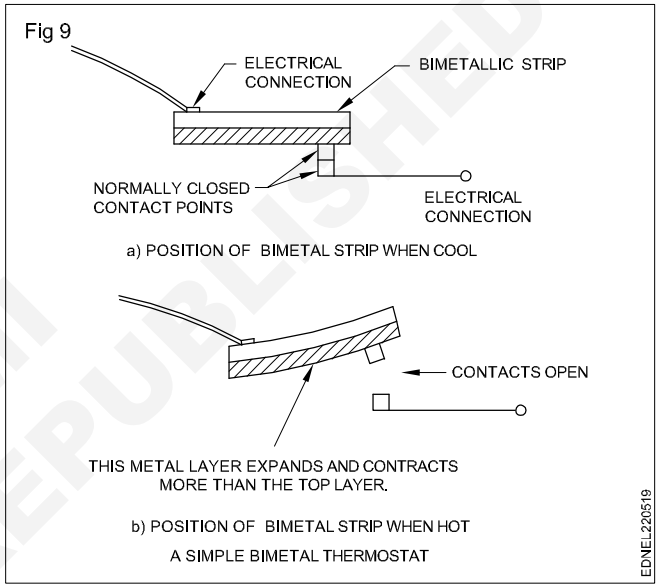
EDNEL220518

Automatic irons are fitted with a thermostatic switch to regulate the heat to a specific predetermined value. The thermostatic switch disconnects the supply when the predetermined value is reached and reconnects the supply when the iron cools down. A turning knob with a dial just below the handle, marked as rayon, cotton, silk, wool etc. can be operated to select the preset temperature.

Thermostats

A thermostat is a switch which can be designed to close or open a circuit at predetermined temperature. One of the simplest and most dependable components in the modern heating appliances is the BIMETAL THERMOSTAT. It controls the temperature in stoves, toasters, food warmers, irons etc. It serves as a safety device to prevent overheating of the appliances. (Fig 9)

Fig 9

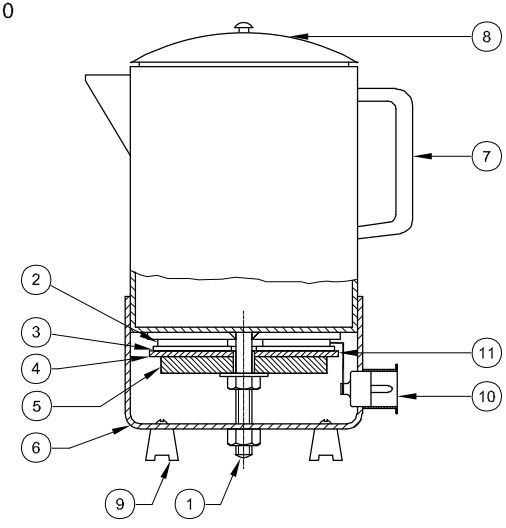


A SIMPLE BIMETAL THERMOSTAT

EDNEL220519

Saucepan type: The construction of the sauce pan type kettle is given in Fig 10.

Fig 10



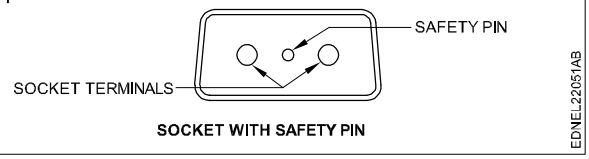
CONSTRUCTION OF SAUCEPAN TYPE KETTLE

EDNEL22051A

Immersion type: The heating element in this type is of tubular immersion heating design. In some kettles an ejector type safety device is incorporated in the socket terminal side.

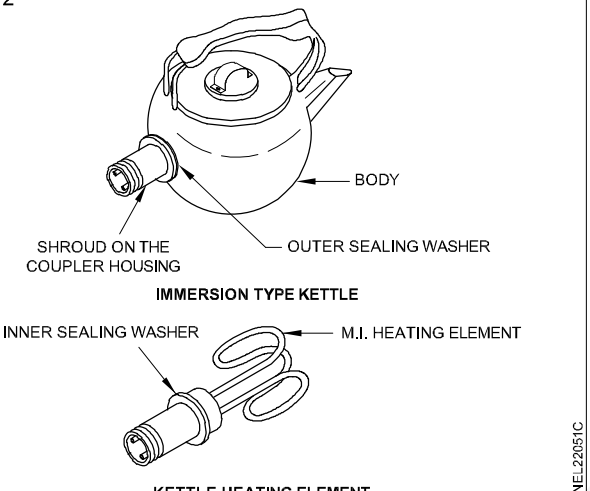
In case the kettle is switched ON without water the safety pin (Fig 11) which is soldered against a spring which is under tension comes out and pushes the plug out. This safety pin can be placed in position by soldering. The heating element is concealed inside a hollow tube and mineral insulated (Fig 12).

Fig 11



SOCKET WITH SAFETY PIN

Fig 12

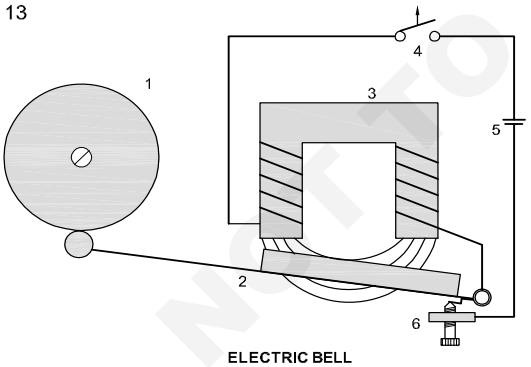


KETTLE HEATING ELEMENT

Electric bell

An electric bell is a mechanical bell that works of an electromagnet. When the current is passed through it, produces buzzing sound. It is used in rail road crossings, telephones, fire/burglar alarms, school bells and door bells etc, Now, they are replaced with electronic sounders. (Fig 13)

Fig 13



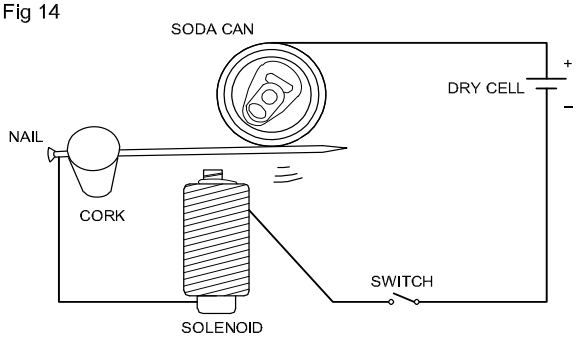
ELECTRIC BELL

Electric buzzer

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical (or) piezoelectric.

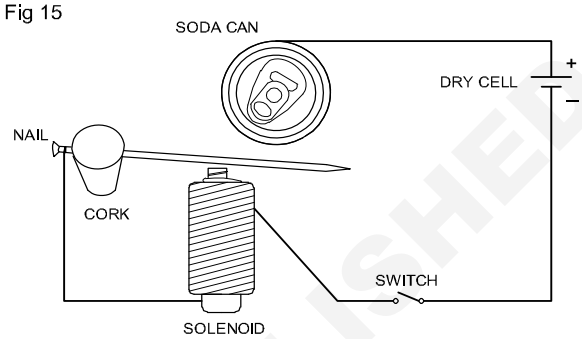
The closed & open position of buzzer are shown in Fig 14 & Fig 15.

Fig 14



BUZZER CIRCUIT IN CLOSED POSITION

Fig 15



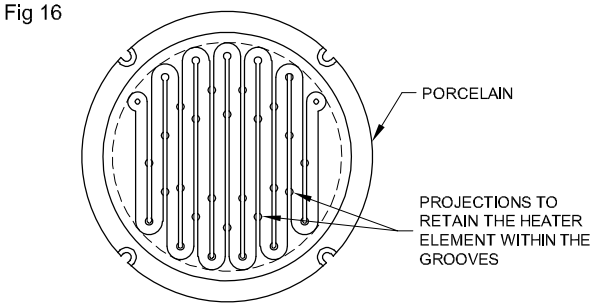
BUZZER CIRCUIT IN OPEN POSITION

Elecric heater: One of the methods of obtaining heat for cooking is to use the heating effect of electricity. An electric heater is the simplest form of an electric cooking device.

Heater plate:

A porcelain plain with a groove is made as shown in Fig 16. It houses the Nichrome wire in a coil form. It is the type of Exposed element type heater.

Fig 16

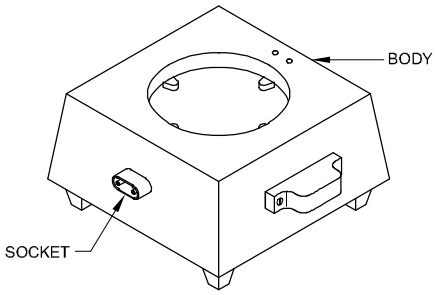


PORCELAIN PLATE OF THE HEATER

The end of the coiled elements are terminated with bolts and nuts in the plate. The frame of the heater is shown in Fig 17.

Immersion heater : As the name implies, these heaters are used in immersed conditions. These are used to heat the water or other liquid directly. The heat produced is directly dissipated to the water and thus the water is heated. In general the construction of the heating element is made of spiral shape wound with nichrome wire. The element is placed in the copper tube and insulated from the walls etc. by means of the insulated and fire proof powder or sand all around.

Fig 17

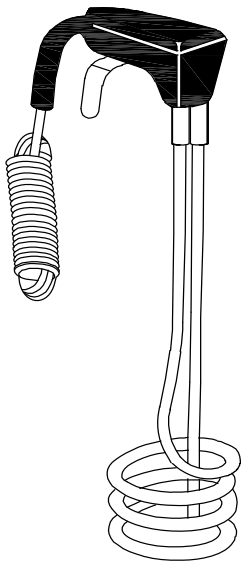


FRAME OF THE HEATER

EDNEL22051H

The arrangements as shown in fig 18

Fig 18



IMMERSION HEATER

EDNEL22051I

Electric stove

An electric stove is a common domestic heating appliances used for cooking. It works with 240V AC supply and different models are available with power rating usually from 750 to 1500 watts (Fig 19).

Hotplate:

A hotplate is a heating appliance which is basically an electrically heated plate on which flat bottomed containers to be heated are placed (Fig 20). It may be a single unit type or double unit type.

Fig 21 shows the different connections of hot plate for various wattage output.

