

CHAPTER 14

MOTOR CONNECTION DIAGRAMS

- 1 — THREE-PHASE MOTORS
- 2 — SINGLE-PHASE MOTORS
- 3 — FRACTIONAL H.P. MOTORS

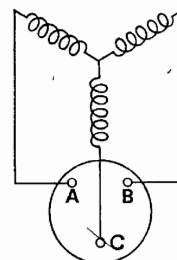
Connections for all standard Brook motors and control gear are given on the following pages.

A fully detailed connection diagram is sent out with every starter, and an internal wiring diagram with every motor.

Two- and Three-phase Brook motors can be used with any make of starter and Brook starters with any make of motor, but we advise that they be ordered together so that they can be tested at the same time.

Single-phase motors and starters are only offered as one unit as these must be tested together. This does not apply to certain self-starting types of motor.

THREE-PHASE MOTORS



TERMINALS

A, B, C connected to supply.

REVERSAL

Exchange one pair of supply lines.

DIRECT

TERMINALS

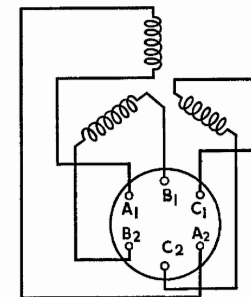
All connected to 'Star-Delta' starter for normal duty.

DIRECT STARTING

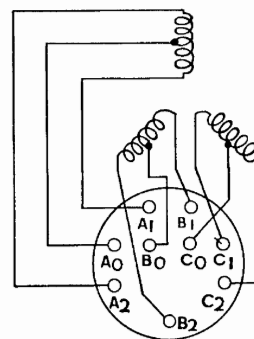
A_1-B_2 , B_1-C_2 , C_1-A_2 are linked and supply connected to A_2 B_2 C_2 .

REVERSAL

Exchange one pair of the supply lines.



STAR-DELTA



TERMINALS

All connected to 'Series-Delta' (ZDD) starter for Series-Delta starting.

DIRECT STARTING

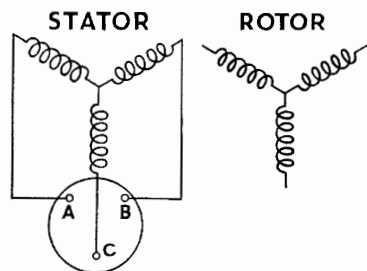
A_1-B_2 , B_1-C_2 and C_1-A_2 are linked. Mains connected to A_2 B_2 C_2 .

REVERSAL

Exchange one pair of the supply lines.

SERIES-DELTA

THREE-PHASE MOTORS



SLIP RING

STATOR TERMINALS
A, B, C connected to supply.

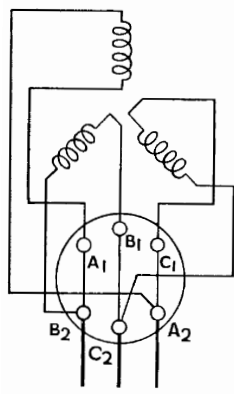
ROTOR TERMINALS
Connected to resistance during starting and then short circuited.

REVERSAL
Exchange one pair of supply lines.

DUAL VOLTAGE (DELTA-STAR)

TERMINALS — LOW VOLTAGE. Link A_1-B_2 , B_1-C_2 , C_1-A_2 .
Line connected to B_2 , C_2 , A_2 .

HIGH VOLTAGE. Link $A_1-B_1-C_1$. Line connected to B_2 , C_2 , A_2 .

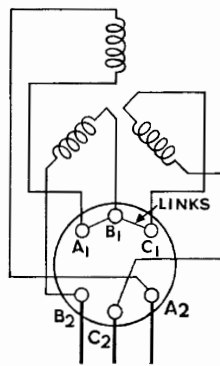


LINE

LOW VOLTAGE

Alternatively on low voltage, a standard 'Star-Delta' starter may be used. On high voltage only direct-on-line starting is possible.

REVERSAL
To reverse direction of rotation, exchange one pair of supply lines.



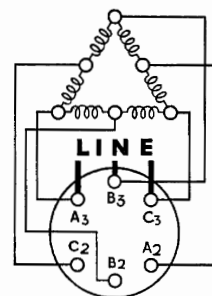
LINE

HIGH VOLTAGE

THREE-PHASE MOTORS

TWO SPEED (POLE CHANGE)

TERMINALS — LOW SPEED. Line connected to A_3 , B_3 , C_3 .
HIGH SPEED. Line connected to C_2 , B_2 , A_2 , and terminals A_3 , B_3 , C_3 linked.

