

TECHNICAL DRAWING

Electrical General 3



GOVERNMENT OF THE PUNJAB
TECHNICAL EDUCATION & VOCATIONAL TRAINING AUTHORITY
PUNJAB BOARD OF TECHNICAL EDUCATION
TRADE TESTING CELL, LAHORE.

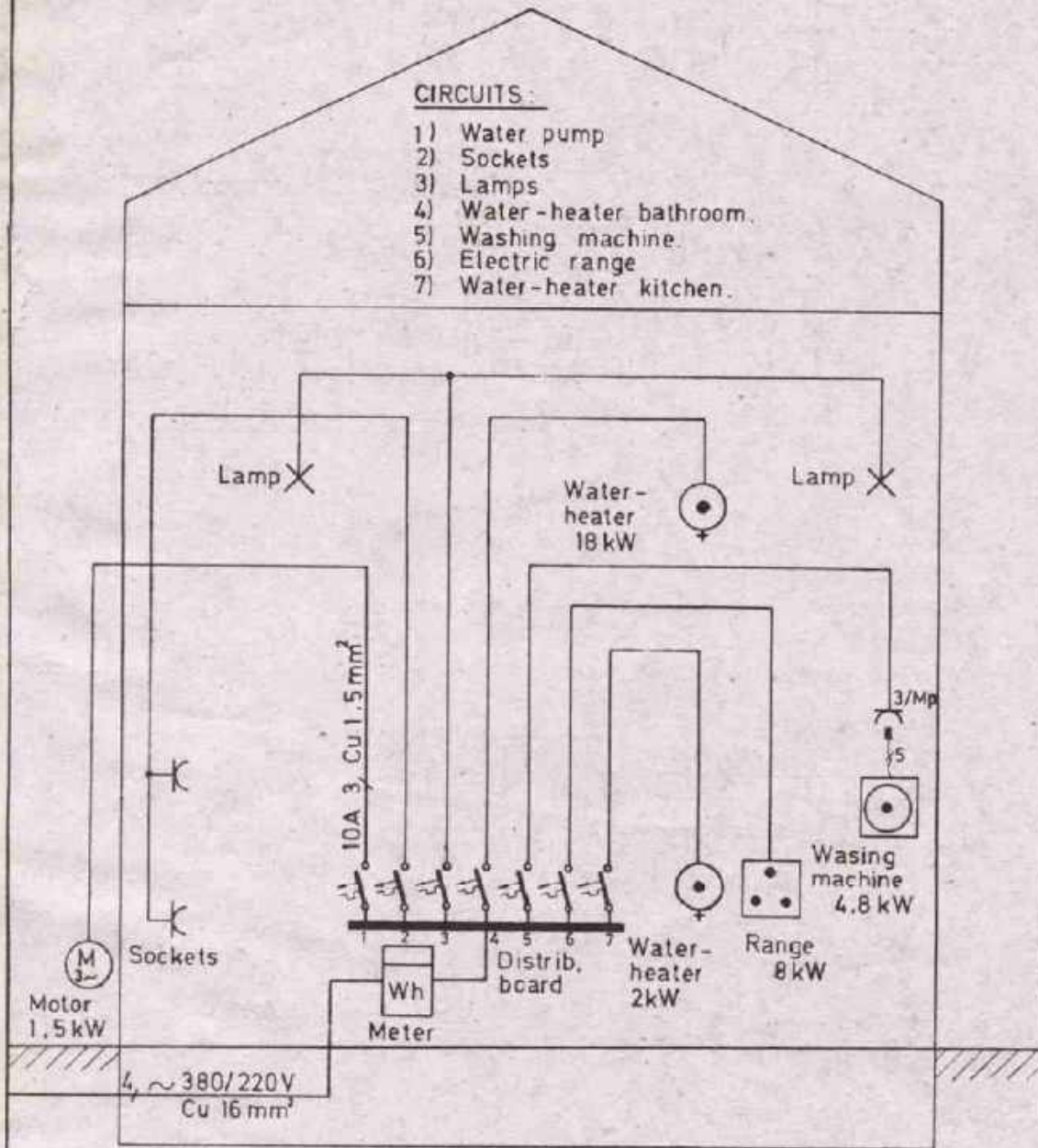
T.T.P. Series No.6

Price Rs. 35/-



Enter the following particulars into the layout diagram as shown for the first circuit:

- Numbers of circuitbreakers and rated current values.
- Number of wires for each circuit.
- Material and size of conductors.



LAYOUT DIAGRAM
WITH PARTICULARS OF CABLES & FUSES

TECHNICAL DRG.
No. 109

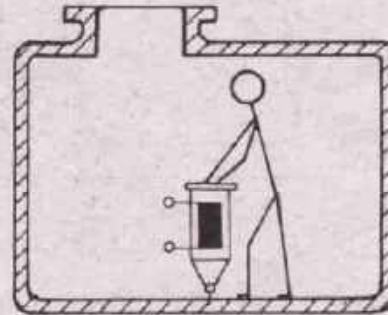
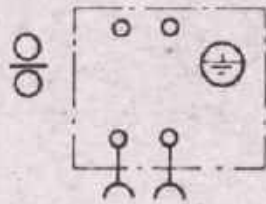
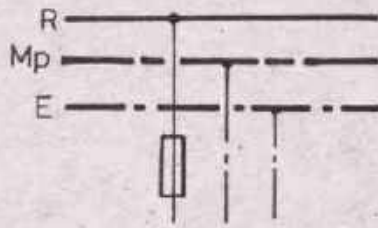


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

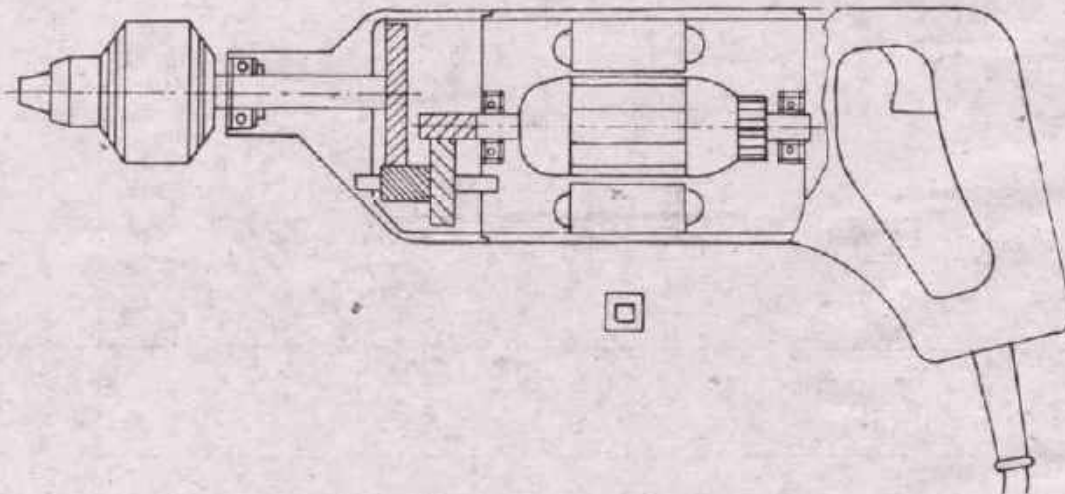
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

a) An electric hand drilling machine used within a metal container is supplied by a protective transformer. Complete the wiring diagram.



b) An electric hand drilling machine is constructed with an additional (protective) insulation.
Mark the additional insulation with red pencil.
1. Casing of insulation material.
2. Gear of insulation material.



PROTECTED APPLIANCES
PROTECTIVE TRANSFORMER
PROTECTIVE INSULATION

TECHNICAL DRG.
NO. 110

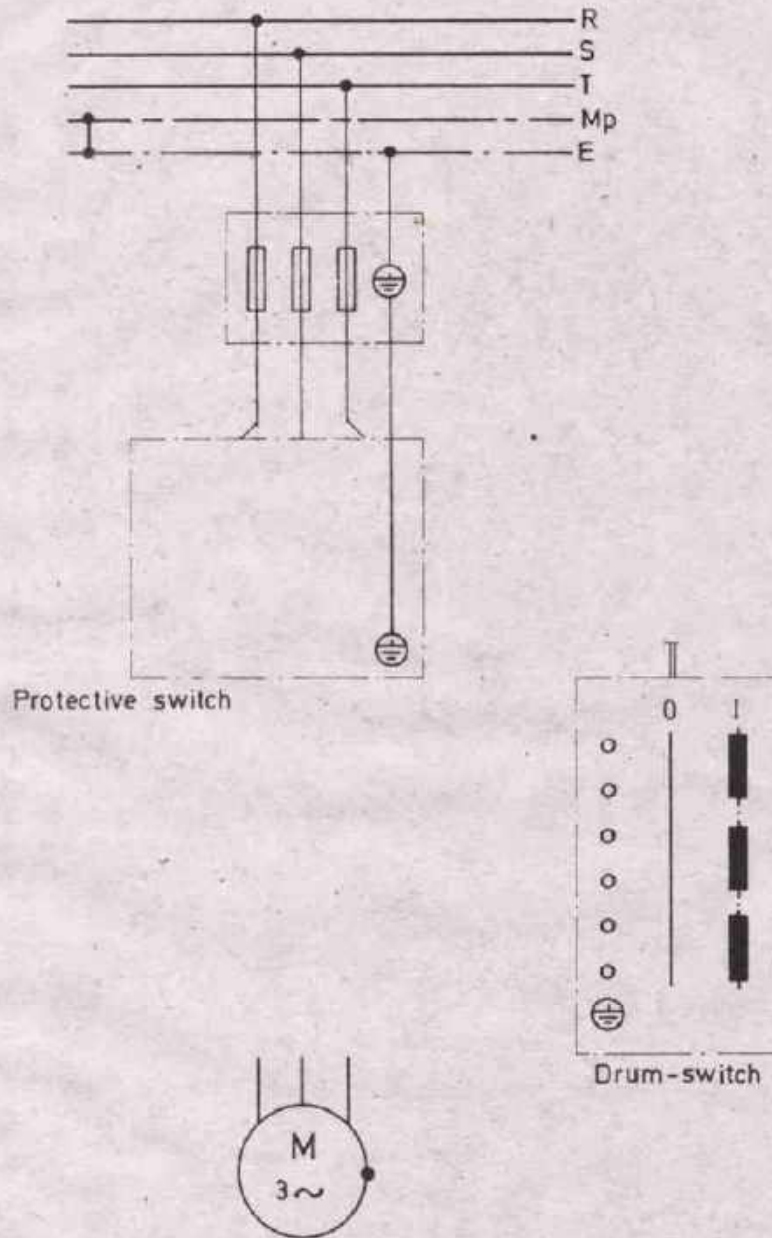


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

A three-phase motor is protected by a motor protection switch with overload and short circuit protection.
 Complete the connection diagram.



MOTOR PROTECTIVE SWITCH

TECHNICAL DRG.
 No. 111

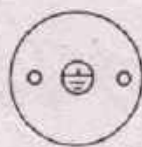
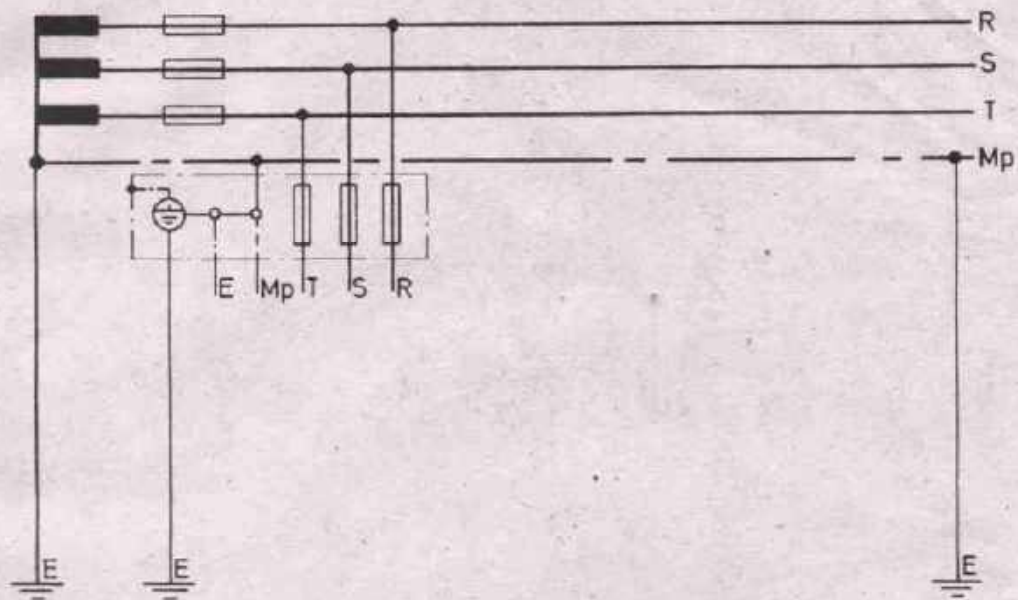


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

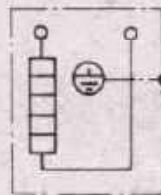
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
 GENERAL

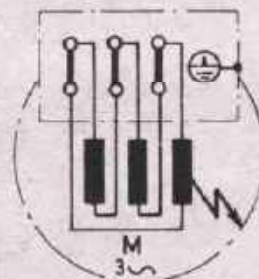
- 1.) Complete the wiring diagram and connect the socket, heater and motor to the distribution board.
- 2.) Since in the electric motor there is one faulty coil, one of the lines has direct connection to the motor-body. Mark the complete circuit of the fault-current with red pencil.