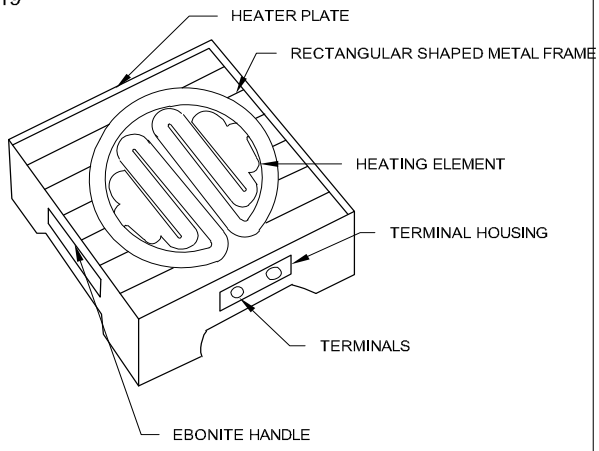
Micro oven:

It is an Electronic cooking devices which uses energy of micro waves to cook/prepare/pressure the foods unlike the conventional ovens. Micro wave energy cooks the food without applying external heat Fig 22

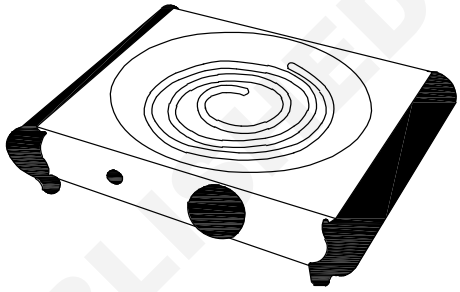
Function of microwave oven

The microwaves are short electromagnetic waves of radio frequency (RF) energy which would pass through materials such as paper, glass and plastics. Aluminum and other metal tend to reflect the microwaves so they should not be used inside.

Fig 19



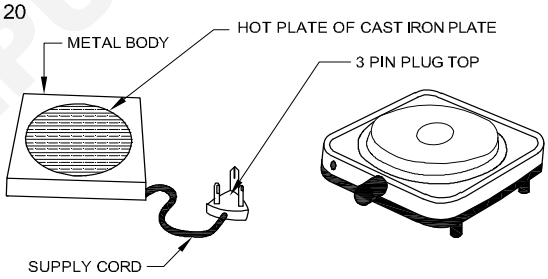
A BASIC ELECTRIC STOVE



A MODERN ELECTRIC STOVE

EDNEL22051J

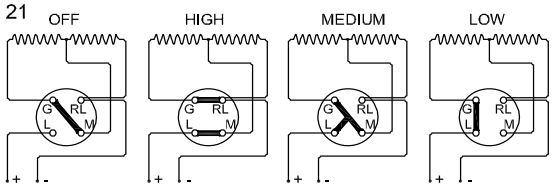
Fig 20



(A) HOT PLATE (B) A MORDERN HOT PLATE

EDNEL22051K

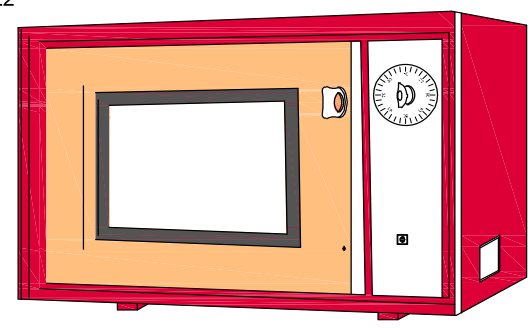
Fig 21



DEFFERENT CONNECTIONS OF HOT PLATE

EDNEL22051L

Fig 22



TYPICAL MICROWAVE OVEN ASSEMBLY

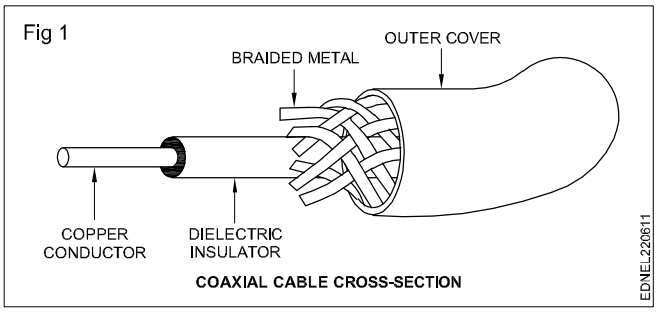
EDNEL22051M

Sketches of cable components

Sketches of components - cables

Co-axial cable (Fig 1)

Fig 1



Types of Co-axial cable

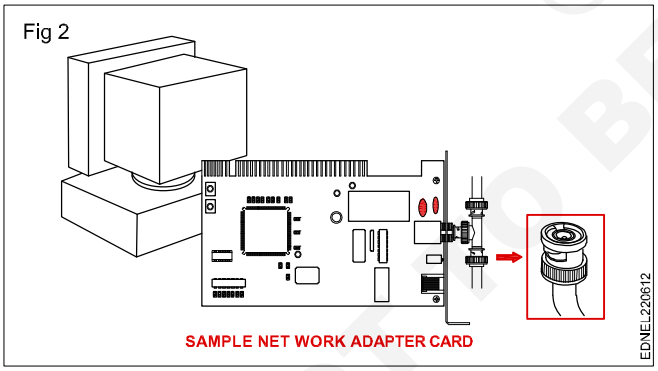
There are two types of co-axial cable

- Thin (Thinnet)
- Thick (Thicknet)

Thinnet: Thinnet is a flexible coaxial cable about 0.25 inch thickness. Because this type of coaxial is flexible and easy to work with, it can be used in almost any type of network installation.

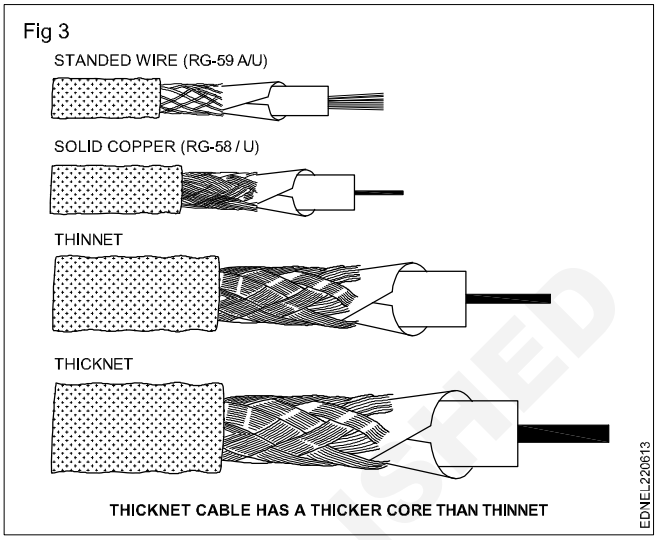
Networks that use a thinnet have the cable connected directly to a computer's network interface card as shown in Fig 2.

Fig 2



Thicknet: 'Thicknet isrelatively rig(d co-axialcable) about 0.405 inches in diameter. The copper core is thicker than a thinnet core as shown in Fig 3.

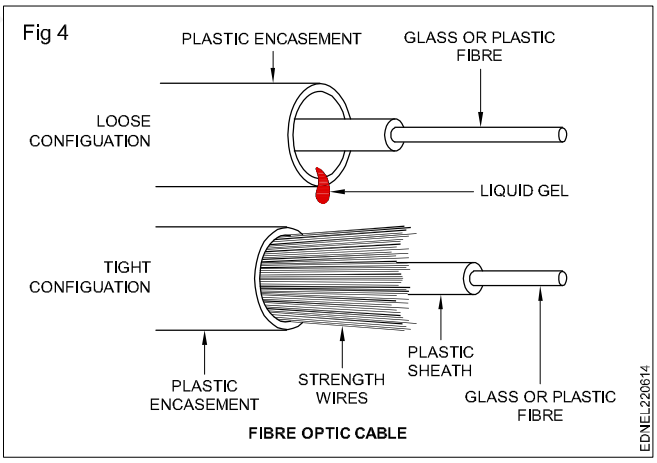
Fig 3



Fiber Optic Cable

Fiber optic cable is made of light-conducting glass or plastic core surrounded by more glass and a tough outer sheath as in Fig 4. The center core provide the light pathor wave guide while the glass or cladding is composed of varying layers of reflective glass. The glass cladding is designed to refract light back into the core. Each core and cladding strand is surrounded by a tight or loose sheath in tight configurations, the strand is completely surrounded by the outer plastic sheath.

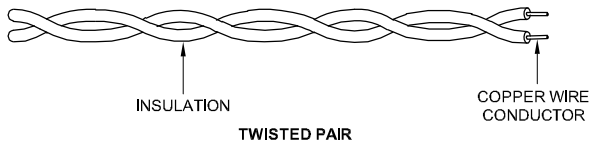
Fig 4



Different types of cable and connectors used in LAN

Twisted pairs are formed by two insulated 22 to 26 gauge copper wires that are twisted each other as in Fig 1. These twisted cables are available in two types.

Fig 1

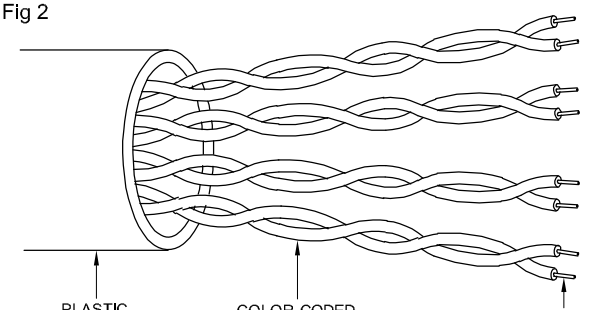


TWISTED PAIR

Unshielded twisted pair cable (UTP)

Unshielded twisted pair cable is composed of a set of twisted pairs with a simple plastic encasement as in Fig 2.

Fig 2



UNSHIELDED TWISTED PAIR CABLE

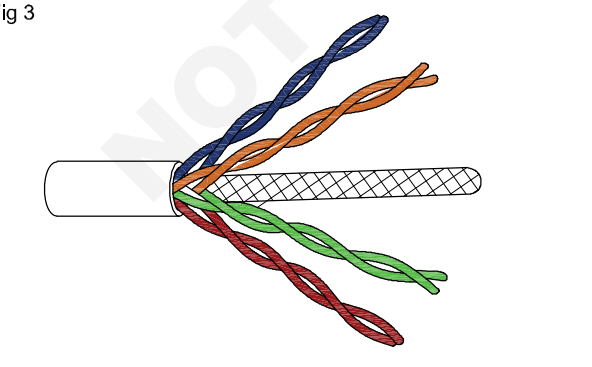
It is commonly used in telephone systems and has been largely standardized.

Twisted pair network cables are rated in terms of their capability to carry network traffic. They are referred as category 3, 4 5e and cat 6.

CAT 6 cable

Cat6 is backward compatible with the CAT 3, 5, 5e cable standards. As with Cat5 and Cat5e cabling, Cat6 cables consists of 4 unshielded twisted pairs(UTP) of copper wires with a soft supporting member in the center of the cable as shown in Fig 3.