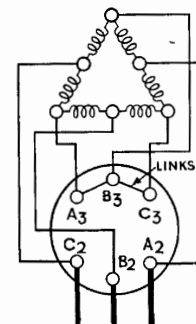


LOW SPEED

REVERSAL

To reverse direction of rotation of both speeds, exchange one pair of supply lines.

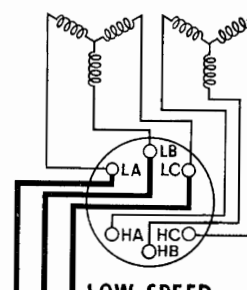
To reverse direction of one speed only, exchange two wires from the motor on to the terminal board, A_3 and B_3 for the low speed, C_2 and B_2 for the high speed.



LINE
HIGH SPEED

TWO SPEED (DUAL WOUND)

TERMINALS — LOW SPEED. Line connected to LA, LB, LC.
HIGH SPEED. Line connected to HA, HB, HC.

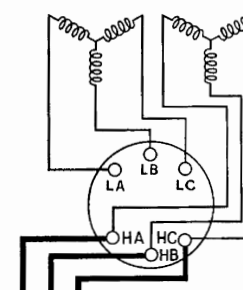


LINE
LOW SPEED

REVERSAL

To reverse direction of rotation of both speeds, exchange one pair of supply lines.

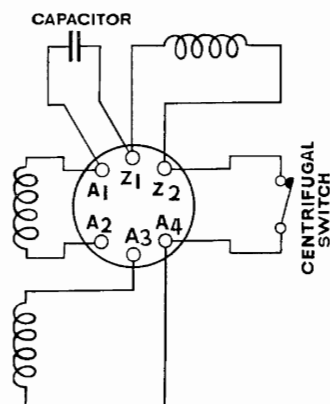
To reverse direction of one speed only, exchange any two wires coming from that winding on to the terminal board.



LINE
HIGH SPEED

SINGLE-PHASE MOTORS

SERIES PARALLEL, CAPACITOR START INDUCTION RUN — HC1 AND ZC2 TYPE STARTERS



TERMINALS

HC1 — A₁, A₂, A₃, A₄, Z₁ connected to starter.

ZC2 — A₁, A₂, A₃, A₄ connected to starter.

REVERSAL

Exchange position of two red leads from starting winding connected to Z₁ and Z₂.

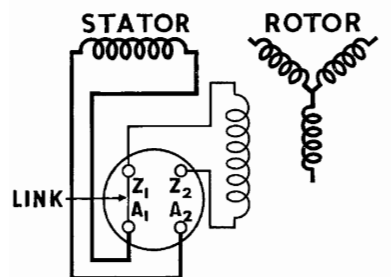
TERMINALS

A₁, A₂ connected to supply.
Z₂, A₂ connected to capacitor.

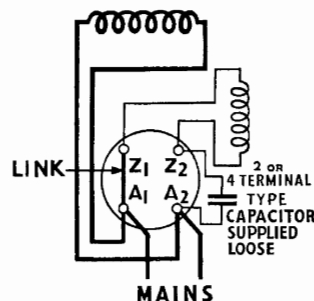
REVERSAL

Exchange position of two red leads from starting winding connected to Z₁ and Z₂.

Suitable for direct-on-the-line starting.



CAPACITOR SLIP RING



PERMANENT CAPACITOR START AND RUN

TERMINALS

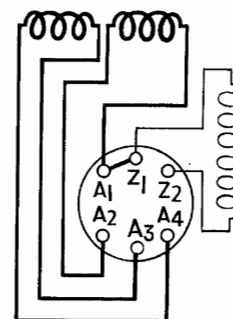
A₁, A₂, Z₂ connected to starter.

REVERSAL

Exchange position of two red leads from starting winding connected to Z₁ and Z₂.

This type uses capacitor slip ring starters in conjunction with continuously rated capacitors.

SINGLE-PHASE MOTORS



CAPACITOR LO-AMP-TORQUE

LO-AMP-TORQUE TERMINALS

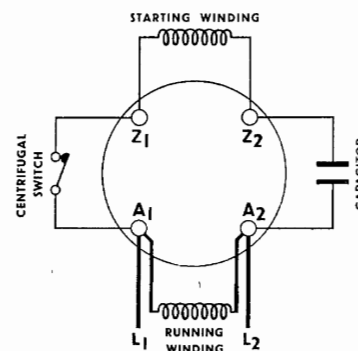
A₁, A₂, A₃, A₄, Z₂ connected to starter.

REVERSAL

Exchange position of two red leads from starting winding connected to Z₁ and Z₂.