Socket



Heater



Motor

NEUTRALIZATION
IN THREE PHASE SYSTEM

TECHNICAL DRG.
No. 112

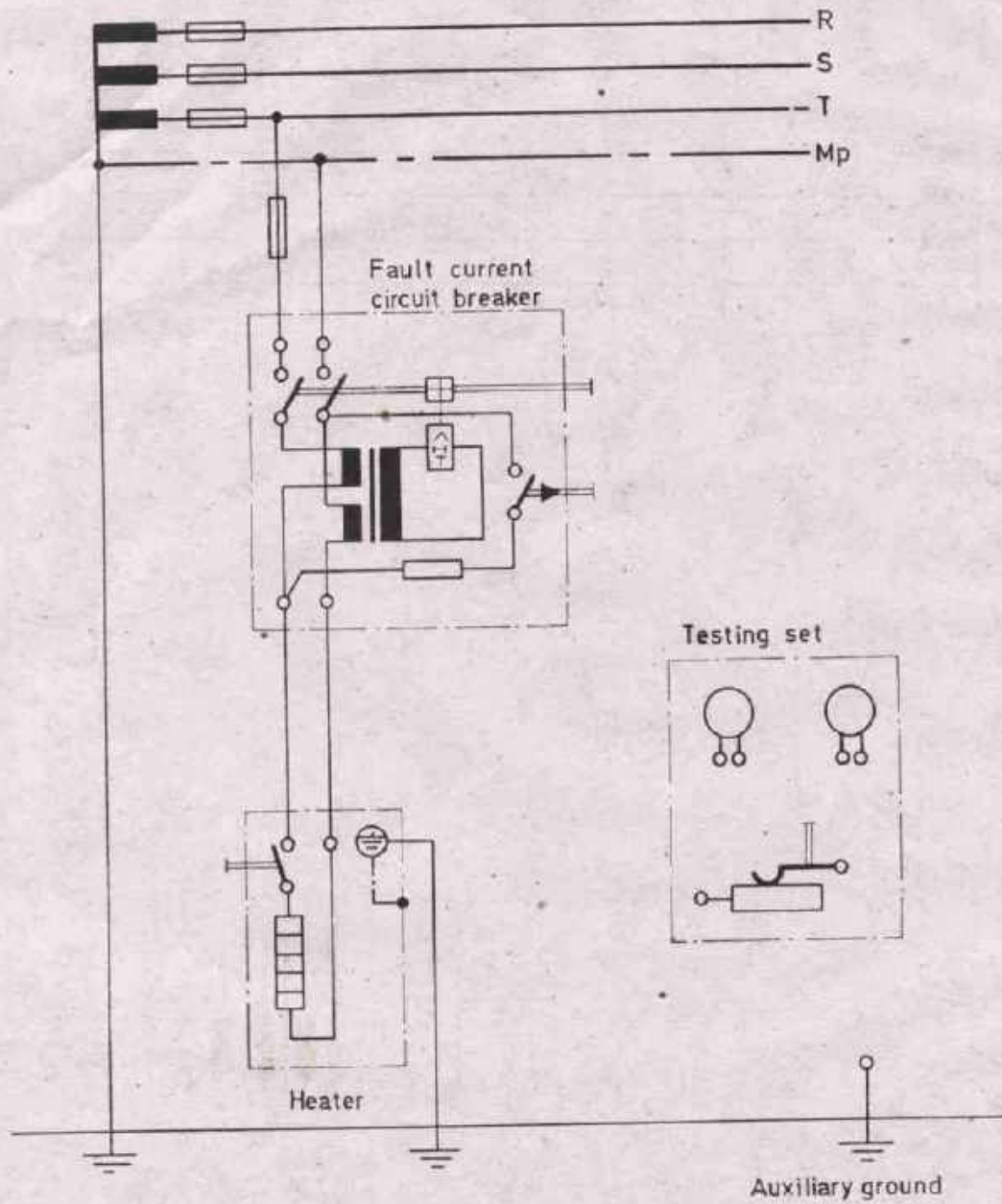


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

An electric heater is protected by a fault-current circuitbreaker.
 To determine the tripping current and the maximum contact voltage complete
 the connection diagram of the measuring connection.



FAULT CURRENT PROTECTION

TECHNICAL DRG.
 No. 113

DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

ELECTRICIAN
 GENERAL



PAK-GERMAN TECHNICAL TRAINING PROGRAMME

A single phase induction motor has a rated voltage of 110V. This motor is to be connected to a power supply of 220V with the help of a step down transformer. Draw all necessary components and connections.

R _____
Mp _____
E(SL) _____



TRANSFORMER
connection diagram

TECHNICAL DRG.
No. 114



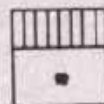
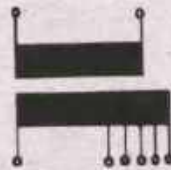
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING


PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

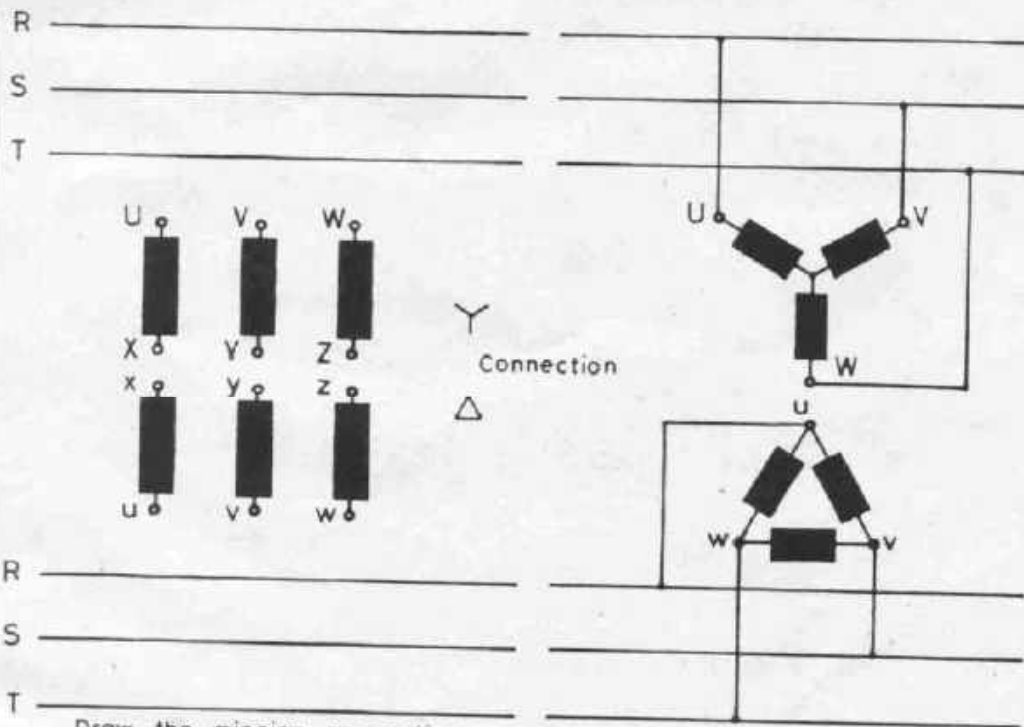
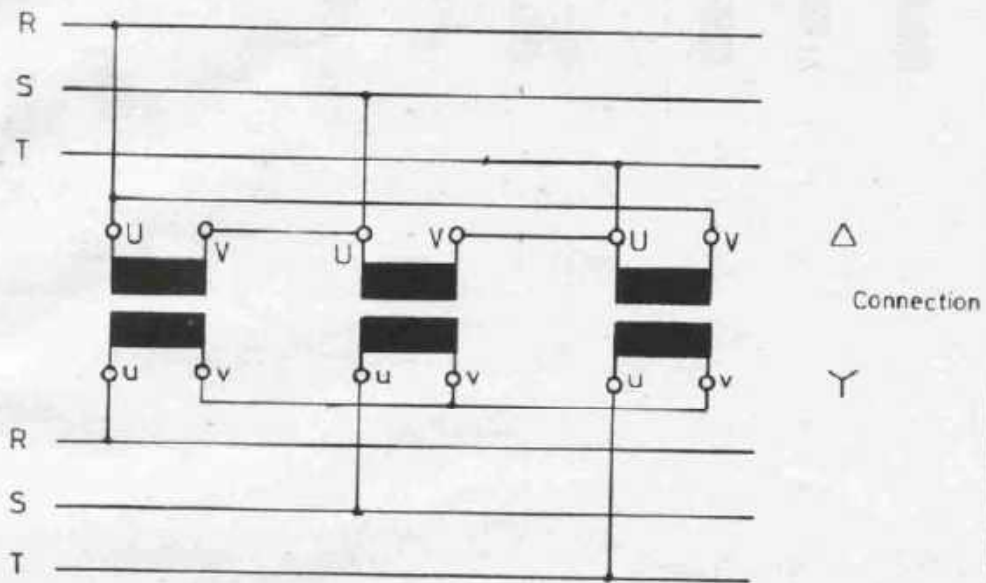
An air conditioner is to be connected to a power supply 220 V. To compensate voltage fluctuation a tapped transformer is connected between power supply and air conditioner. Draw all necessary components incl. one voltmeter and complete the connections.

R _____
Mp - - - - -
E(SL) - - - - -



	TAPPED TRANSFORMER	TECHNICAL DRG. No. 115
	DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME	ELECTRICIAN GENERAL

The combination of 3 single phase transformers results in 1 three phase transformer. There is star connection (Y) and delta connection (Δ) possible.



Draw the missing connections.

THREE PHASE TRANSFORMER

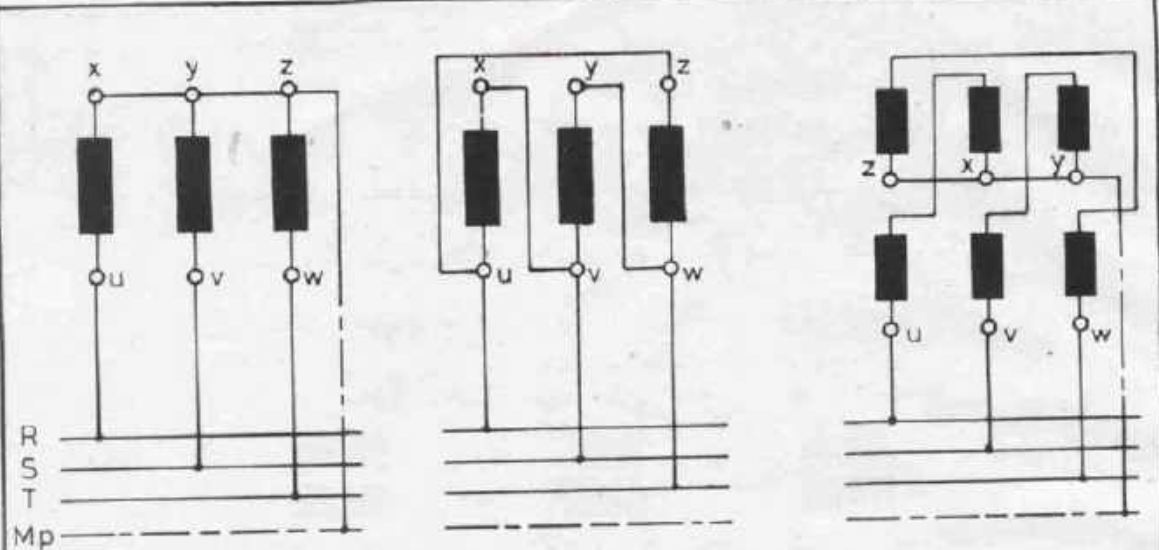
TECHNICAL DRG.
No. 116



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL



Star connection

delta connection

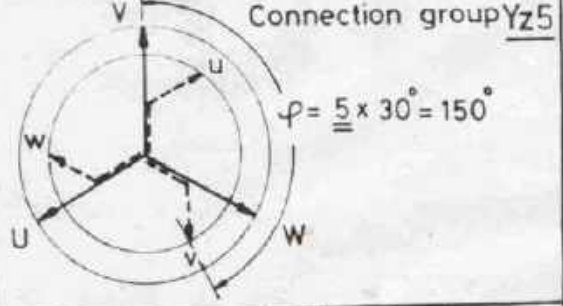
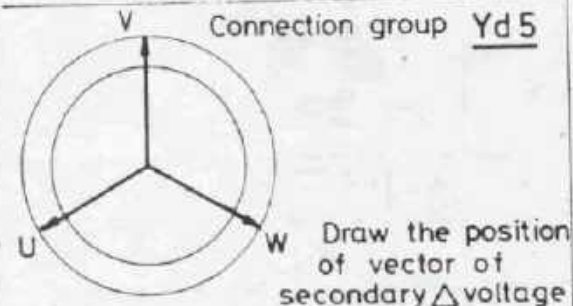
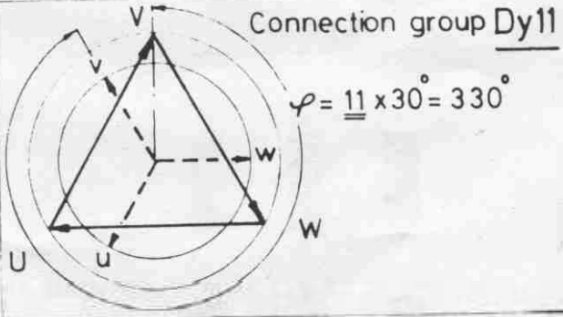
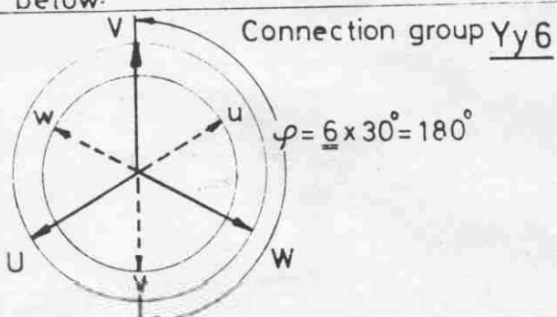
zig zag connection

$\text{Y} = Y; y$

$\Delta = D, d$

$Z = Z; z$

It is possible to vary the kind of connection of primary and secondary side. It is also possible to arrange a phase displacement between secondary and primary windings. This is to be represented by vectors which indicate the kind of connection as well as the phase displacement between primary and secondary voltage. Discuss the examples below.