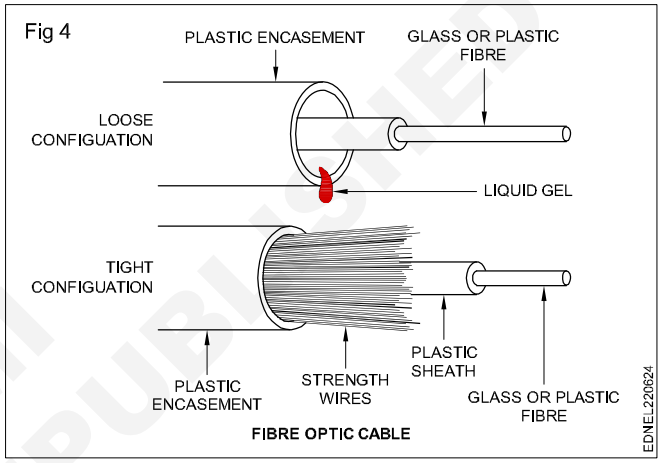
Fig 3



Fiber optic cable

Fiber optic cable is made of light- coducting glass or plastic core surrounder by more glass and a tough outer sheath as in Fig 4 The center core provide the light path or wave guide while the galss or cladding is composed of varying layers of reflective glass. The glass or cladding is composed of varying layers of reflective glass. The glass cladding is designed to refract ligh back into the core. Each core and cladding strand is surronded by a tight or loose sheath in tight configurations, the strand is completely surrounded by the outer plastic sheath. Loose configuration use a liquid gel or other material between the strand and the protective sheath.

Fig 4



FIBRE OPTIC CABLE

Diffrent Types of Level Sensors and their Workings

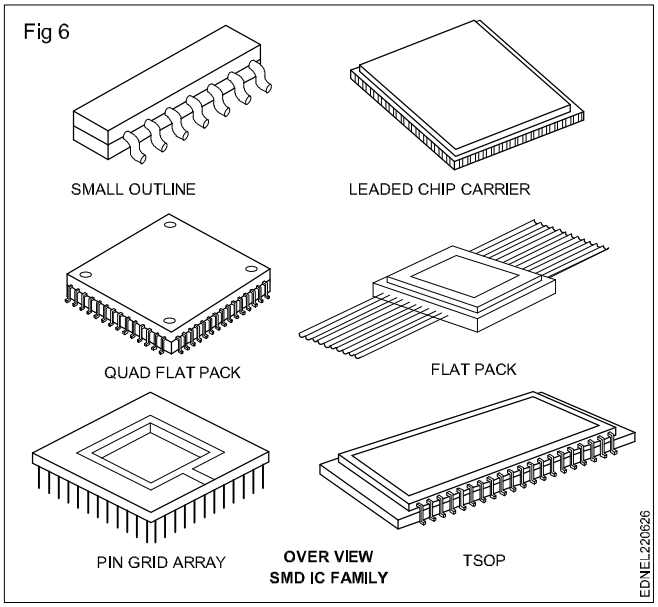
A level sensor is one kind of device used to determine the liquid level that flows in an open system or closed system The level measurements can be available in two types namely continous measurements and point level measurements. The continuous level sensor is used to measure the levels to a precise limit whereas point level sensors used to determine the level of liquid wheather that is high or low. (Fig 5)

Fig 5

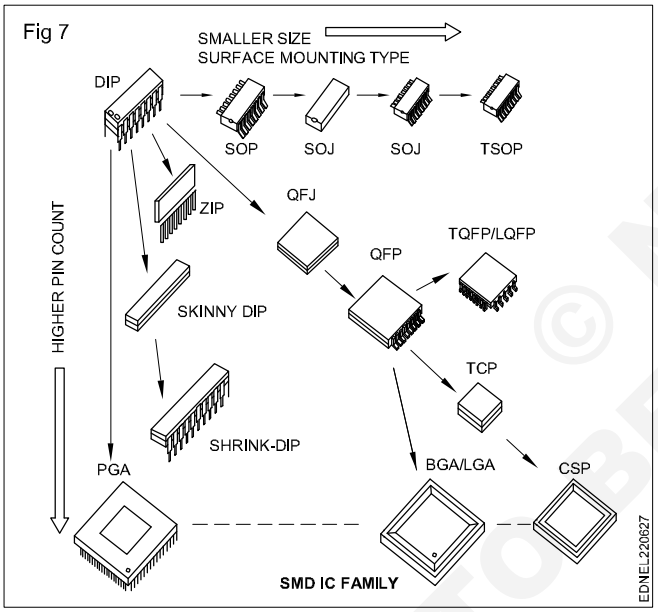
LEVEL SENSORS

Generally these sensors are connected to an output unit for sending out the results to a monitoring system The present technologies use wireless transmission of information to the monitoring system, which is very useful in important and hazardous locations that cannot be simply accessed by common workers.

SMD IC family overview (Fig 6)

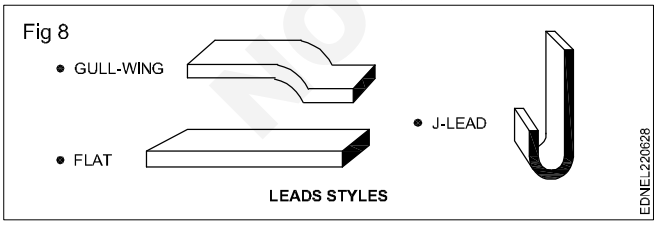


Package classifications (Fig 7)



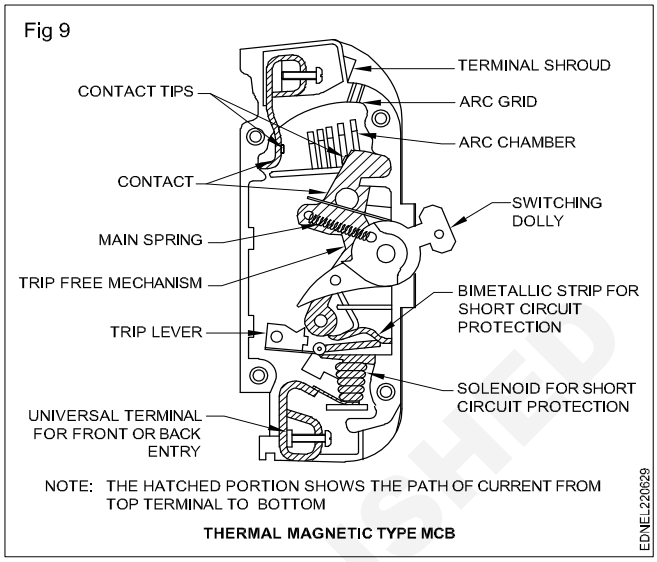
Lead styles

Heads system as shown in Fig 8.

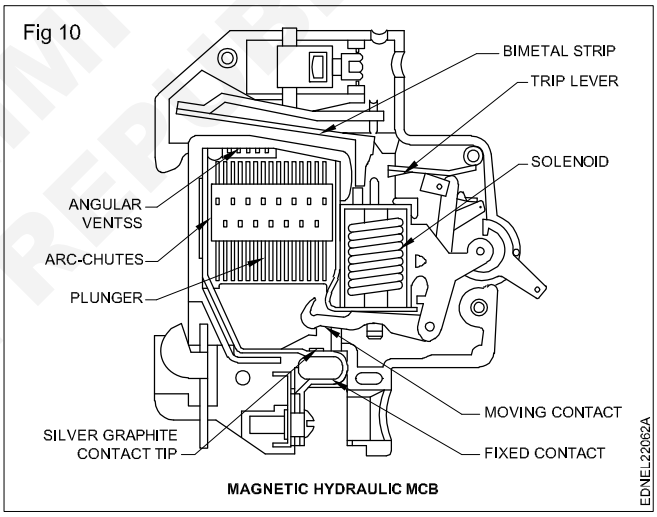


Thermal magnetic MCB

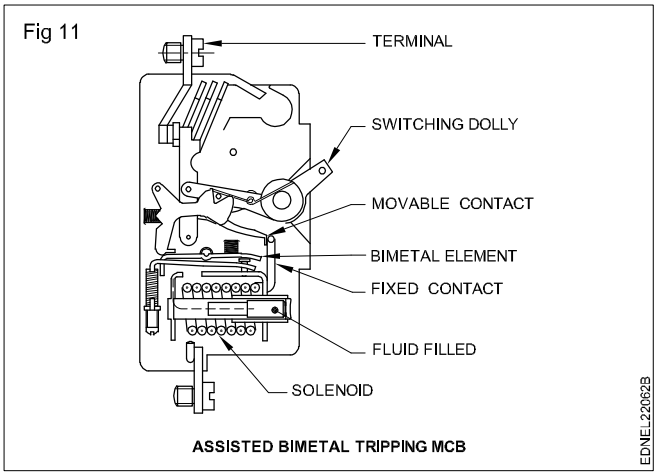
As shown in Fig 9, the switching mechanism is housed in a moulded housing with phenolic moulded high mechanically strong switching dolly. This type of MCB is also provided with bimetallic over load release.



Magnetic hydraulic MCB (Fig 10)

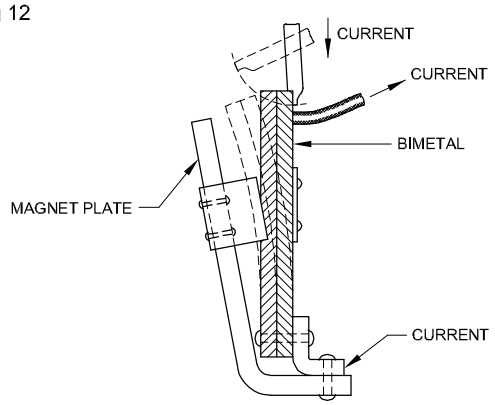


Assisted Bimetal Tripping MCB (Fig 11)



Assisted bimetal tripping (Fig 12)

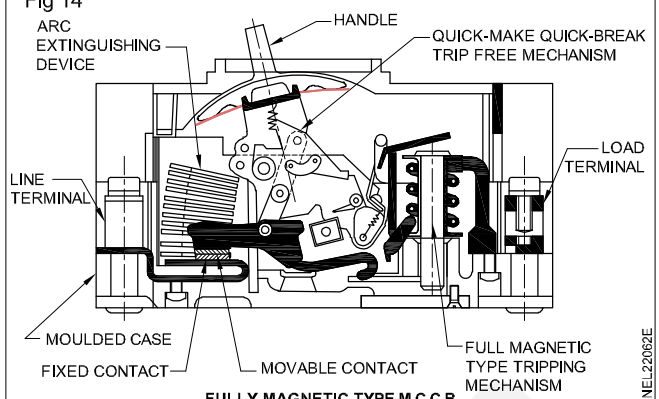
Fig 12



ASSISTED BIMETAL TRIPPING

The constructional feature of a fully magnetic MCCB design is shown in Fig 14.