This type uses special starters in conjunction with continuously rated capacitors.

SINGLE-PHASE, CAPACITOR START INDUCTION RUN, SELF-STARTING MOTORS



Centrifugal switch is connected internally between Z₁ and A₁.

This motor is completely wired internally and does not require any additional links.

This motor incorporates a centrifugal switch and is self-starting against full load torque.

The CAPACITOR is a two terminal electrolytic type mounted in a steel case on the side of the motor.

MAINS are connected to A₁ and A₂.

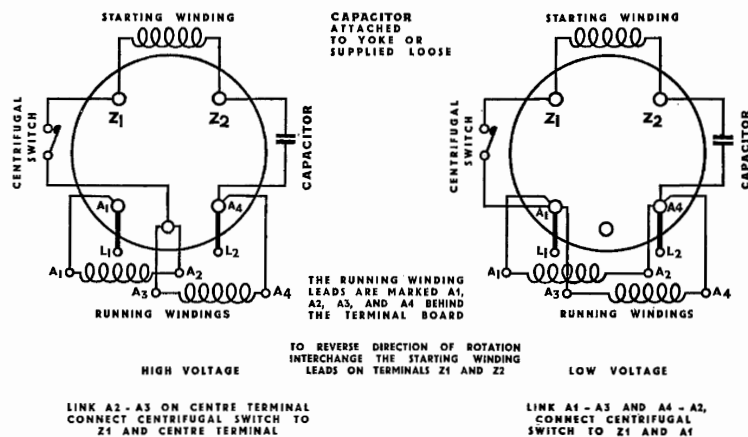
REVERSAL

Exchange position of two red leads from starting winding connected to Z₁ and Z₂.

DIRECTION

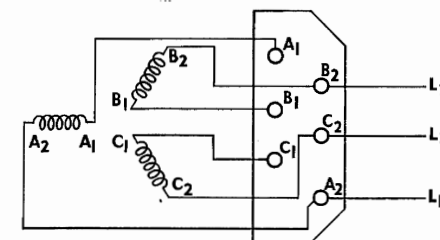
This motor is connected to run in a clockwise direction looking at the driving end.

CAPACITOR START INDUCTION RUN DUAL VOLTAGE MOTOR



THREE PHASE DELTA-STAR DUAL VOLTAGE MOTOR

To reverse direction of rotation interchange lines L_1 and L_2 .



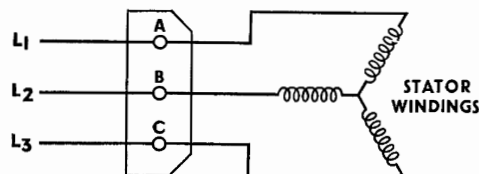
Voltage	Line connections	Link together
	$L_1 \ L_2 \ L_1$	
High	$A_2 \ B_2 \ C_2$	$A_1-B_1-C_1$
Low	$A_2-C_1 \ B_2-A_1 \ C_2-B_1$	

FRACTIONAL HORSE POWER MOTORS

'GRYPHON' RANGE
42 FRAME RANGE
66 FRAME RANGE

CONNECTION DIAGRAMS THREE PHASE

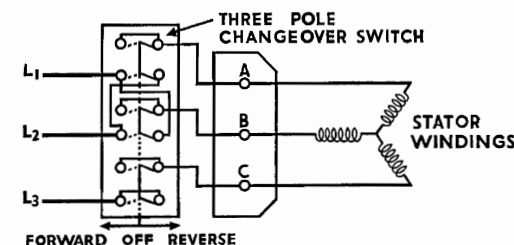
All motors are direct starting



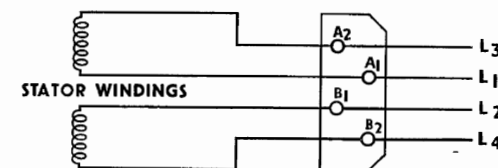
THREE PHASE, THREE WIRE

To reverse direction of rotation interchange lines L_1 and L_2 .

THREE PHASE FITTED WITH REVERSING SWITCH



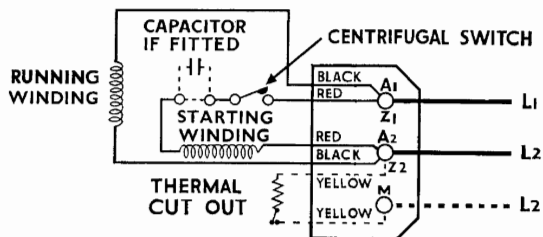
TWO PHASE



Note — If the system is three wire, link A_1-B_1 and connect to the common line.