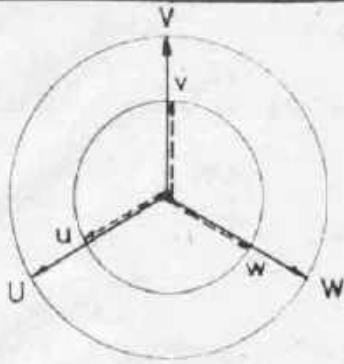
THREE PHASE TRANSFORMER
vector representation

TECHNICAL DRG.
No. 117

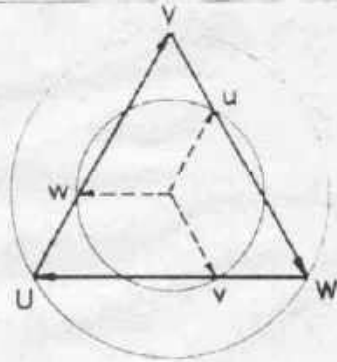


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

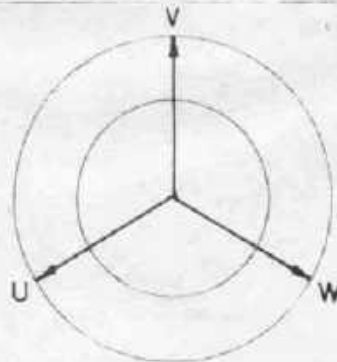
ELECTRICIAN
GENERAL



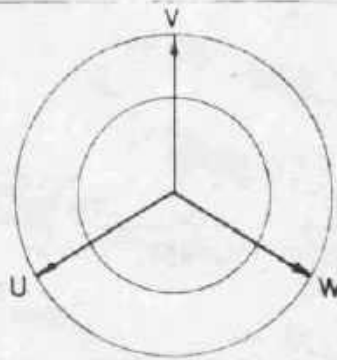
Yy 0



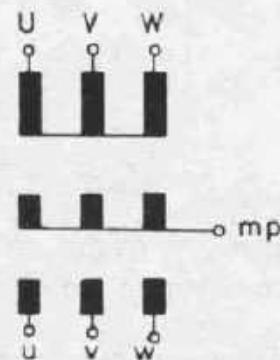
Dy 5



Yd 5



Yz 5



Complete the connections of the secondary windings and the vector diagrams according to the given connection group.

THREE PHASE TRANSFORMER
connection groups

TECHNICAL DRG.
No. 118



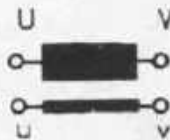
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

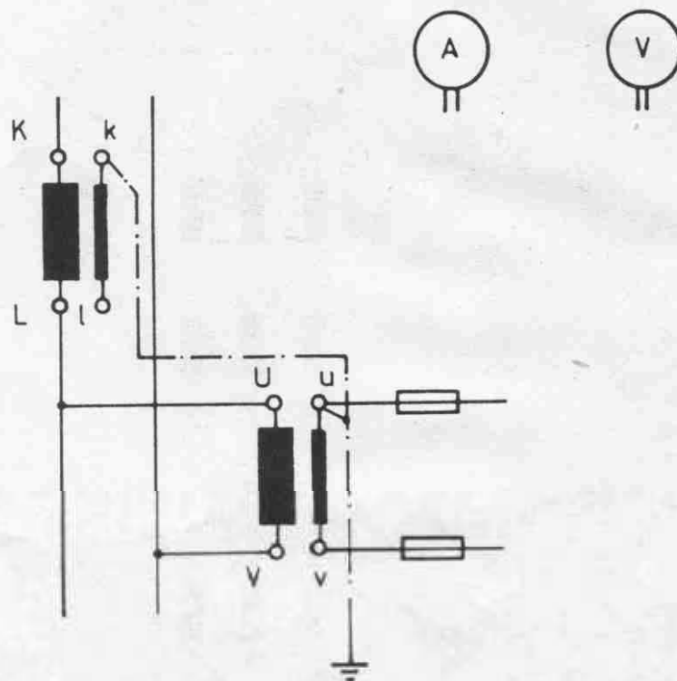
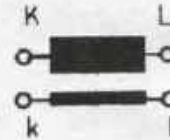
ELECTRICIAN
GENERAL

Instrument transformers are used to measure high voltages or big currents. Voltage transformers have a rated secondary value of 100 V, current transformers have a secondary value of 5 A. Note the necessary earth connections.

Voltage transformer



Current transformer



Complete the missing connections from the instrument transformers to the measuring instruments.

INSTRUMENT TRANSFORMER

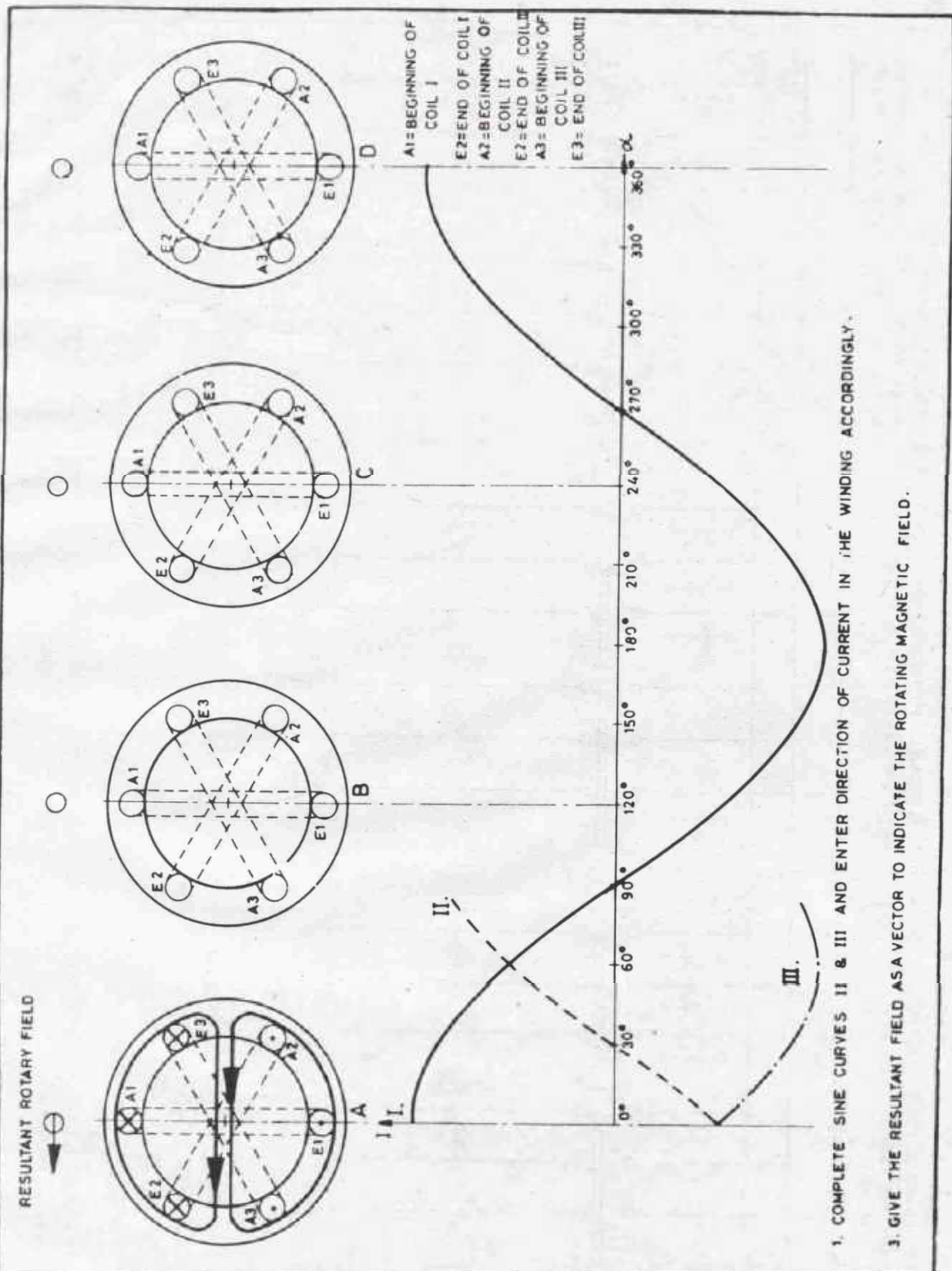
TECHNICAL DRG.
No. 119



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL



ROTARY MAGNETIC FIELD
ONE POLE PAIR

TECHNICAL DRG.
No. 120

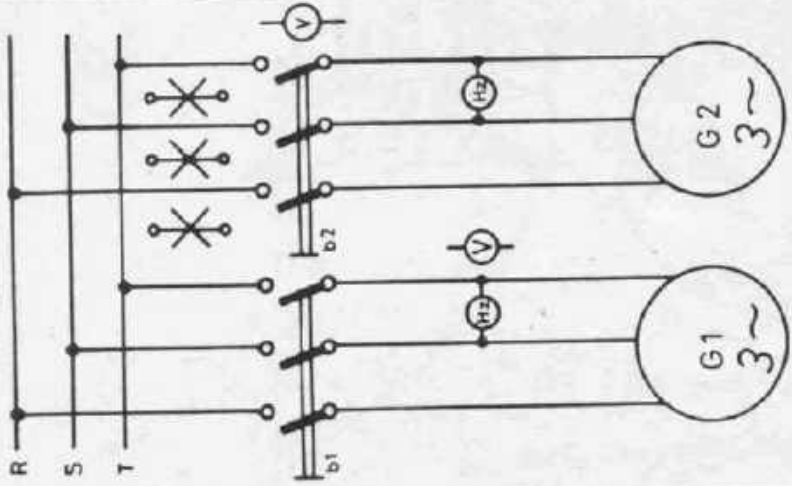


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

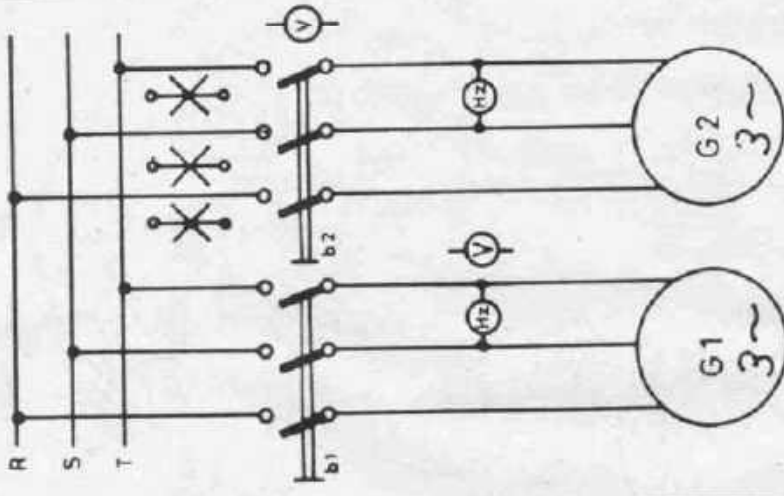
ELECTRICIAN
GENERAL

SYNCHRONISED POSITION OF G1 AND G2.
WHEN THE ROTATING ON AND OFF IMPRESSION
OF THE LAMPS STOPS AND REMAINS CONSTANT



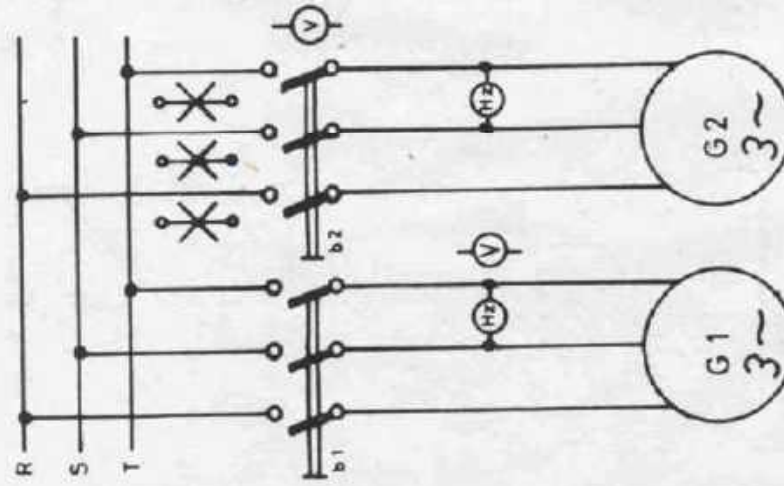
COMPLETE THE CONNECTIONS OF G2 FOR
ROTARY LAMP METHOD.