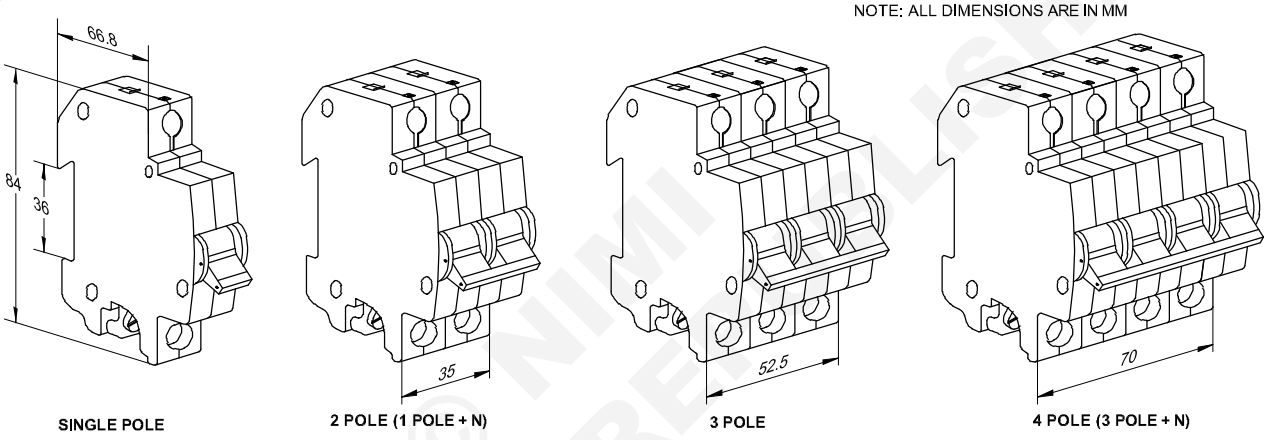
Fig 14



FULLY MAGNETIC TYPE M.C.C.B

Different types of MCB (Fig 13)

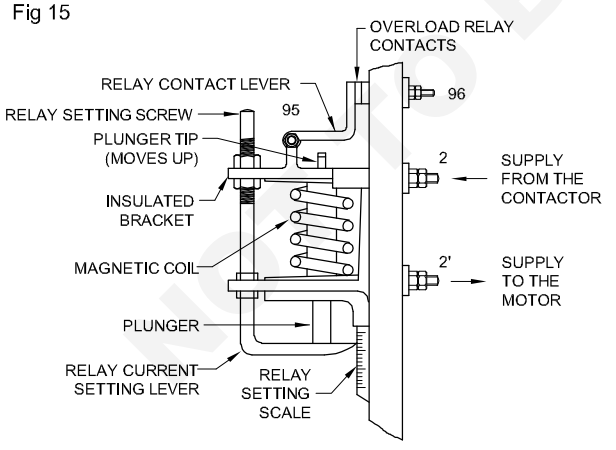
Fig 13



DIFFERENT TYPES OF MCB'S

Magentic overload relay (Fig 15)

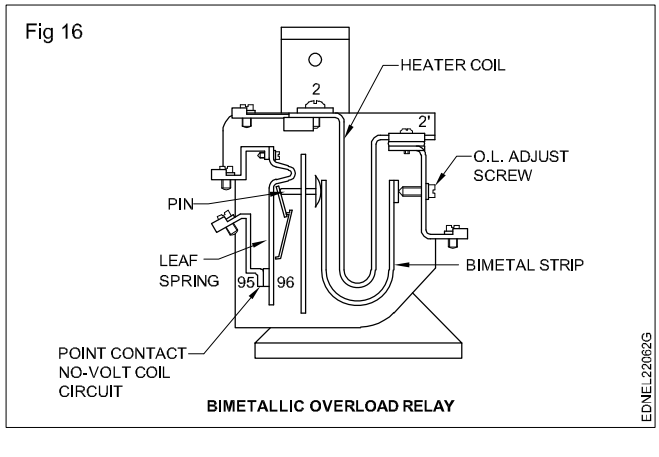
Fig 15



MAGNETIC OVERLOAD RELAY

Bimetallic overload relay (Fig 16)

Fig 16



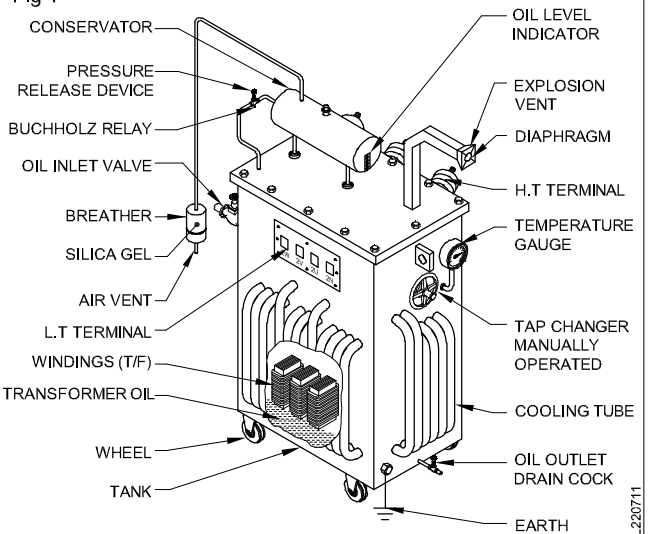
BIMETALLIC OVERLOAD RELAY

Sketches of transformer components

Exercise

Draw by free hand the following transformer parts and auxiliaries on separate A3 drawing paper.

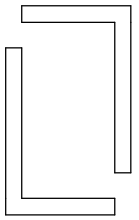
Fig 1



PARTS OF A TRANSFORMER

EDNEL220711

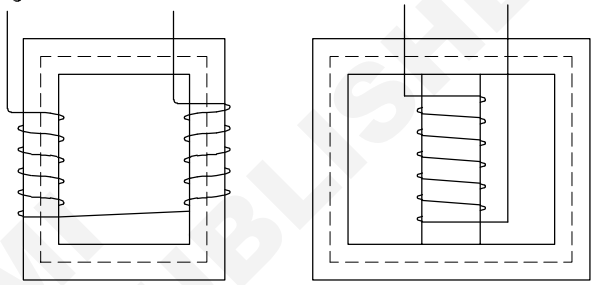
Fig 2



TWO HALF OF A LAMINATION IN 'L' SHAPE

EDNEL220712

Fig 3

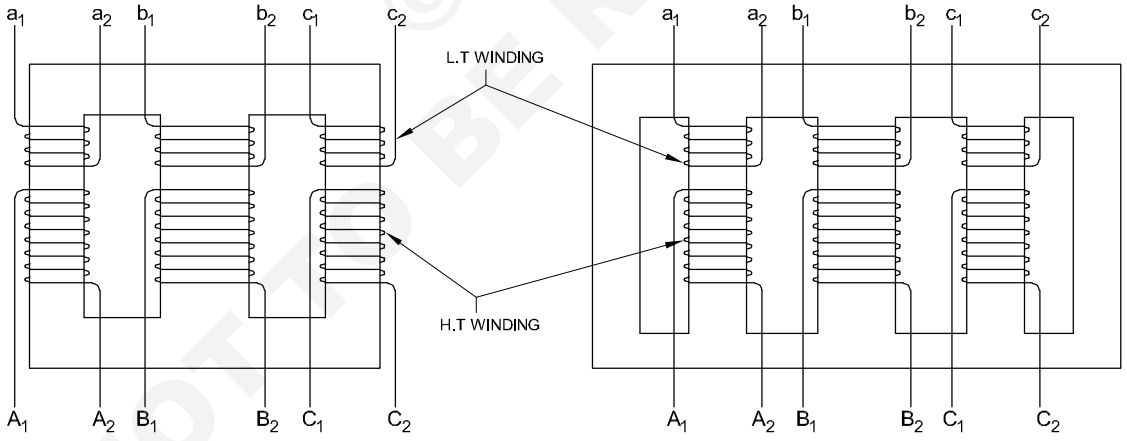


(a) TWO LIMB CORE (b) DIVIDED CORE

CORE SECTIONS FOR SINGLE PHASE TRANSFORMER

EDNEL220713

Fig 4



(a) THREE LIMB CORE (b) FIVE LIMB CORE

CORE SECTIONS FOR THREE PHASE TRANSFORMER

EDNEL220714

Fig 1 **CORE-TYPE TRANSFORMER**

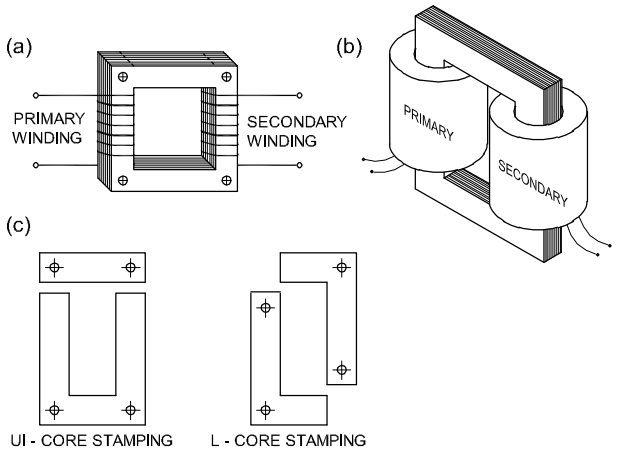


Fig 2 **SHELL-TYPE TRANSFORMER**

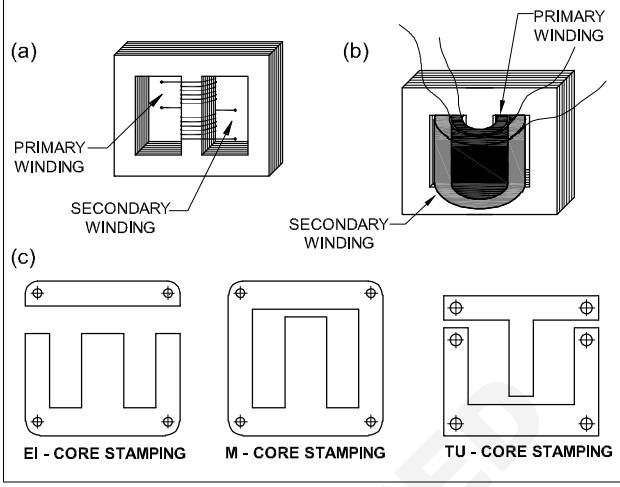


Fig 3 **RING - TYPE TRANSFORMER**

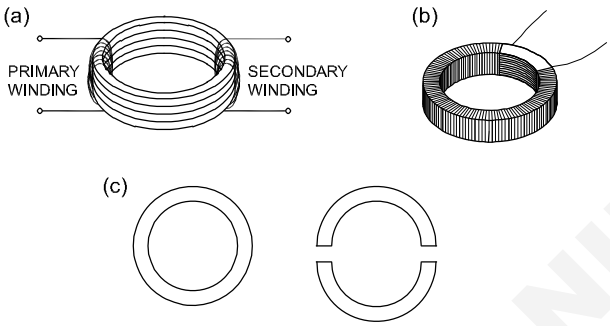


Fig 4

MAINS FREQUENCY TRANSFORMER

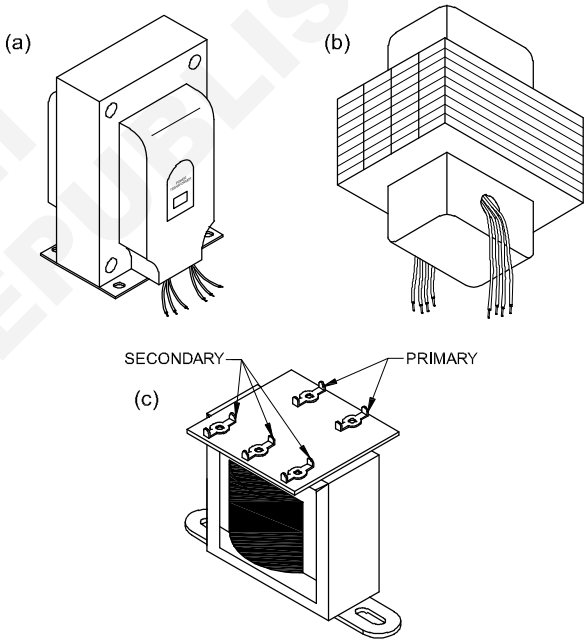


Fig 5

AUDIO FREQUENCY TRANSFORMER

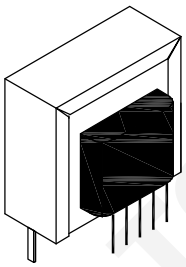
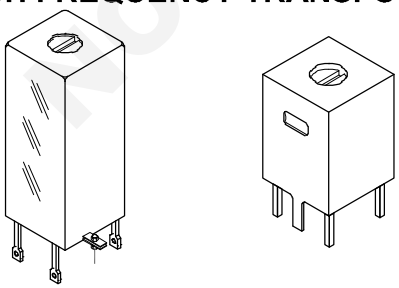


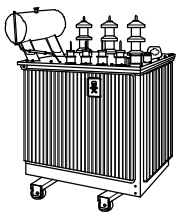
Fig 6

HIGH FREQUENCY TRANSFORMER



RFT's/IFT's

Fig 7 **POLY - PHASE TRANSFORMER**

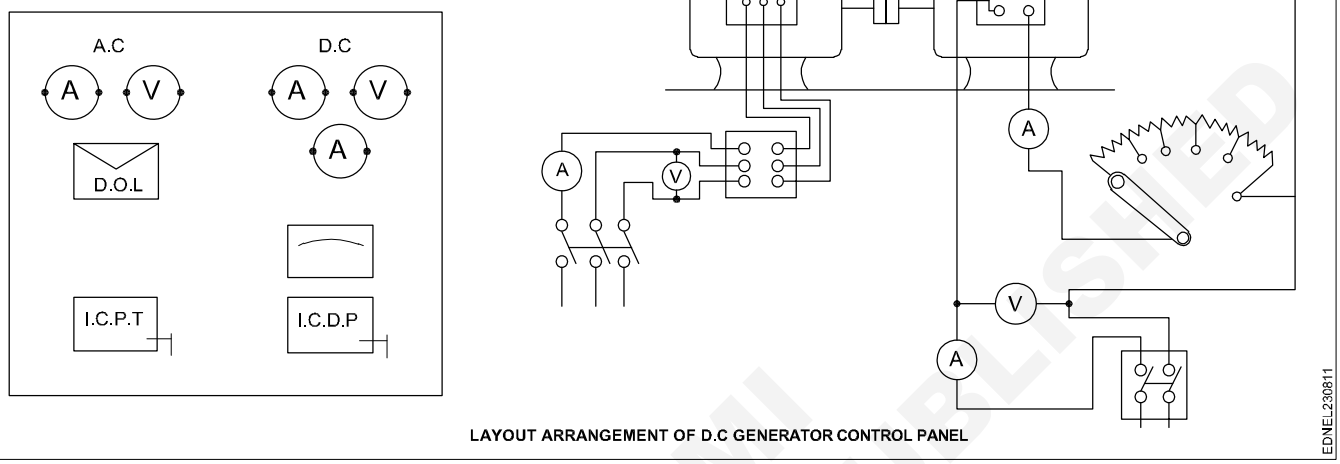


EDNEL2207T1

Reading of electrical wiring diagram and layout diagram

Layout arrangement of D.C Generator control panel (Fig 1)

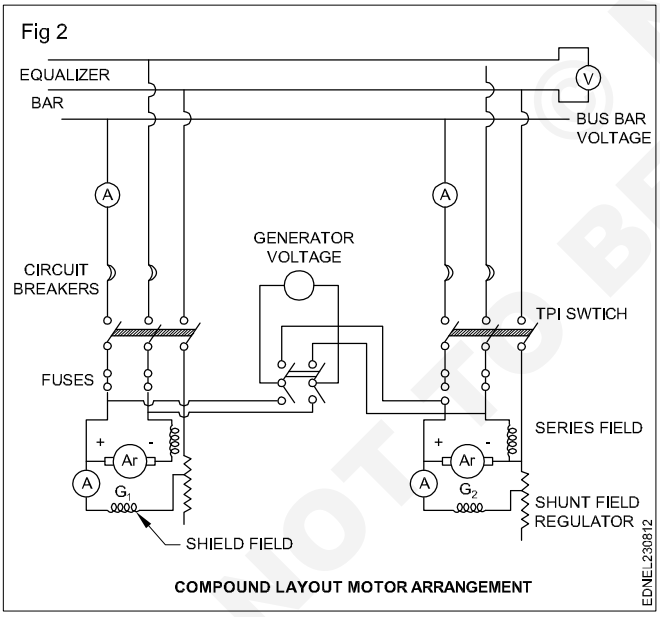
Fig 1



LAYOUT ARRANGEMENT OF D.C GENERATOR CONTROL PANEL

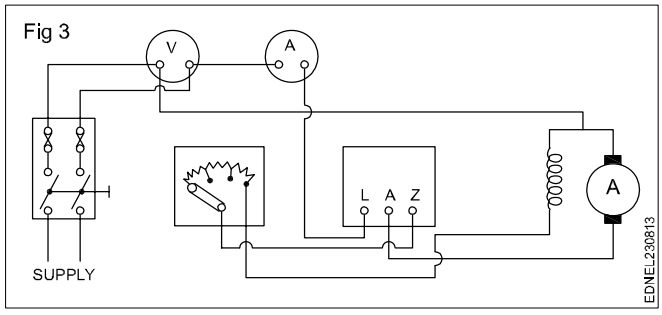
Compound motor layout arrangement (Fig 2 & 3)

Fig 2



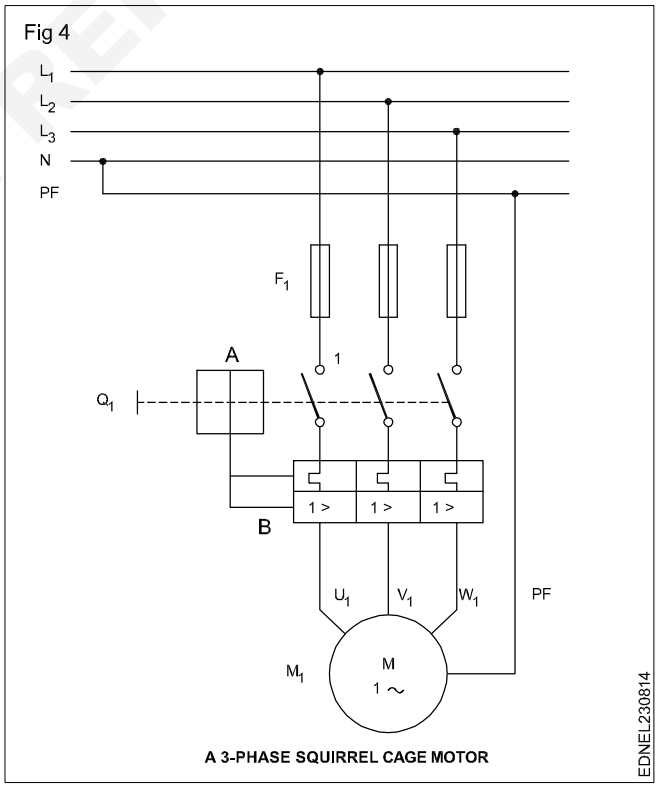
COMPOUND LAYOUT MOTOR ARRANGEMENT

Fig 3



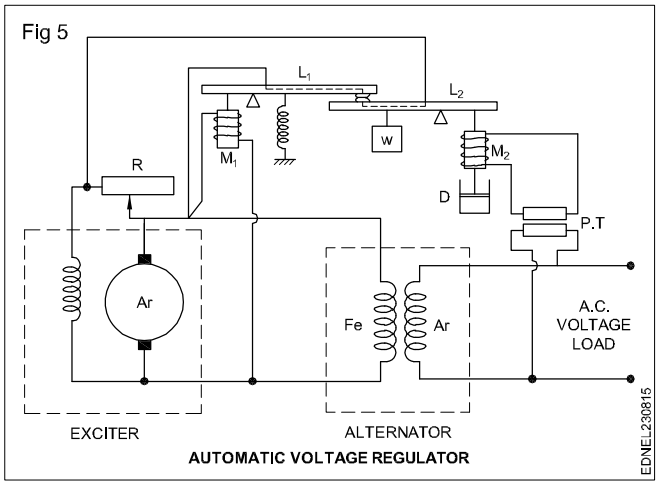
3-phase squirrel cage motor. (Fig 4)