SYNCHRONISED POSITION OF G1 AND G2
WHEN THE LAMPS REMAIN BRIGHT.



COMPLETE THE CONNECTIONS OF G2 FOR
BRIGHT LAMP METHOD.

SYNCHRONISED POSITION OF G1 AND G2
WHEN THE LAMPS REMAIN DARK.



COMPLETE THE CONNECTIONS OF G2 FOR
DARK LAMP METHOD.

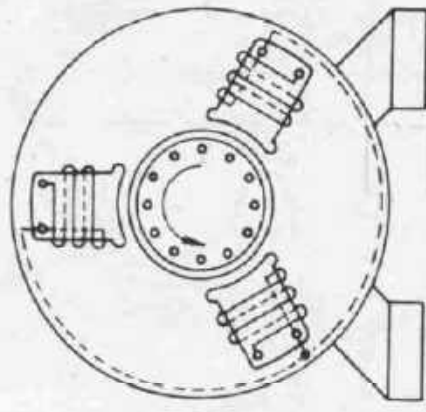
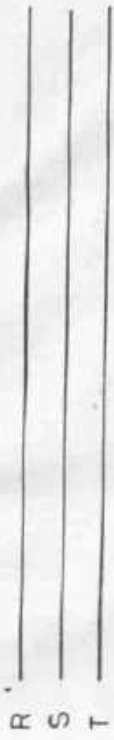
SYNCHRONISING OF ALTERNATORS

TECHNICA DRG.
No. 121

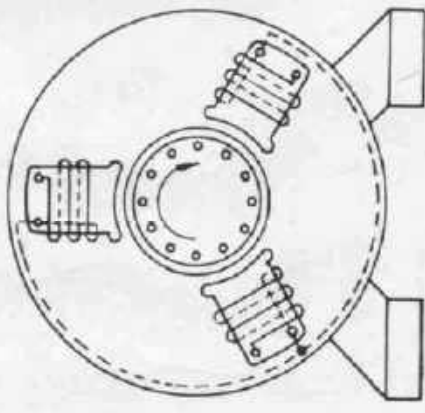
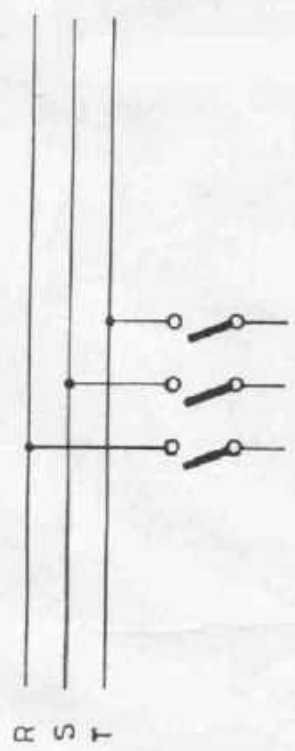


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL



COMPLETE THE CONNECTION OF INDUCTION MOTOR FOR
ANTICLOCKWISE ROTATION



COMPLETE THE CONNECTION OF INDUCTION MOTOR FOR
CLOCKWISE ROTATION

INDUCTION MOTOR
DIRECTION OF ROTATION

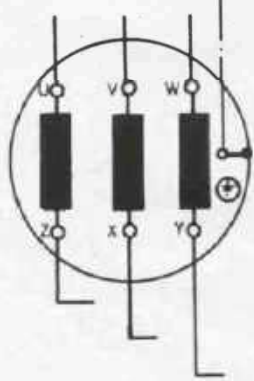
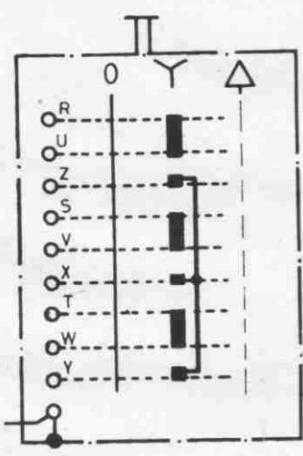
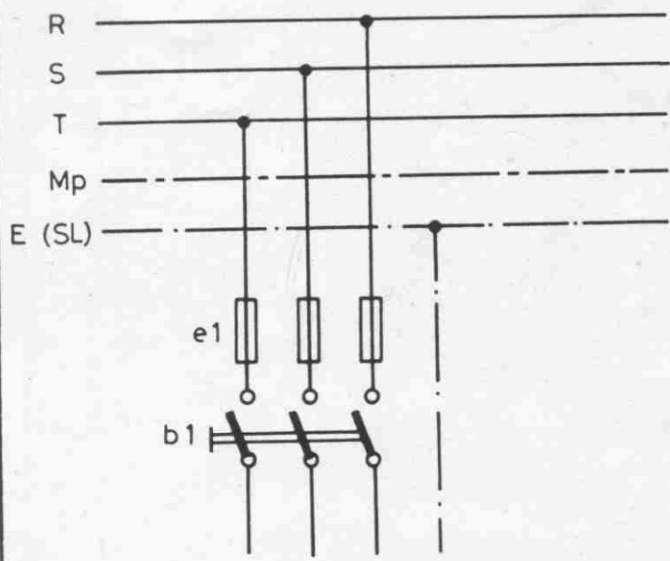
TECHNICAL DRG.
No. 122



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL



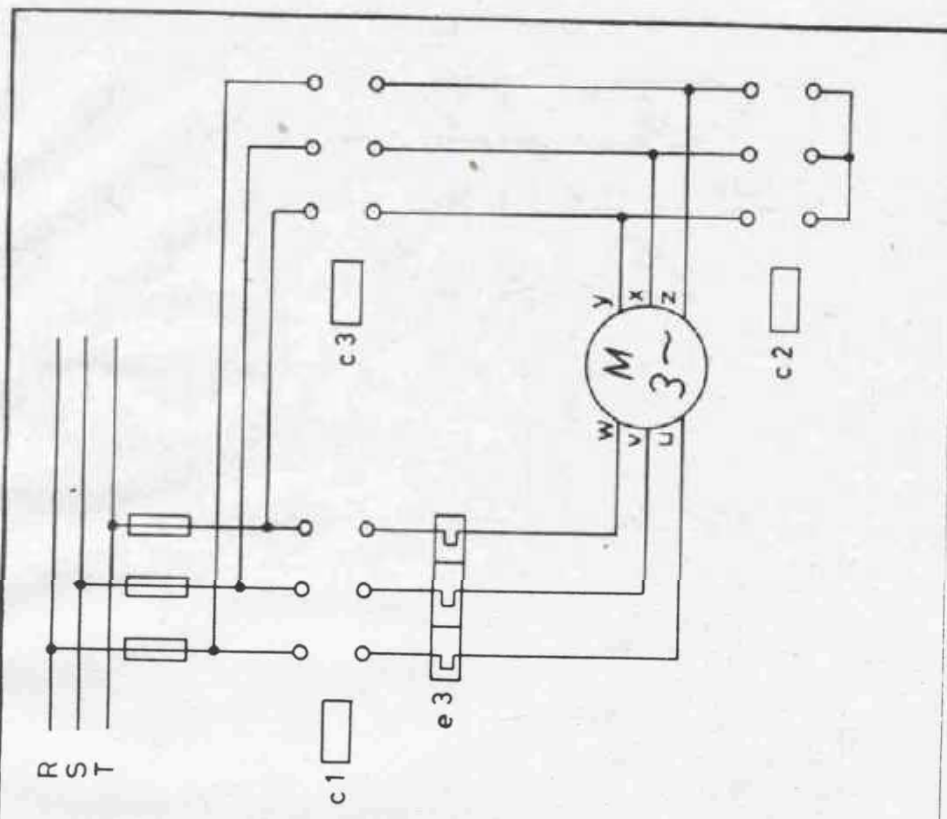
IN SWITCH POSITION Y THE FOLLOWING CONNECTIONS ARE MADE.

R → U
 S → V
 T → W
 Z → X → Y

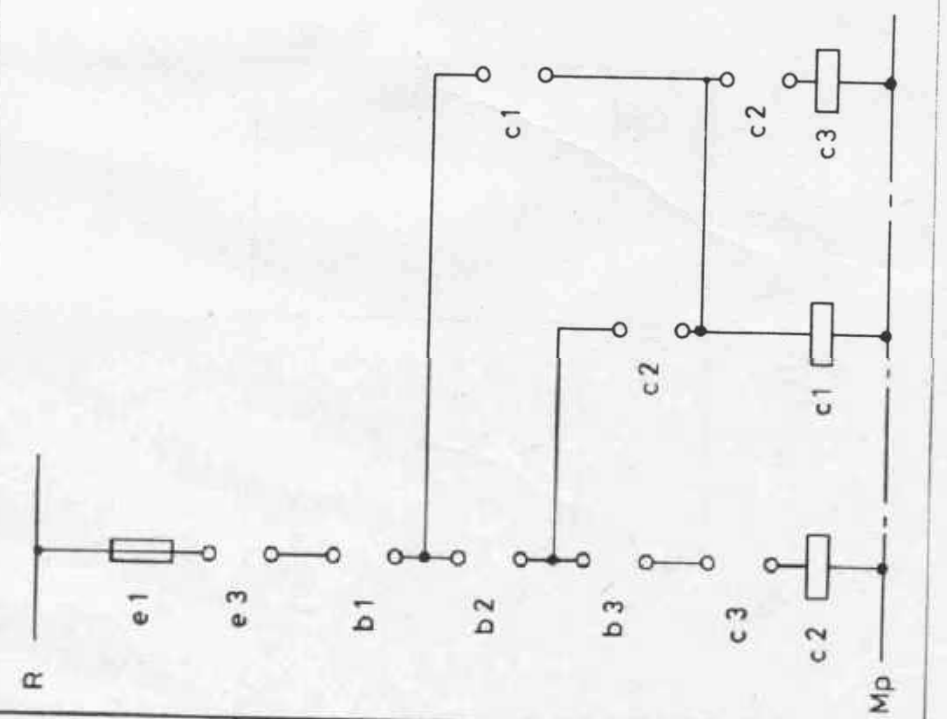
DRAW THE SWITCH POSITION FOR Δ CONNECTION AND COMPLETE THE EXTERNAL WIRING.