Fig 4

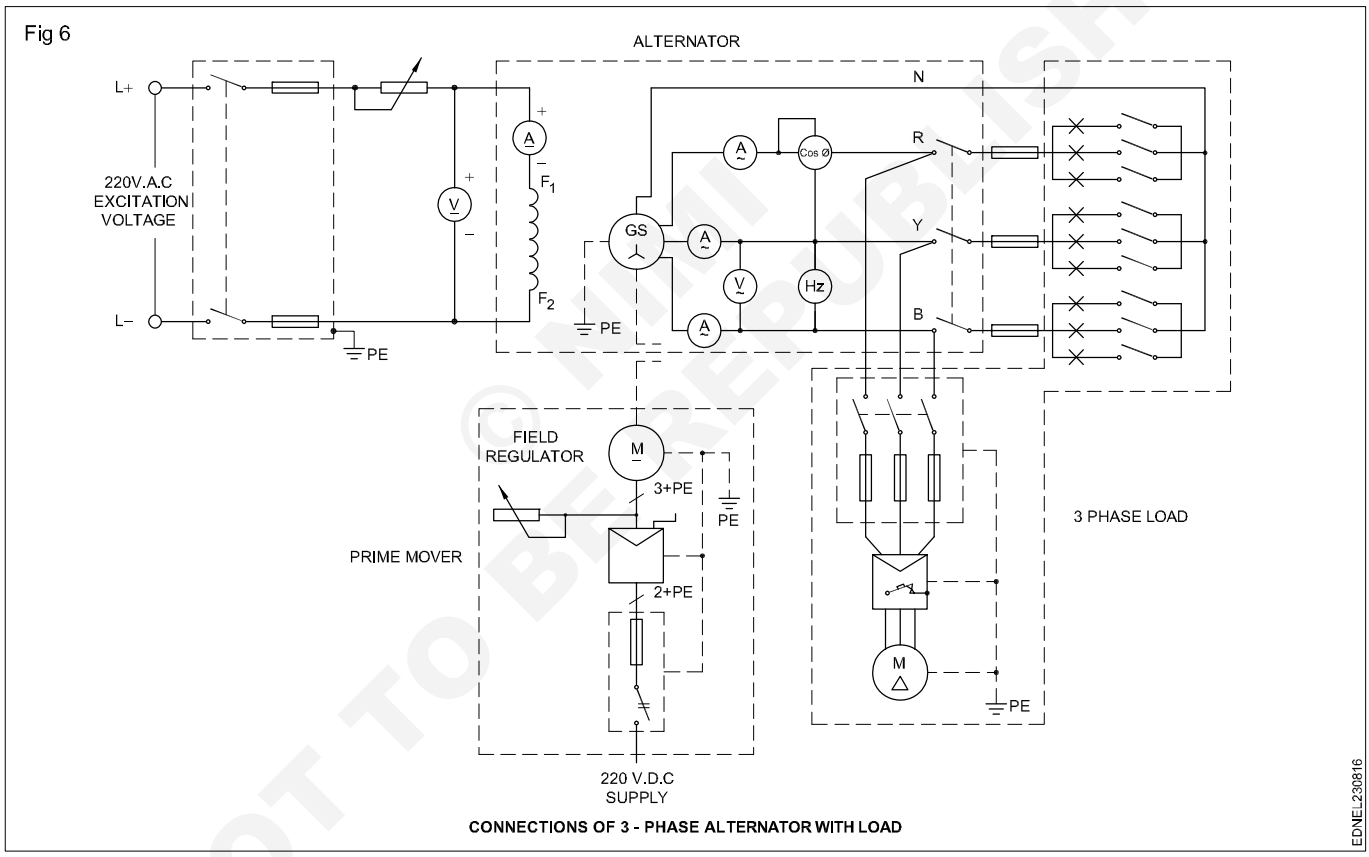


A 3-PHASE SQUIRREL CAGE MOTOR

Automatic voltage regulation (Fig 5)

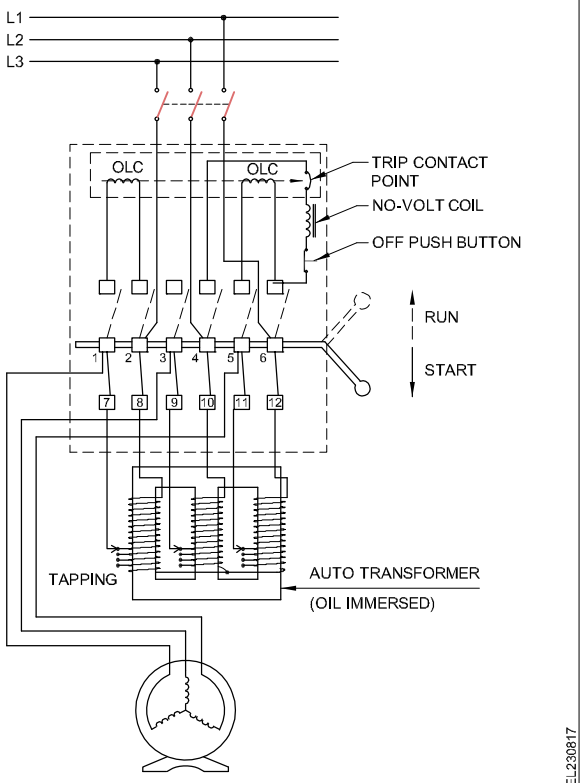


Connections of 3-phase alternator with load (Fig 6)



Connection diagram of auto-transformer starter (Fig 7)

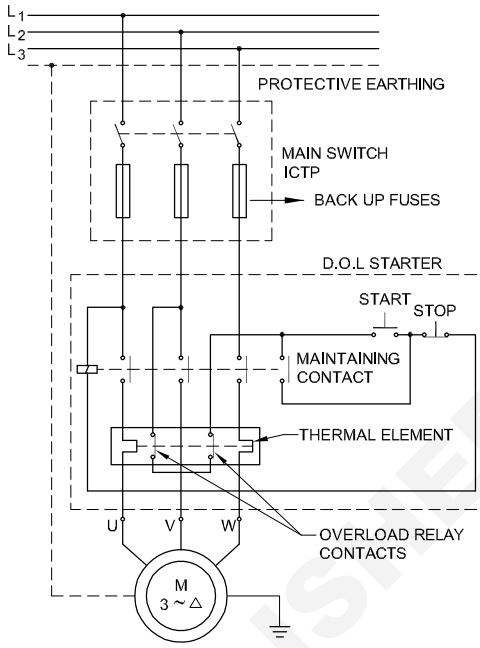
Fig 7



CONNECTION DIAGRAM OF AUTO-TRANSFORMER STARTER

Wiring diagram of a direct online starter with protective devices (Fig 8)

Fig 8



WIRING DIAGRAM OF A DIRECT ON-LINE STARTER WITH PROTECTIVE DEVICES

Reading of pipe earthing diagram

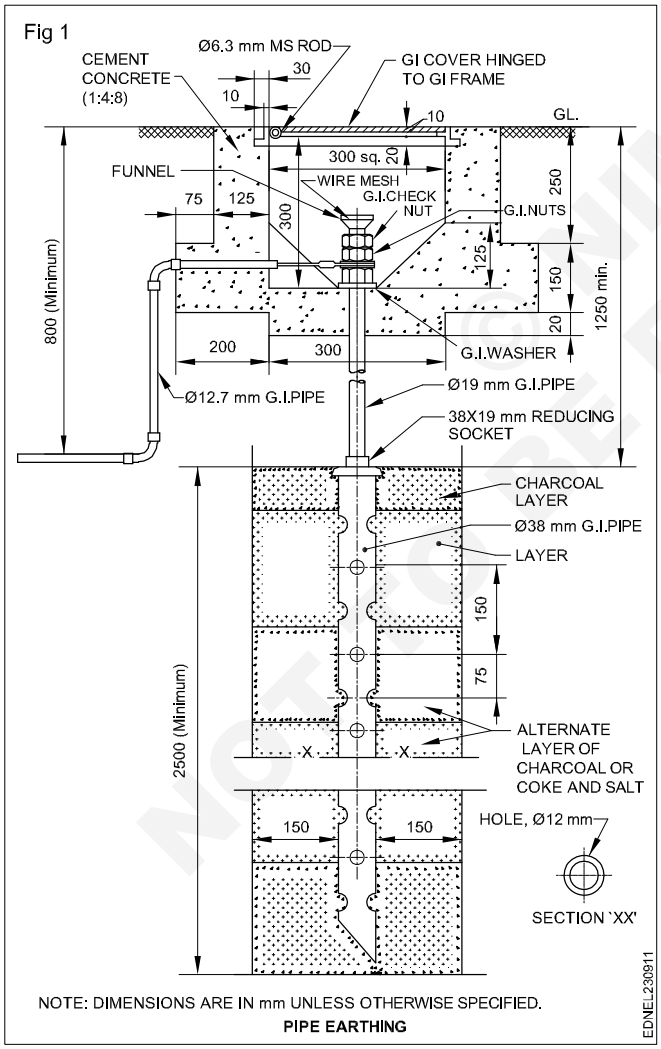
Earthing

General: In general all parts of an apparatus, other than the live parts, shall be at earth potential. For this earthing purpose, earth electrodes are used. These earth electrodes shall be provided at generating stations, substations and consumer premises. A number of earth electrodes in parallel is necessary to bring down the earth resistance to an acceptable low value such that the system's protective devices like earth fault relays and fuses operate properly in case of faults. As far as possible, these earth electrodes shall be visible.

Types of earth electrodes - Pipe earthing

Pipe electrodes (Fig 1): These electrodes shall be made of metal rod or pipe having a clean surface not covered by paint, enamel or other poorly conducting material.

Fig 1



NOTE: DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

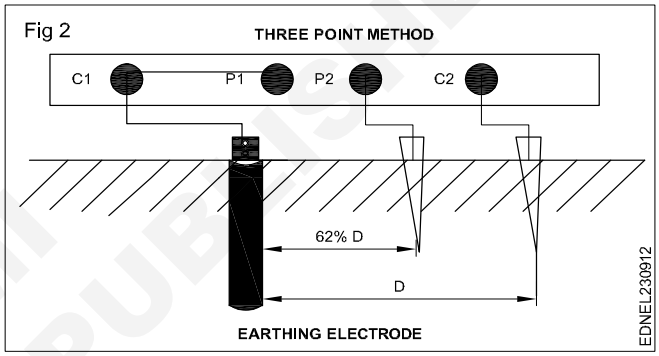
PIPE EARTHING

Measurement of earth resistance (Three point method)

In this method earth tester terminal C1 and P1 are shorted to each other and connected to the earth electrode (pipe) under test. Terminals P2 and C2 are connected to the two separate spikes driven in earth. These two spikes are kept in same line at the distance of 25 meters and 50 meters due to which there will not be mutual interference in the field of individual spikes. (Fig 2)

Suppose, the distance of Current Spike from Earth Electrode D = 60 ft, Then, distance of Potential Spike would be 62 % of D = 0.62D i.e. 0.62 x 60 ft = 37 ft.

Fig 2



EARTHING ELECTRODE

Drawing the schematic diagram of plate earthing

Draw the schematic diagram of plate earthing

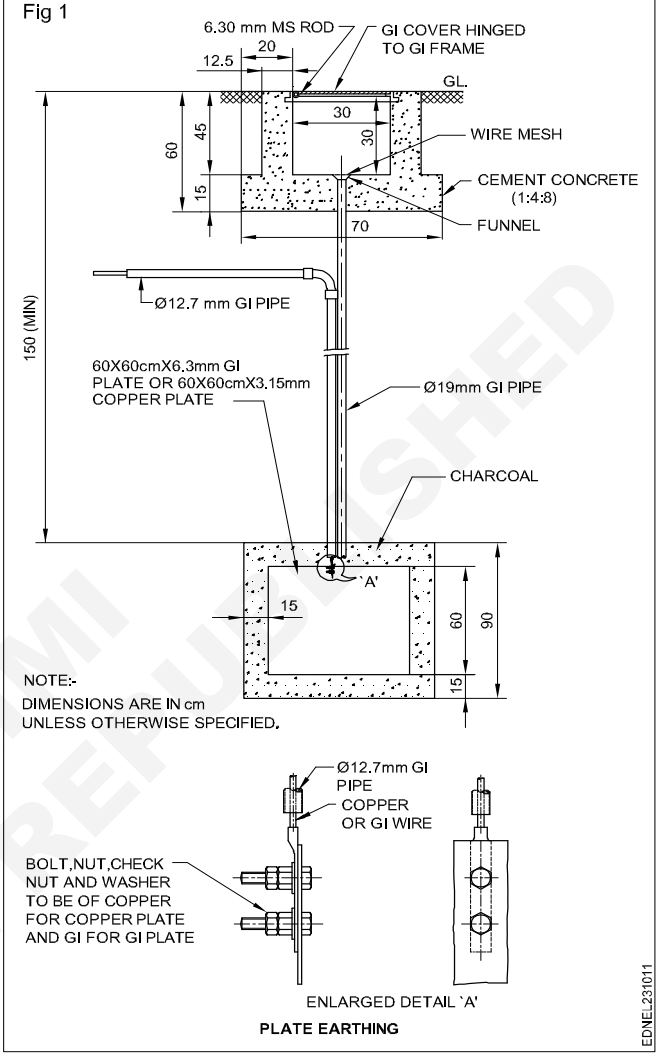
Plate electrodes (Fig 1): Plate electrodes,when made of galvanised iron or steel,shall not be less than 6.3 mm in thickness. Plate electrodes of copper shall be not less than 3.15 mm in thickness. Plate electrodes shall be of a size, at least 60 cm by 60 cm.

1 Which material is used for plate electrode?

2 What is the thickness of plate electrode?

3 How to reduce the earth electrode resistace?

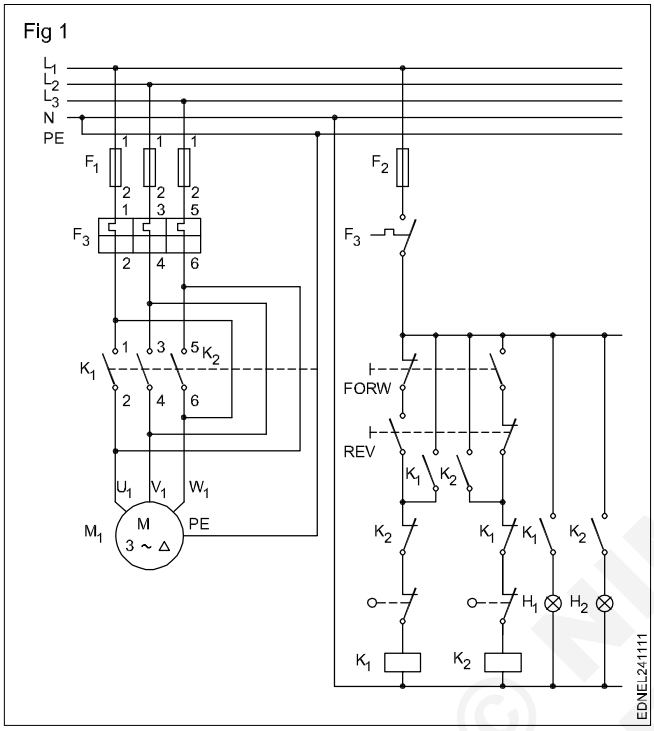
Fig 1



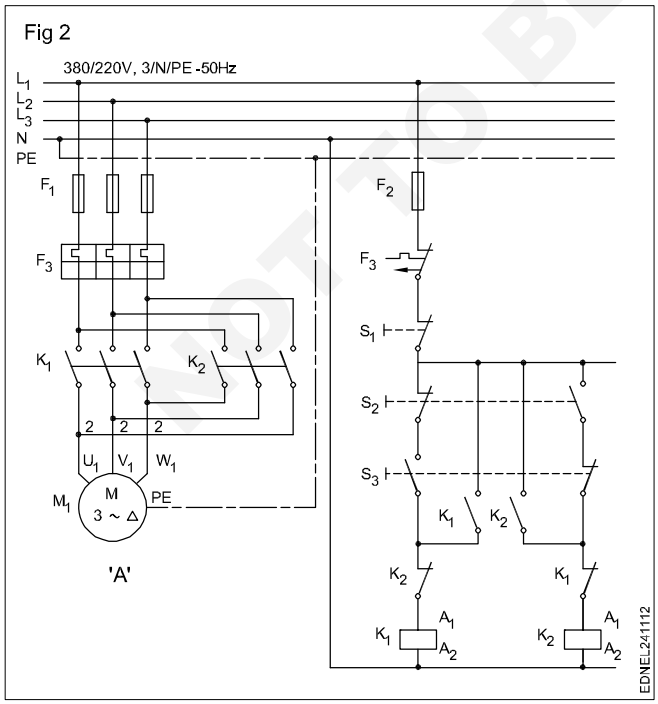
Drawing of electrical circuit diagram

Three phasing switching circuit diagram

1 A 3-phase forward/reverse contactor circuit diagram is shown in Fig 1.

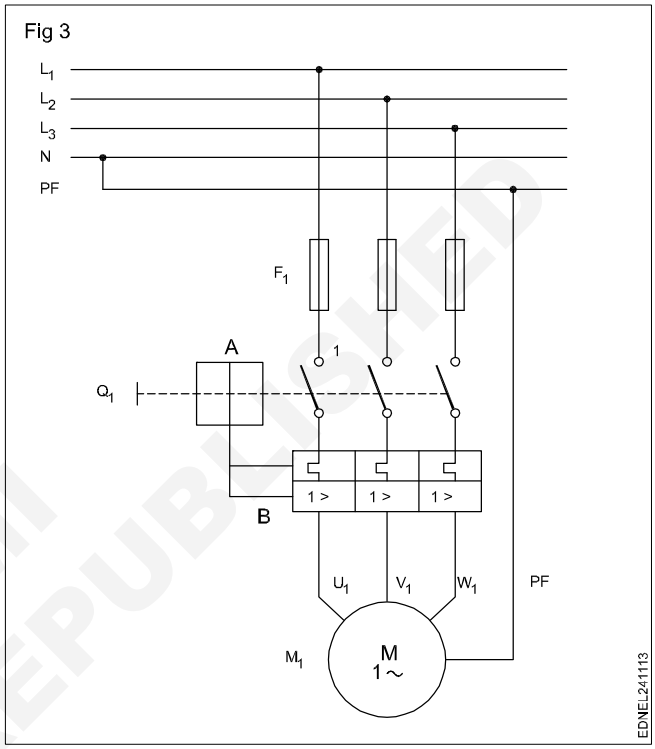


2 A 3-phase forward/reverse switching circuit diagram is shown in Fig 2.

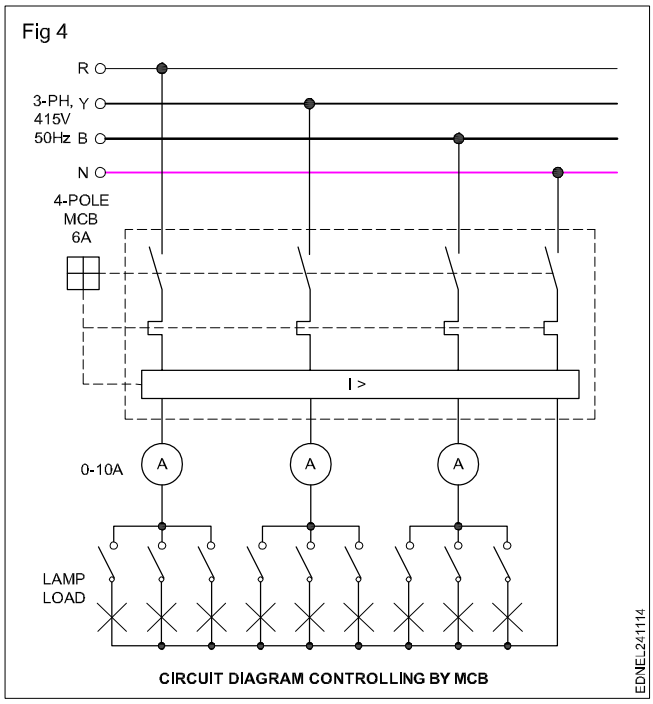


Three phasing squirrel cage motor circuit diagram

A 3-phase squirrel cage motor circuit diagram is shown in Fig 3.

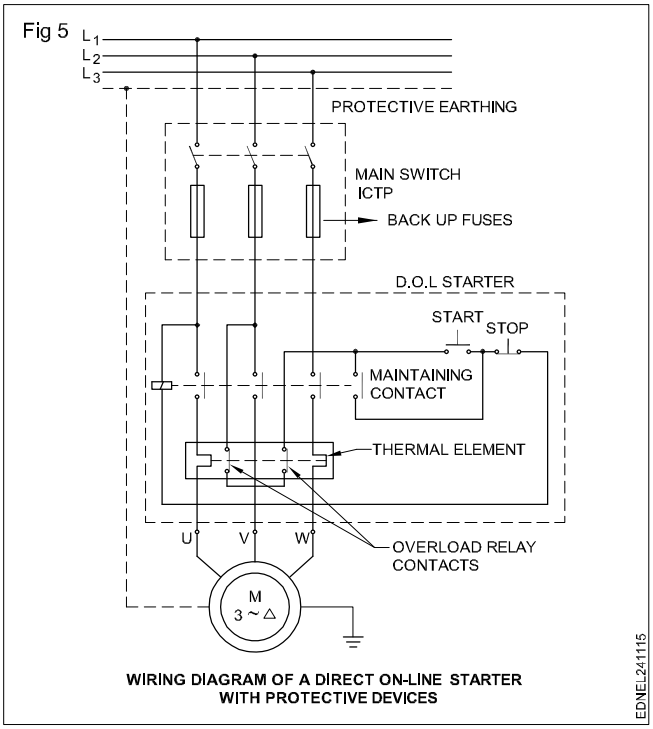


Circuit diagram controlling by MCB (Fig 4)



Wiring diagram of a direct on-line starter with protective devices (Fig 5)

Fig 5



WIRING DIAGRAM OF A DIRECT ON-LINE STARTER WITH PROTECTIVE DEVICES

Draw the schematic diagram of two point and three point starters

The two-point starter is frequently used with a DC series motor. The starting resistance, electromagnet armature and the series field are all connected in series as shown in Fig 6.

Three-point starter: Fig 7 shows the internal diagram of a three(terminal) point starter connected to a DC shunt motor. The direct current supply is connected to the starter, the motor circuit through a double pole switch and suitable fuses. The starter has an insulated handle or knob for the operator's use. By moving the starter handle from the 'OFF' position to the first brass contact (1) of the starter, the armature is connected across the line through the starting resistance.