STARTING CONNECTION —YΔ-START — DRUM SWITCH —		TECHNICAL DRG. No. 123
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING PAK-GERMAN TECHNICAL TRAINING PROGRAMME		ELECTRICIAN GENERAL





COMPLETE THE POWER CIRCUIT DIAGRAM 3 ~ MOTOR / AFTER b2 HAS BEEN PRESSED AND RELEASED



COMPLETE THE CURRENT PATH DIAGRAM OF 3 ~ MOTOR CONTROL CIRCUIT AFTER / b2 HAS BEEN PRESSED AND RELEASED

WITH EXERCISE SHEET NO 18A, 18C

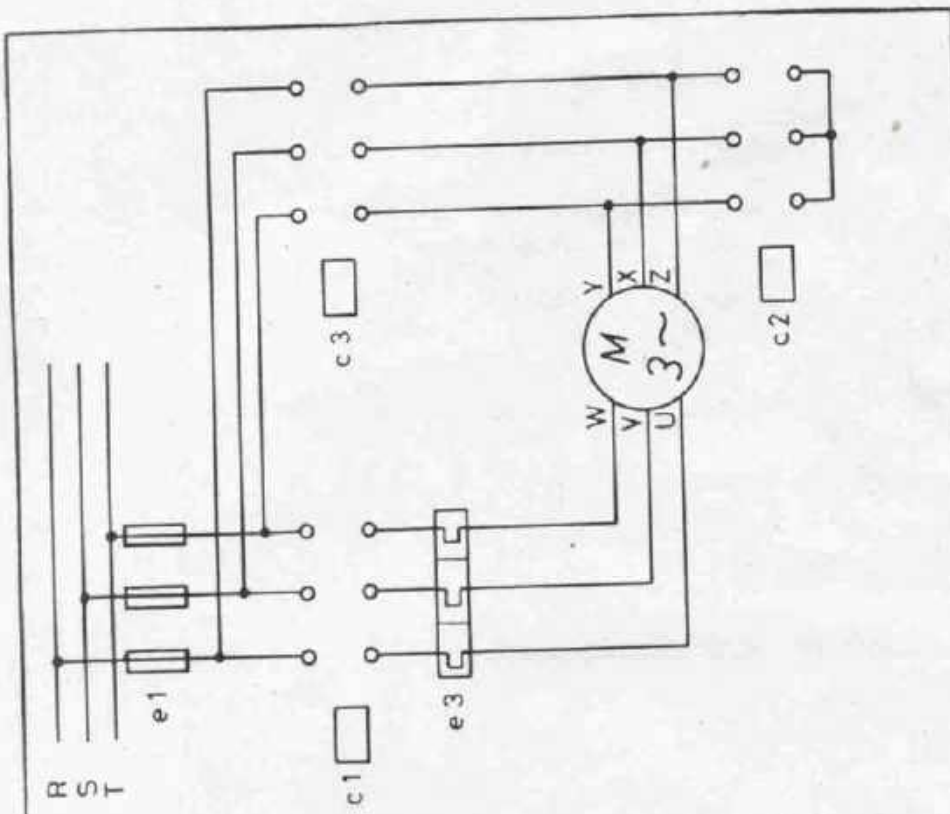
STARTING CONNECTION - YΔ-START-CONTACTOR

TECHNICAL DRG. No. 124

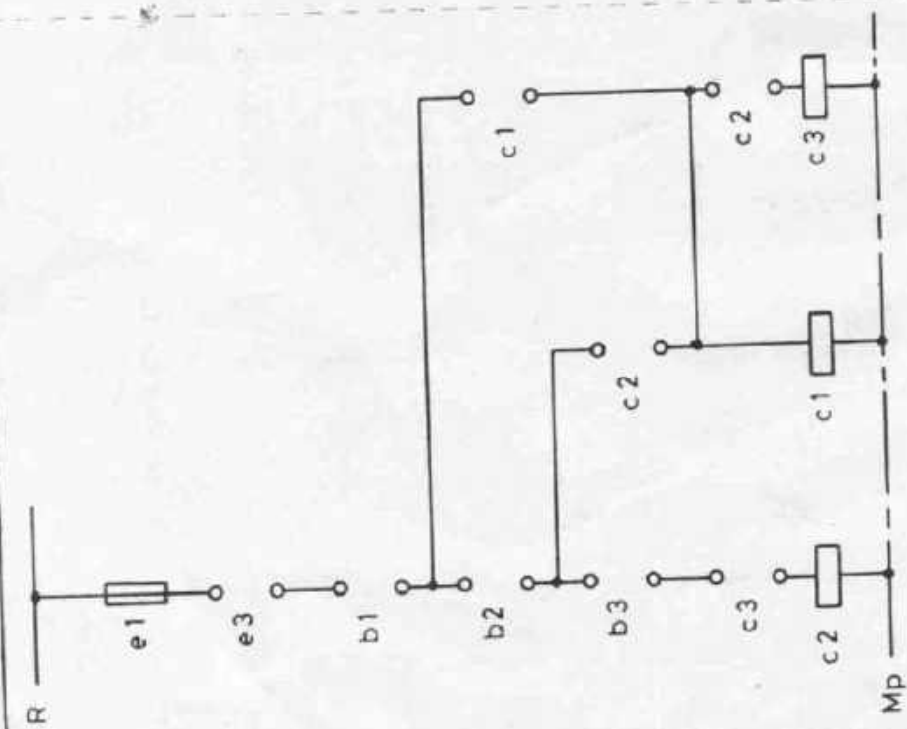


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN GENERAL



COMPLETE THE POWER CIRCUIT DIAGRAM / AFTER b3 HAS BEEN PRESSED AND RELEASED



COMPLETE THE CURRENT PATH DIAGRAM OF 3 ~ MOTOR CONTROL CIRCUIT / AFTER b3 HAS BEEN PRESSED AND RELEASED

WITH EXERCISE SHEETS NO 18A/18B

STARTING CONNECTION
- YΔ-START-CONTACTOR

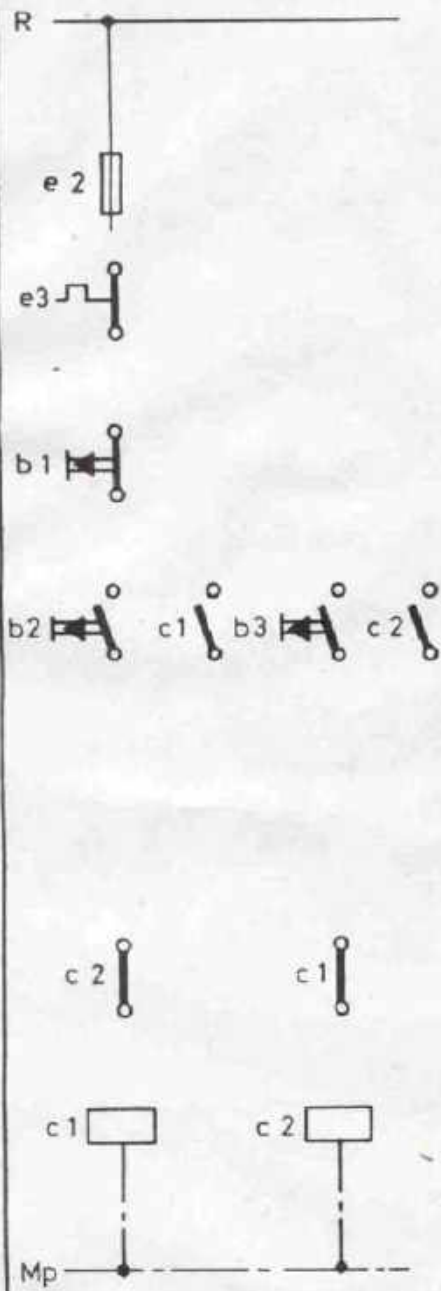
TECHNICAL DRG. No. 125



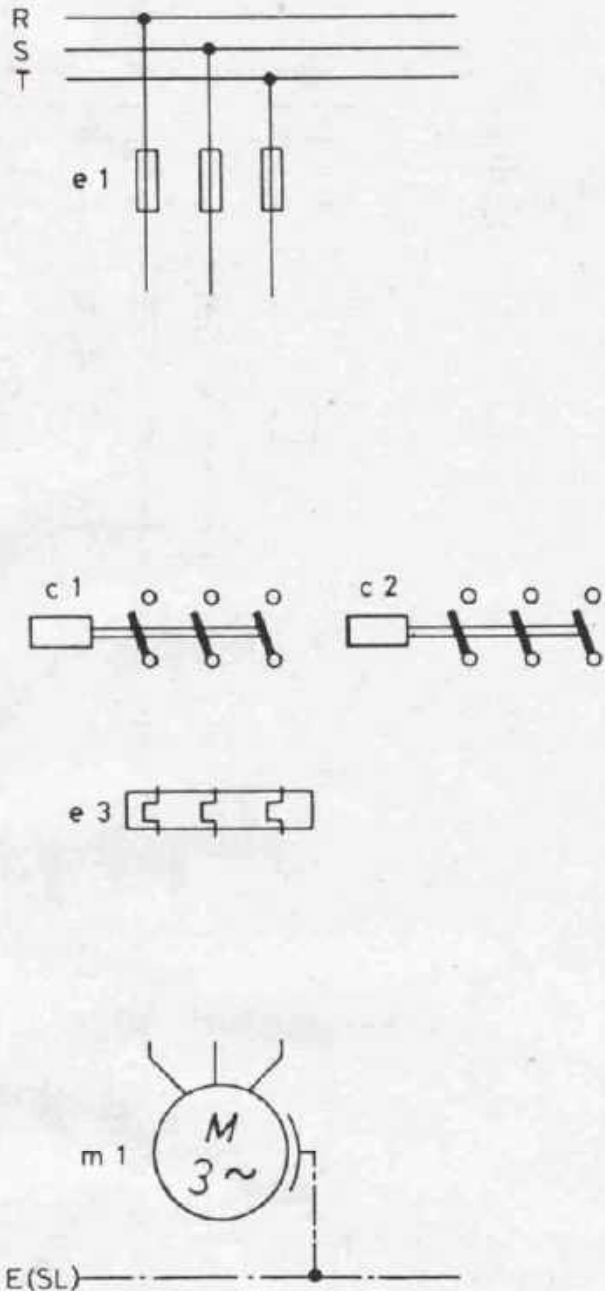
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN GENERAL



COMPLETE THE DIAGRAM OF THE CONTROL CIRCUIT



COMPLETE THE DIAGRAM OF THE POWER CIRCUIT FOR REVERSE CONNECTION BY CONTACTORS

REVERSE CONNECTION BY CONTACTORS

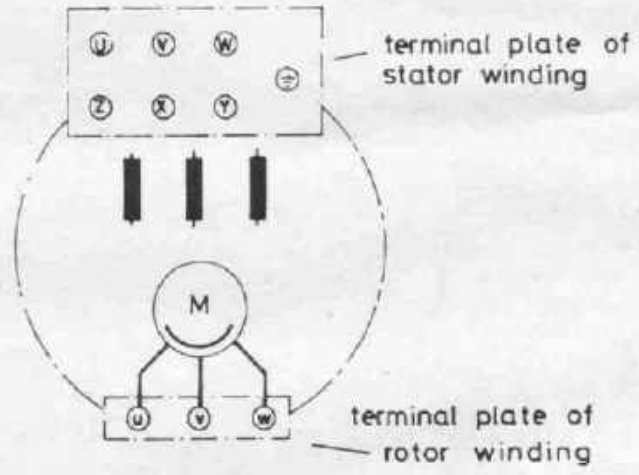
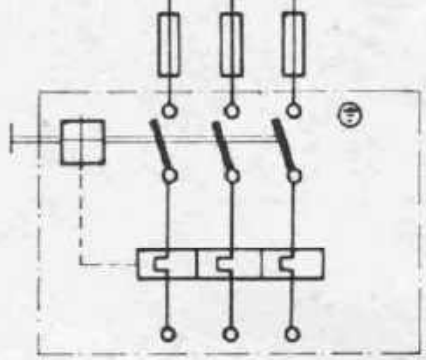
TECHNICAL DRG. No. 126



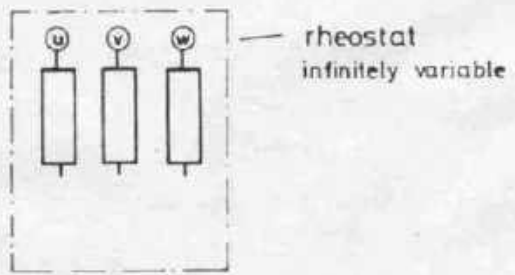
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN GENERAL



COMPLETE THE INTERNAL & EXTERNAL CONNECTIONS OF THE SLIPRING MOTOR WITH STARTING DEVICE. STATOR WINDING IN DELTA CONNECTION.



SLIPRING MOTOR
with STARTING RHEOSTAT

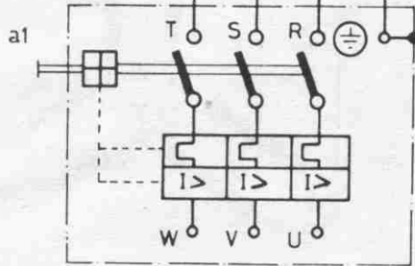
TECHNICAL DRG.
No. 127



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

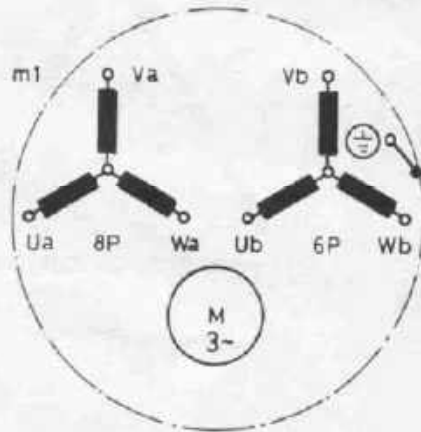
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL



a2

	0	1	2
○ Ua			
○ R			
○ Ub			
○ Va			
○ S			
○ Vb			
○ Wa			
○ T			
○ Wb			
○ ⊕			



Draw the internal connections of the drum switch and complete the external motor connections so that motor works.