Fig 6

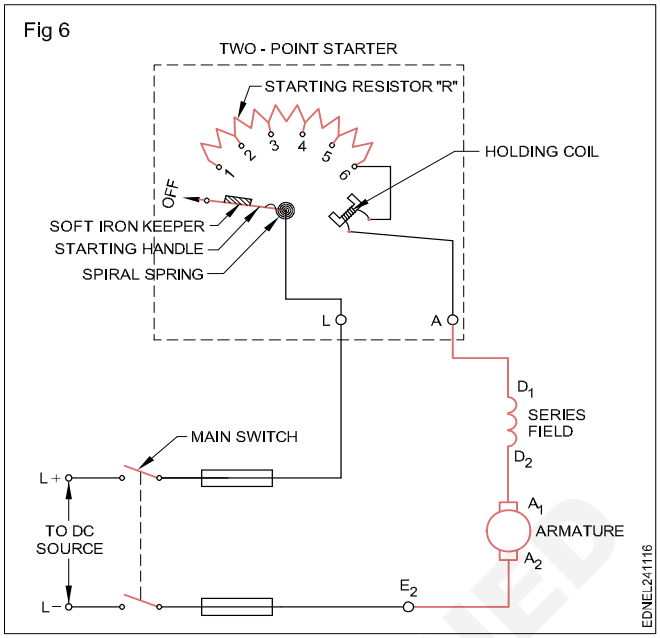
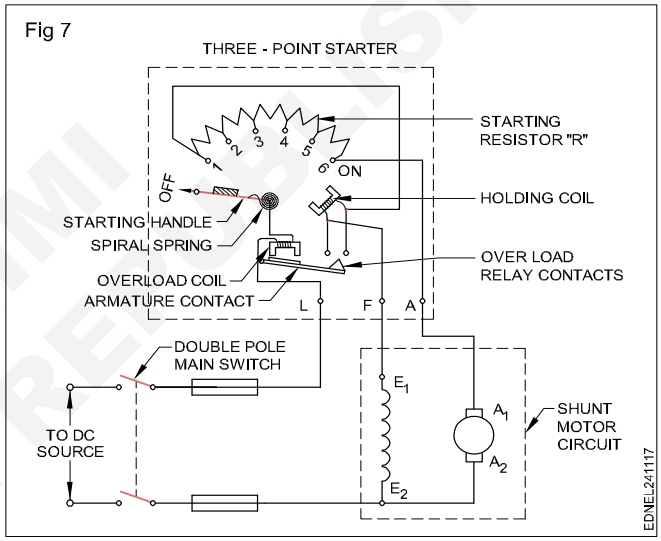


Fig 7



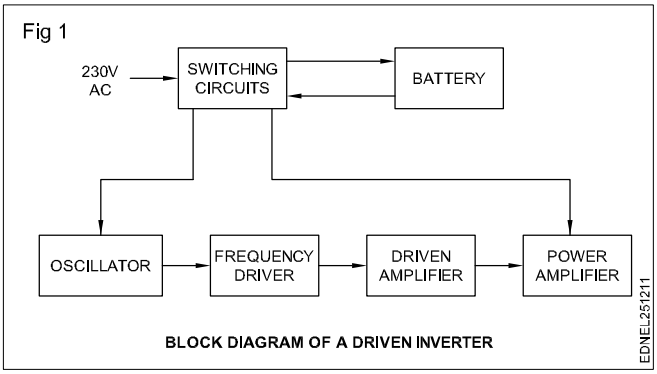
Drawing of block diagram of instruments & equipment of trades

Block diagram of Invertor

Devices that change DC into AC are referred to as invertor. The invertor takes in DC and provides an AC supply for other equipment in which it is turned back to DC, the inverter is also used for the operation of true AC equipment like motors and servos.

The block diagram of a driven inverter is shown in Fig 1.

Fig 1

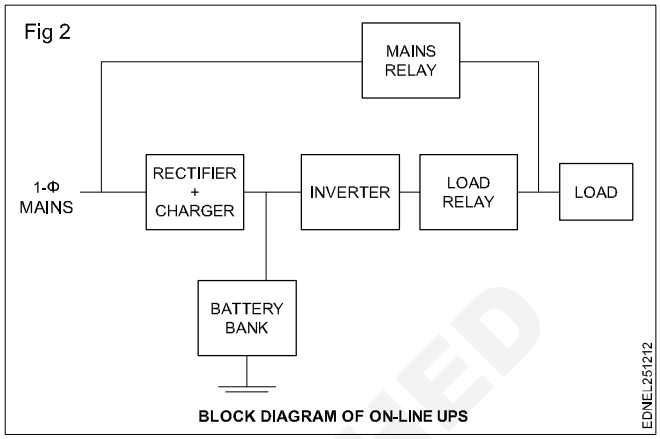


BLOCK DIAGRAM OF A DRIVEN INVERTER

ON line UPS

On line UPS are also known as double conversion UPS or True On Line UPS. There are two stages in its operation. In the first stage the mains AC is rectified to DC. There is a DC bus. DC bus can get power from both the DC battery and DC obtained by rectifying the mains AC. In the second stage DC power available from DC bus is converted to AC by the inverter and this AC is connected to the output. In normal operation output comes from mains AC via rectifier and inverter. When mains AC fail, output comes from DC battery via inverter. The changeover is instantaneous. There is no power transfer switch and hence no time delay. When mains AC is available normal operation continues and the rectifier recharges the battery. A bypass switch connects mains AC directly to the output in case there is some problem with the UPS. (Fig 2)

Fig 2

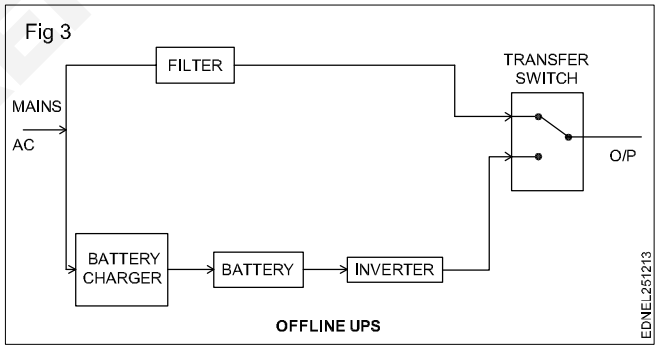


BLOCK DIAGRAM OF ON-LINE UPS

OFF line UPS

An OFF line UPS is shown in Fig 3. It is also known as stand by UPS or Backup UPS and supplies emergency power when mains AC fail. The capacity of an off line UPS is generally below 1kVA. A very common application is with PC. In the event of sudden load shedding the off line UPS supplies emergency power to the PC so that work can be continued till normal power is restored or the PC can be safely switched off.

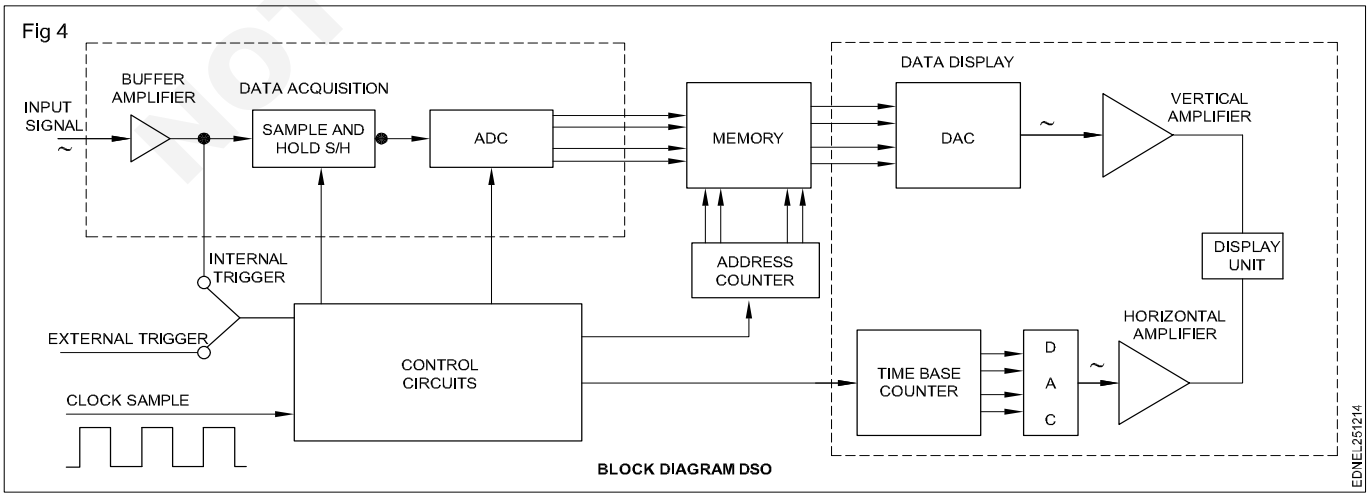
Fig 3



OFFLINE UPS

Block diagram of DSO (Fig 4)

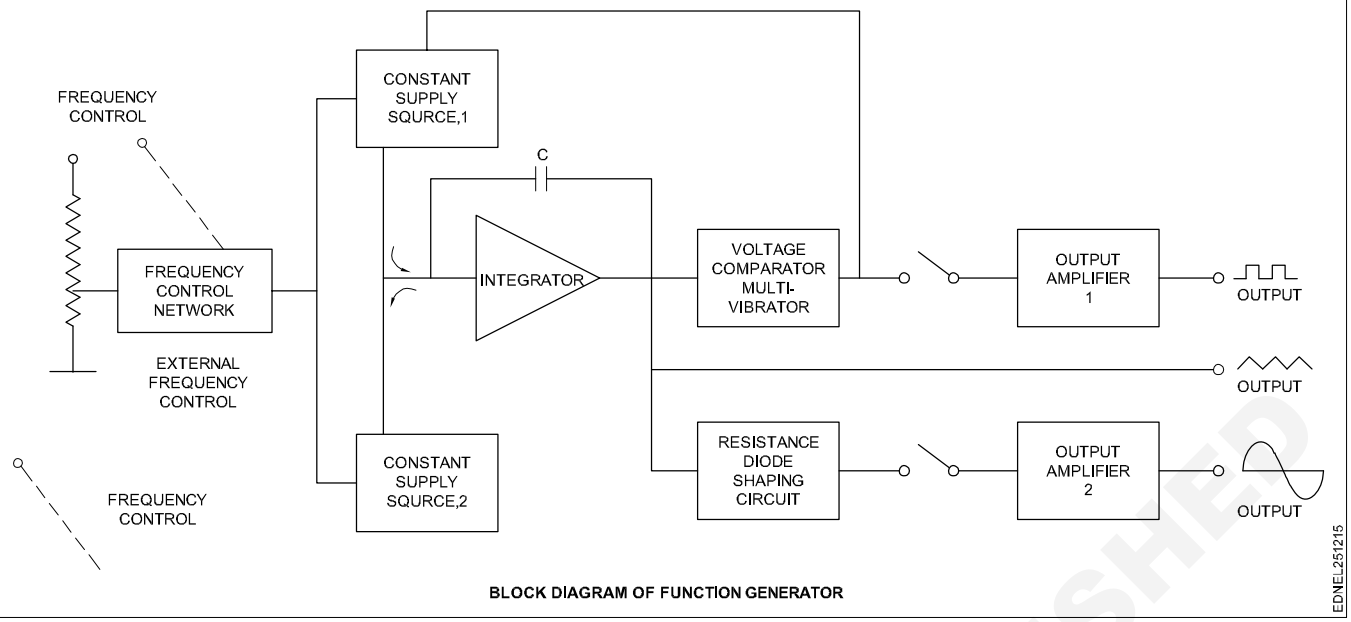
Fig 4



BLOCK DIAGRAM DSO

Block diagram of Function generator (Fig 5)

Fig 5



BLOCK DIAGRAM OF FUNCTION GENERATOR