- 1) With lower speed
- 2) With higher speed

TWO SPEED INDUCTION MOTOR
TWO SEPERATE STATOR WINDINGS

TECHNICAL DRG.
No. 128

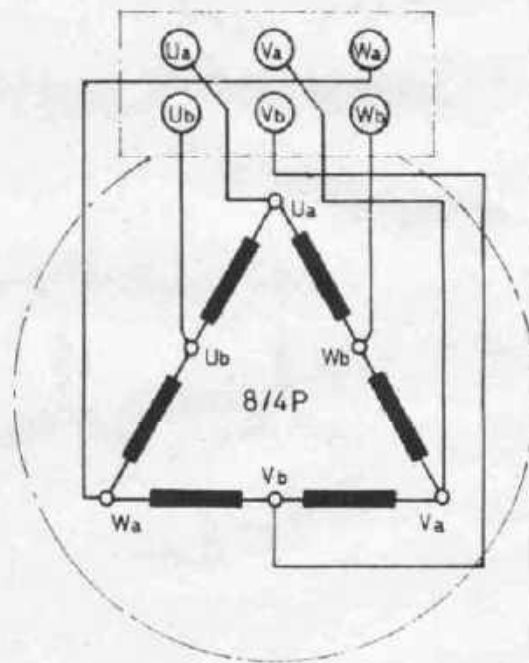
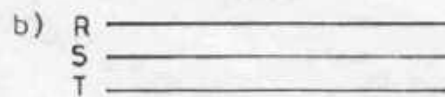
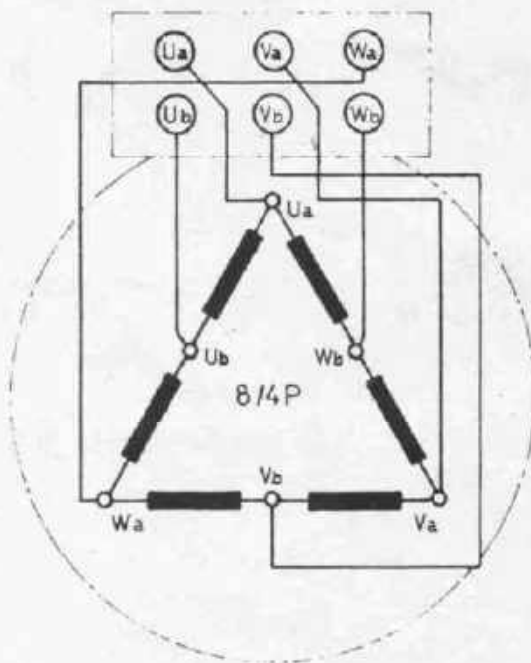
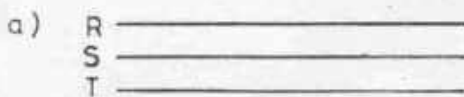
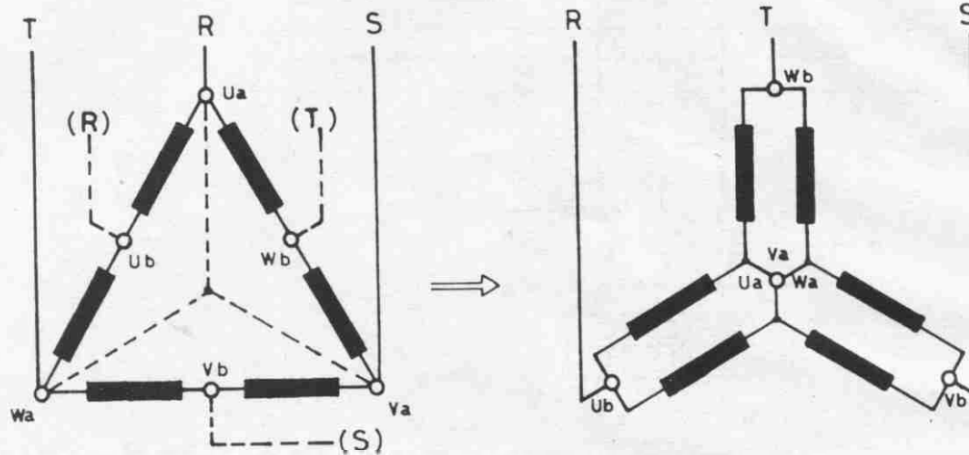


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

This method can be applied if the ratio of number of revolutions is $1 \div 2$



Discuss the development of delta—star—star connection.
Complete the connections to power supply so that motor works
a) With lower speed b) With higher speed

TWO SPEED INDUCTION MOTOR

Δ -Y-Y STATOR CONNECTION

TECHNICAL DRG.

No. 129



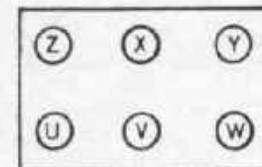
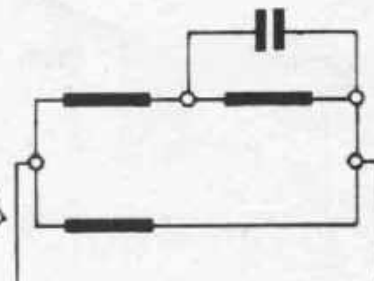
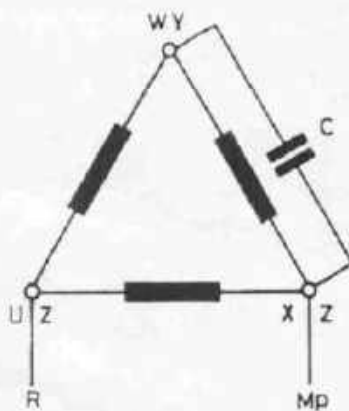
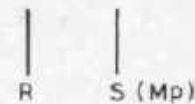
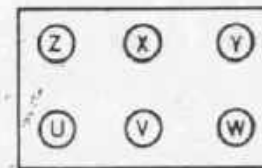
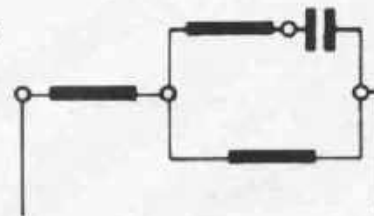
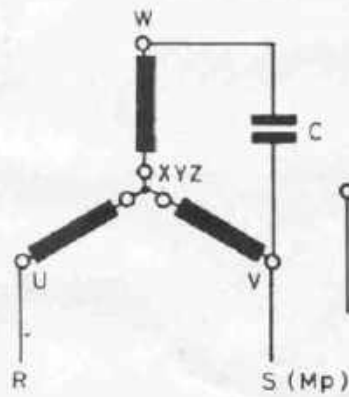
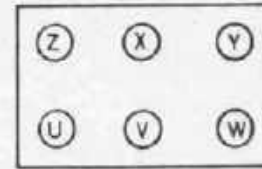
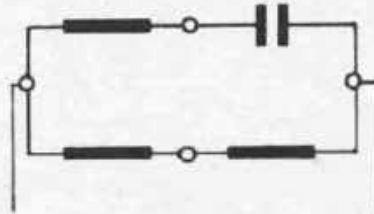
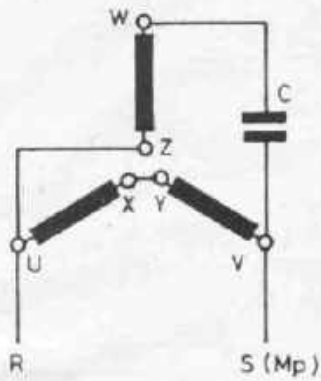
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

Complete the connections to terminals and add the condenser

Capacity $80 \mu\text{F}/\text{KW}$



3 ~ INDUCTION MOTOR
AT SINGLE PHASE

TECHNICAL DRG.
No. 130

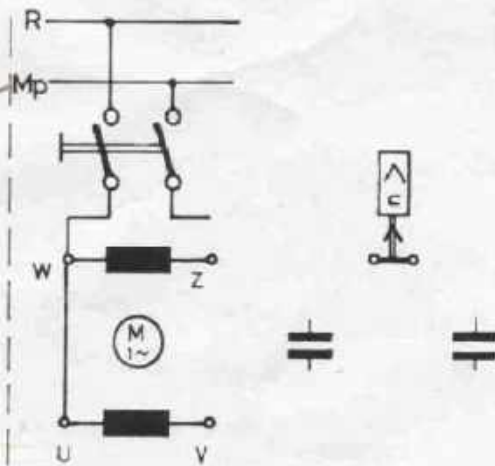
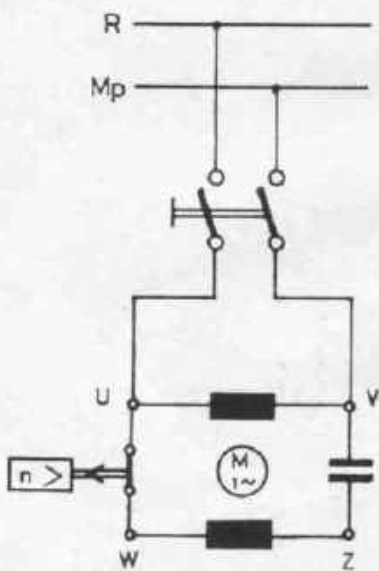
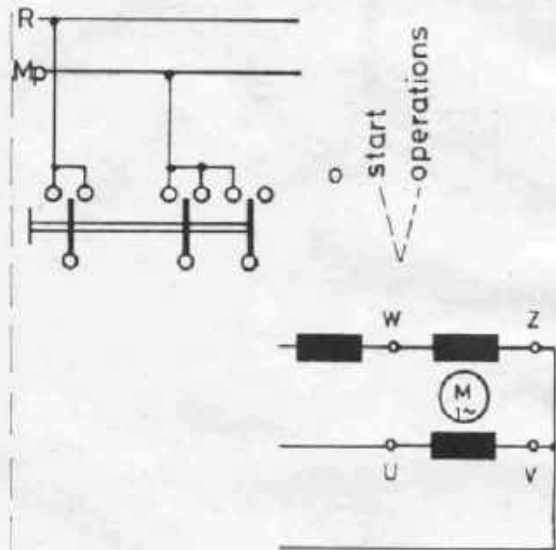
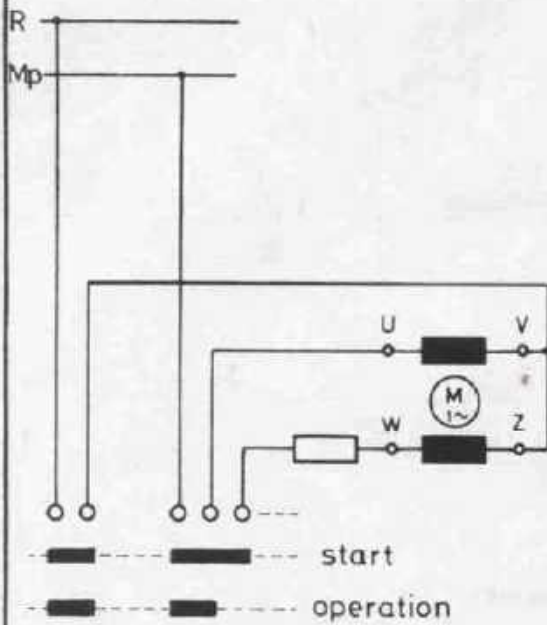


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PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

The auxiliary winding W-Z is used for starting purpose and will be disconnected partly or completely during operation. Complete the connections.



SINGLE PHASE MOTOR
AUXILIARY WINDING

TECHNICAL DRG.
No. 131



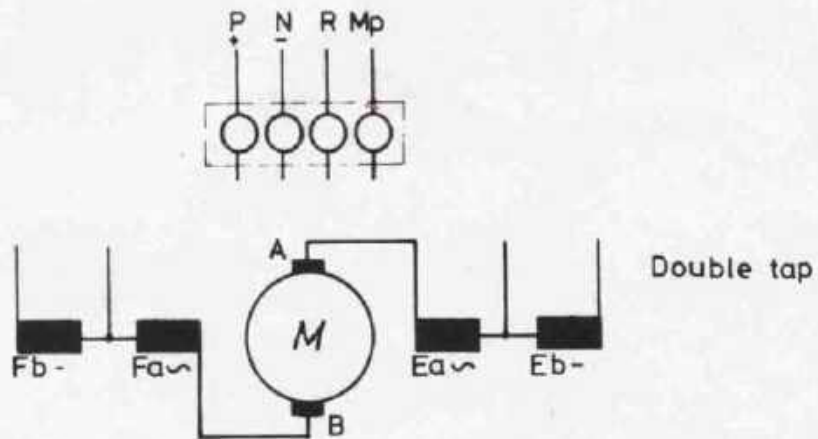
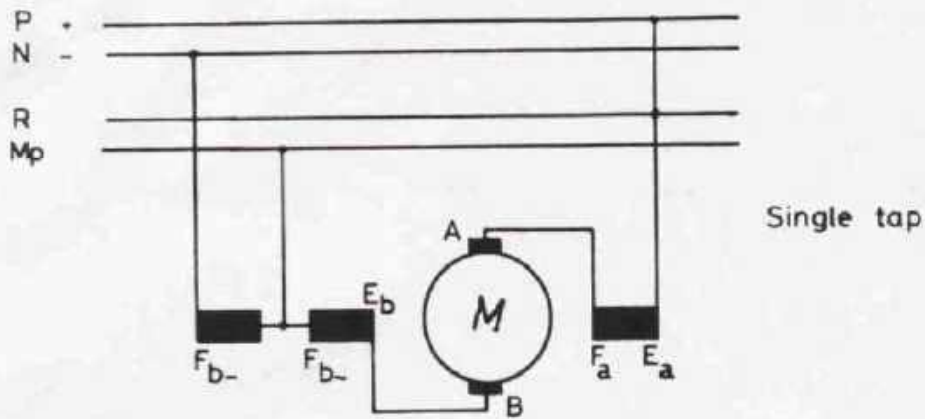
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PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

Universal motors are series wound motors and can be connected to DC and AC supply. The stator winding is tapped to equalize DC and AC power.

Connection diagram



Complete the internal connections of the double tapped series winding

UNIVERSAL MOTOR

TECHNICAL DRG.
No. 132

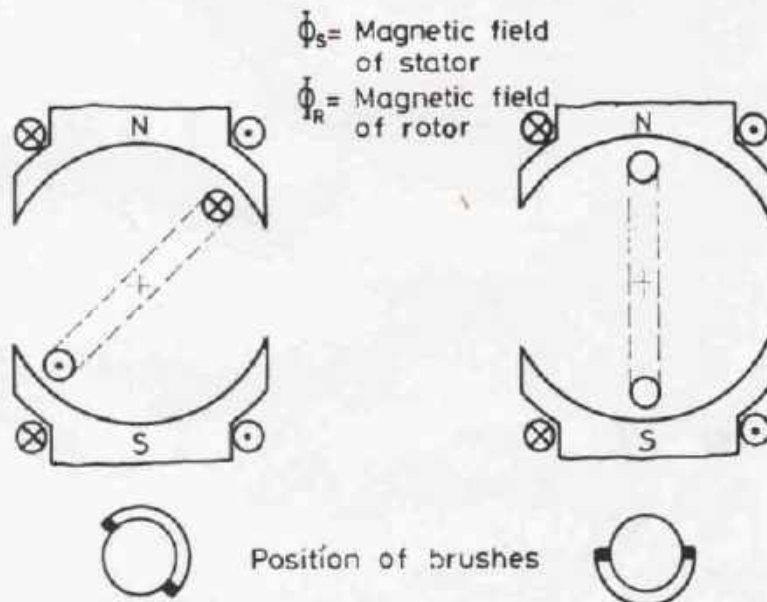
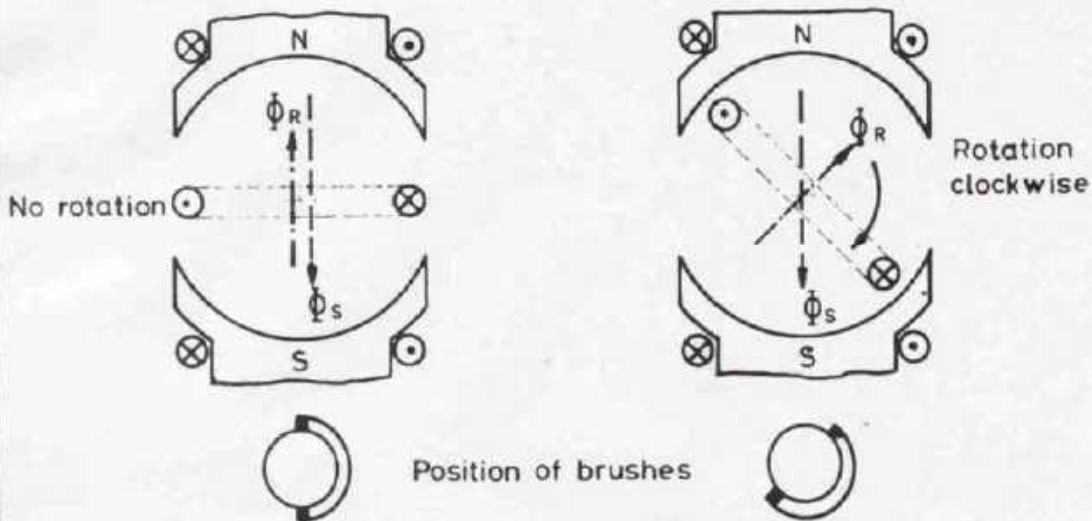


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PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

A repulsion motor has a stator winding like induction motors and an armature winding with commutator like DC-motors. However the brushes are shorted to each other and can be shifted to reverse the direction of rotation.



REPULSION MOTOR

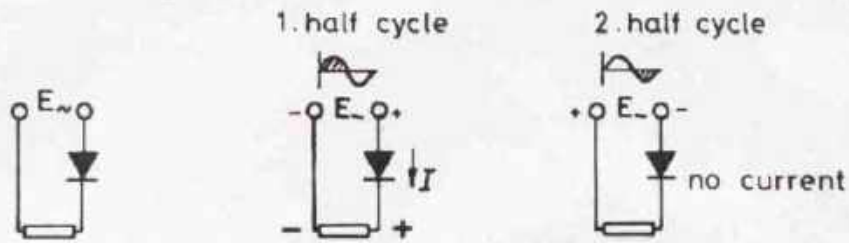
TECHNICAL DRG.
No. 133



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

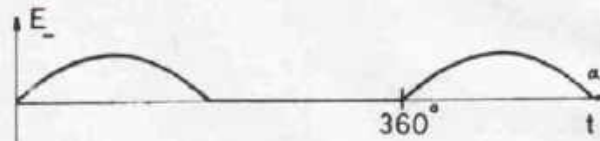
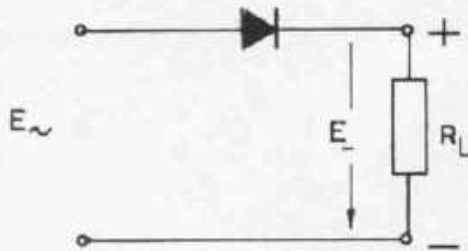
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ELECTRICIAN
GENERAL



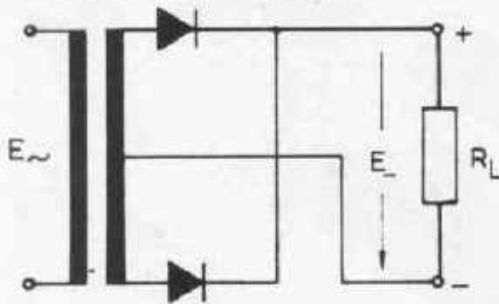
Draw the characteristic line diagrams for the following rectifier connections:

half wave rectifier



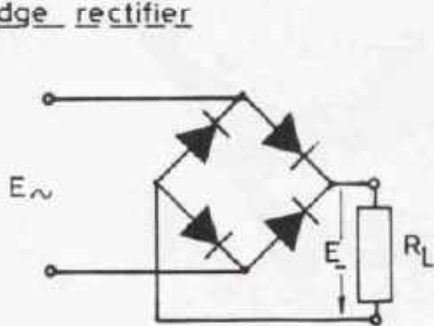
$$E_{-} = \frac{E_{\sim}}{2.22} = 0.45 E_{\sim}$$

full wave rectifier



$$E_{-} = \frac{E_{\sim}}{1.11} = 0.9 E_{\sim}$$

bridge rectifier



$$E_{-} = \frac{E_{\sim}}{1.11} = 0.9 E_{\sim}$$

RECTIFIER CONNECTION

TECHNICAL DRG.
No. 134

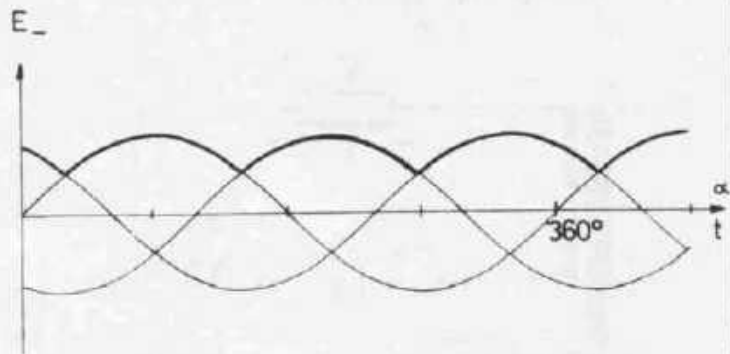
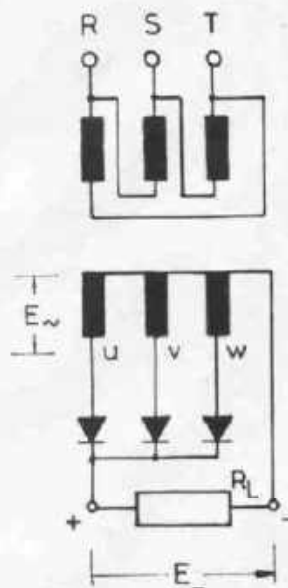


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

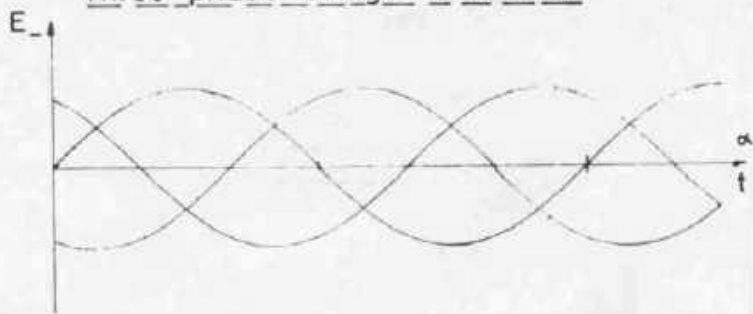
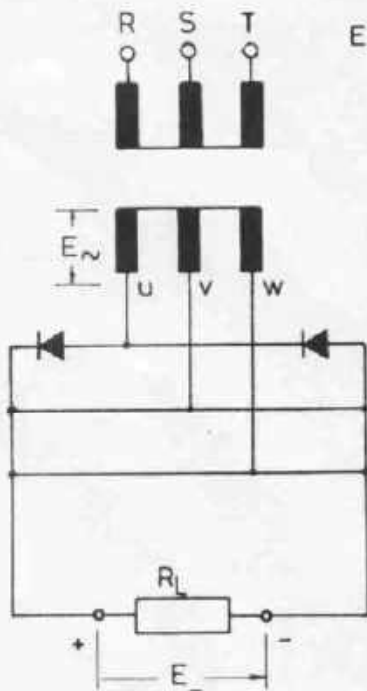
ELECTRICIAN
GENERAL

star connection



$$E_- = 1.17 E_{\sim}$$

Three phase bridge connection



$$E_- = 2.34 E_{\sim}$$

Draw the missing diodes in the connection diagram and the voltage characteristic E_- in the line diagram

THREE PHASE RECTIFIER

TECHNICAL DRG.
No. 135

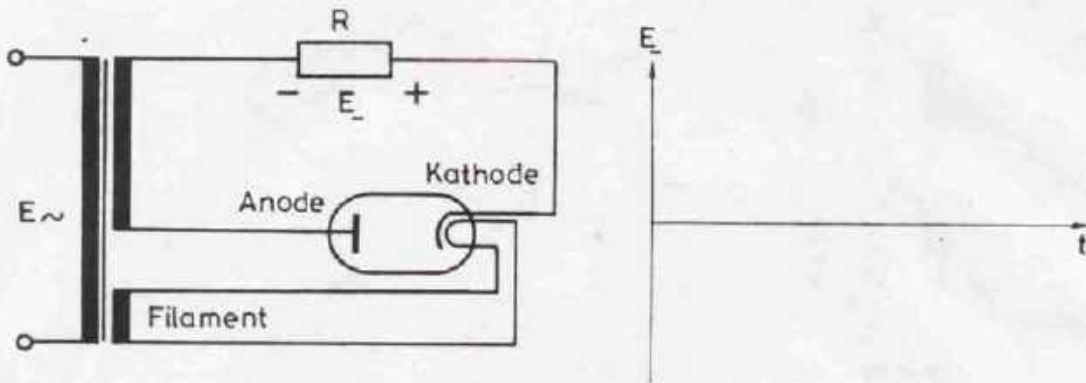


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

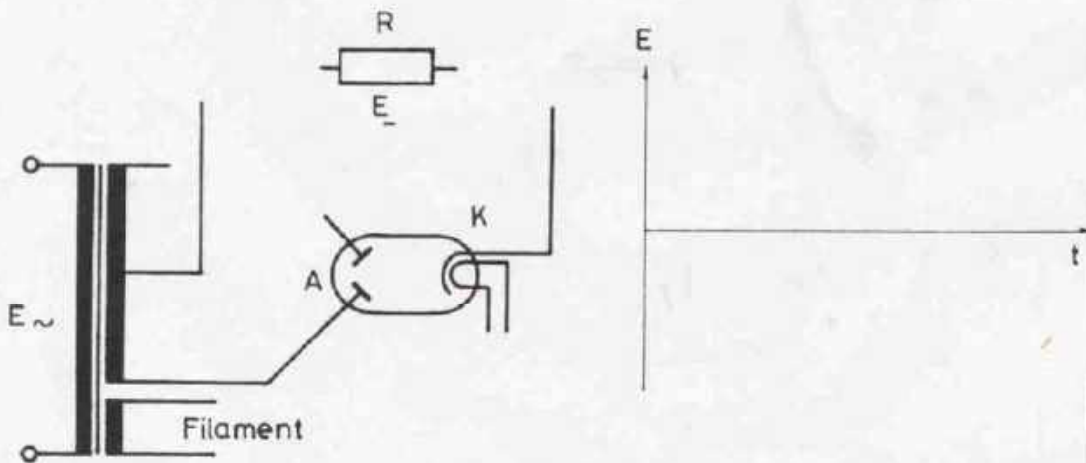
PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

Half wave rectifier



Full wave rectifier



Draw the characteristics of the rectifier voltages $E_$ and complete the connections of the full wave rectifier

VALVE RECTIFIER

TECHNICAL DRG.
No. 136

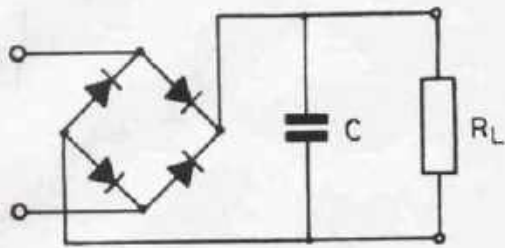


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAX-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

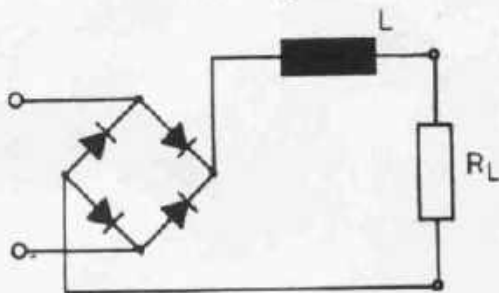
In many cases the pulsating direct current has to be smoothed. This can be done by condensers and chokes



Smoothing condenser

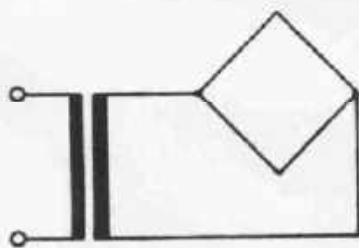
The smoothing effect of the condenser improves with increasing capacitance C and decreasing load R_L

smoothing choke



The smoothing effect of the choke improves with increasing inductance L and increasing load R_L .

bridge rectifier



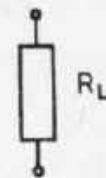
filter capacitor



choke



smoothing condenser



Draw the rectifier and filter circuit.

RECTIFIER
with smoothing components

TECHNICAL DRG.
No. 137

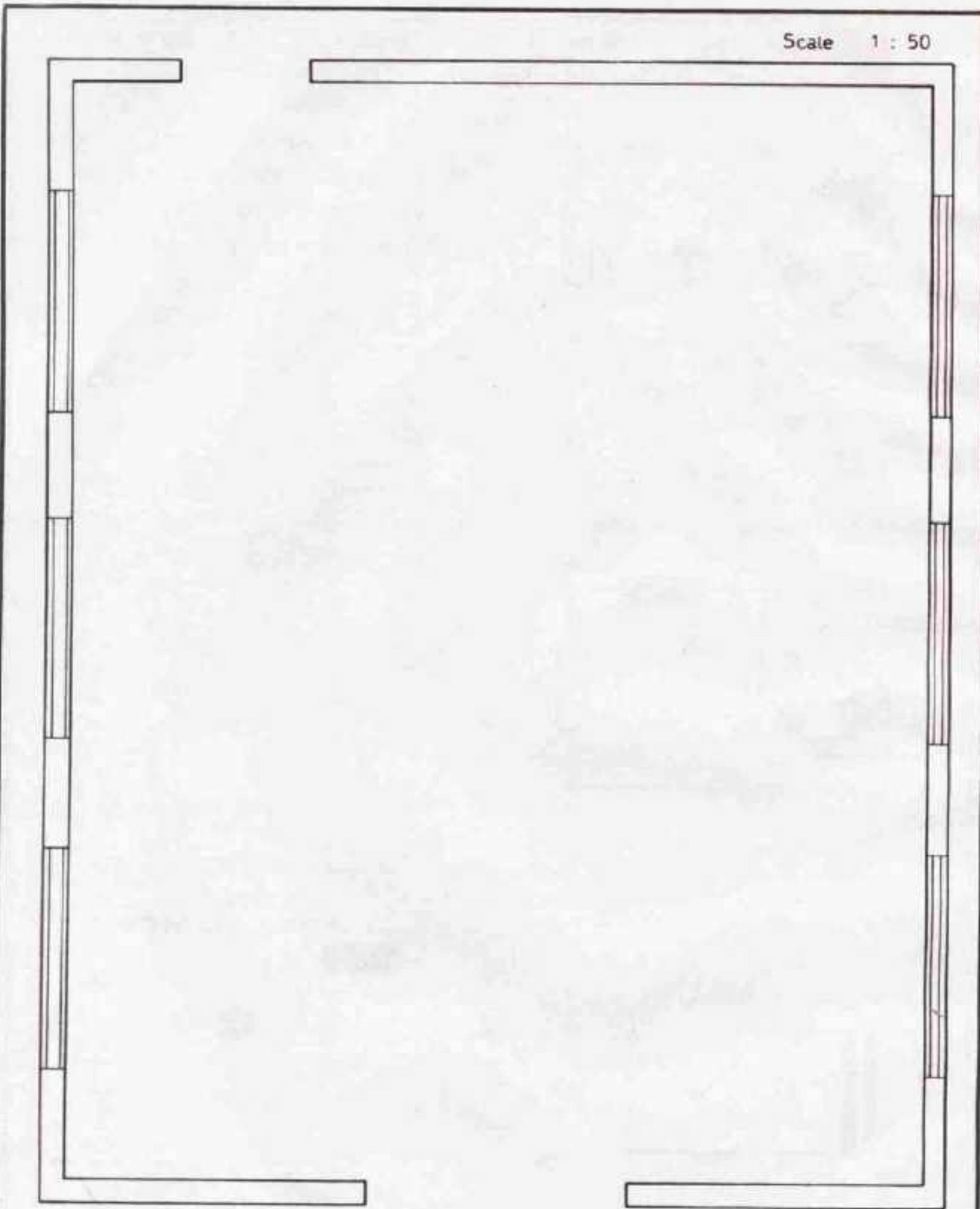


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

Scale 1 : 50



Draw into the above workshop plan the lighting layout with fluorescent lamps. Use 40 W-tubes and provide an average of 10 W per m² shop area. The switchboard is to be located at the main entrance.

LIGHTING LAYOUT

TECHNICAL DRG.
No. 138



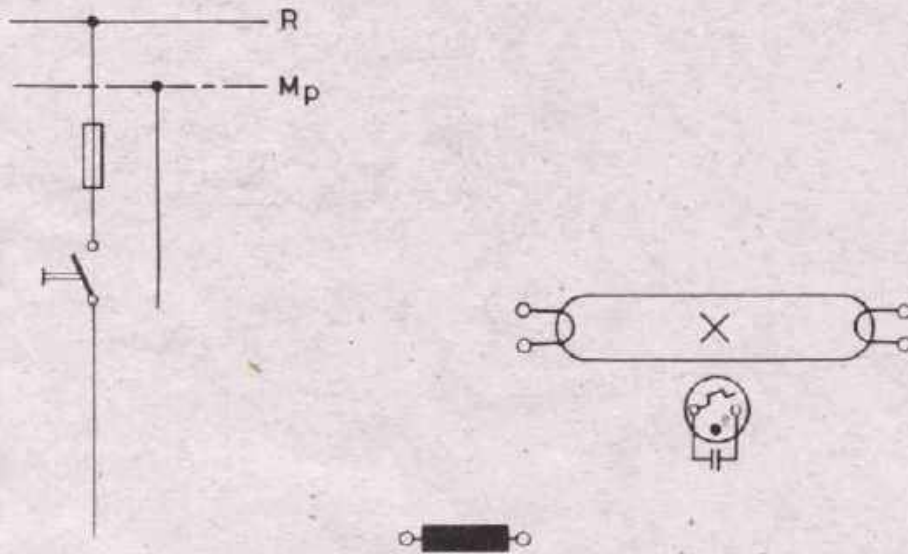
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

Complete the wiring diagram of the fluorescent lamp adding ammeters and voltmeters for the following measurements :

- 1) Total current consumption
- 2) Current of the starter
- 3) Total voltage supply
- 4) Voltage across the choke
- 5) Voltage across the tube
- 6) Voltage across one heating coil



FLUORESCENT LAMP
MEASURING CONNECTION

TECHNICAL DRG.
No. 139

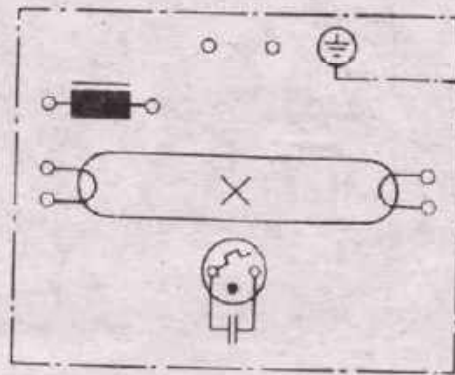
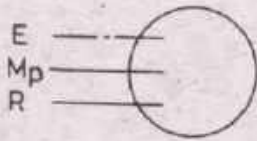


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

Complete the wiring and current path diagram according to the given layout diagram.



FLUORESCENT LAMP
SINGLE POLE SWITCH

TECHNICAL DRG
No. 140



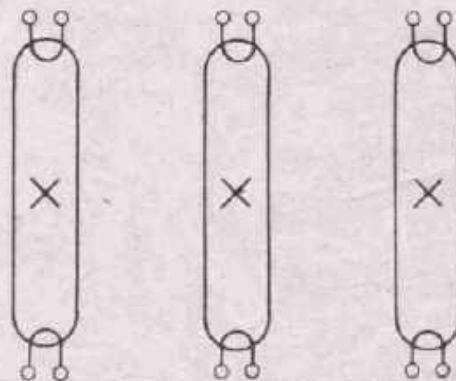
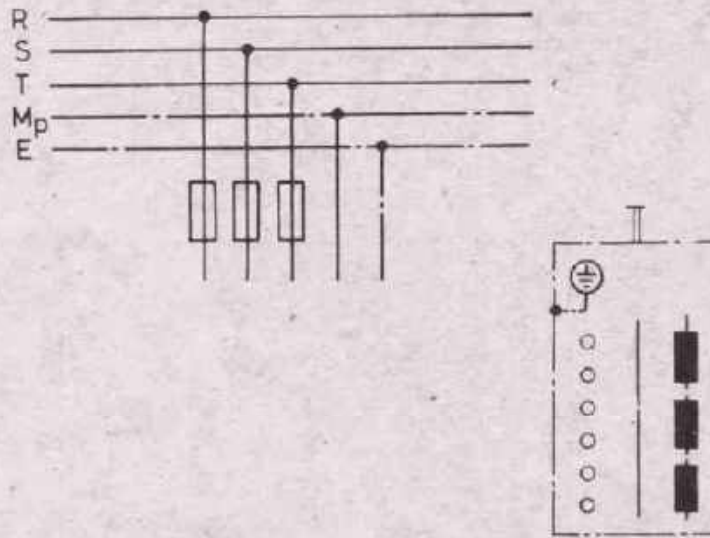
DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

ELECTRICIAN
GENERAL

Three fluorescent lamps are to be connected by a three-pole switch to a three-phase supply.

Complete the wiring diagram.



**FLUORESCENT LAMPS
ON THREE PHASE SUPPLY**

TECHNICAL DRG.
No. 141

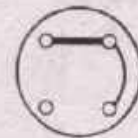
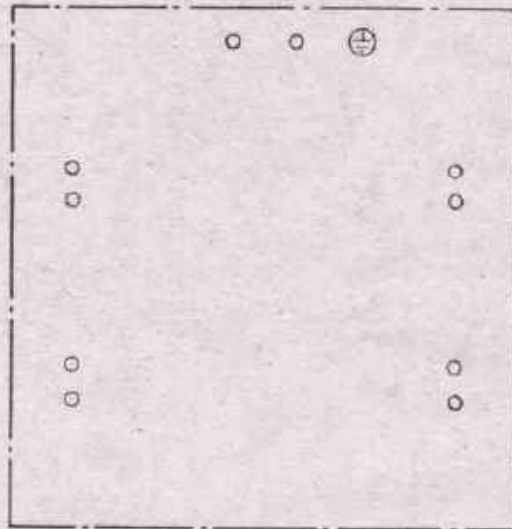
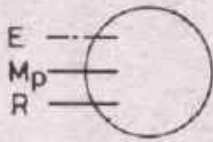


DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

**ELECTRICIAN
GENERAL**

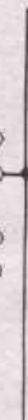
Complete the wiring and current path diagram of two fluorescent lamps in lead-lag connection to be operated by two-way switches.



R



Mp



**FLUORESCENT LAMPS
LEAD-LAG CONNECTION**

TECHNICAL DRG
No. 142



DEVELOPMENT CELL FOR SKILLED LABOUR TRAINING

PAK-GERMAN TECHNICAL TRAINING PROGRAMME

**ELECTRICIAN
GENERAL**