Reversal — three wire system — interchange L_3 and L_4 .
four wire system — interchange L_1 and L_3 .

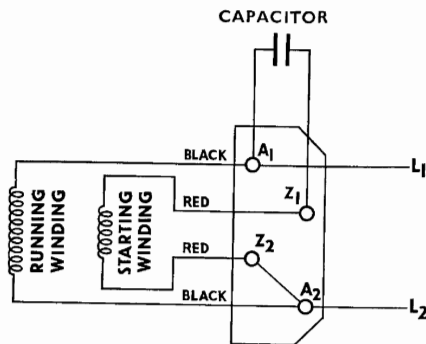
SINGLE PHASE, SPLIT PHASE OR CAPACITOR START INDUCTION MOTOR FITTED WITH THERMAL CUT-OUT



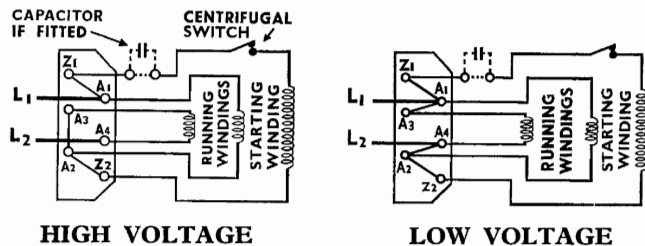
To reverse the direction of rotation, interchange the two red leads from the starting winding terminals A₁, Z₂ and A₂, Z₁.

CAPACITOR START AND RUN

To reverse direction of rotation, interchange the starting winding leads on terminals Z₁ and Z₂.



SPLIT PHASE OR CAPACITOR START DUAL VOLTAGE

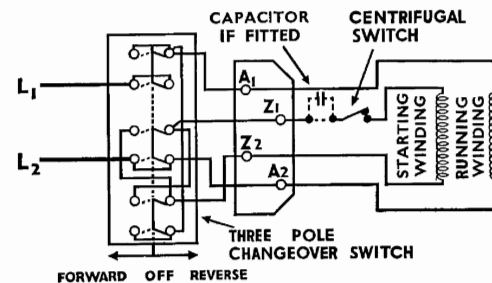


HIGH VOLTAGE

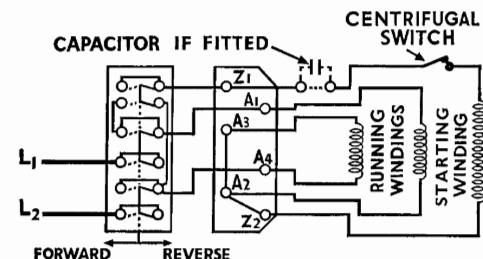
LOW VOLTAGE

To reverse the direction of rotation interchange the starting winding leads on terminals Z₁ and Z₂.

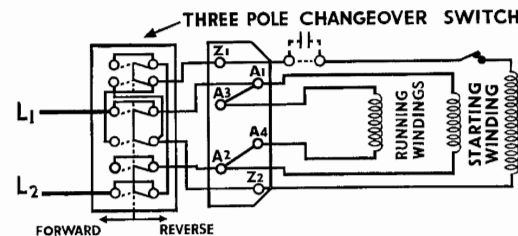
SPLIT PHASE OR CAPACITOR START SINGLE VOLTAGE GRYPHON BRITISH STANDARD MOTOR FOR REVERSING DUTY



SPLIT PHASE OR CAPACITOR START DUAL VOLTAGE FOR REVERSING DUTY



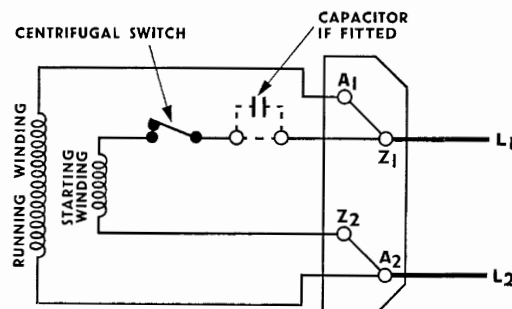
HIGH VOLTAGE



LOW VOLTAGE

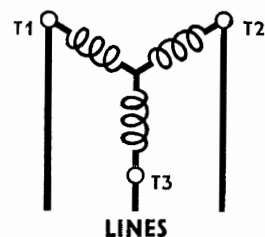
SPLIT PHASE OR CAPACITOR START FOUR-WAY TERMINAL BOARD

To reverse the direction of rotation interchange the starting winding leads on terminals Z_1 and Z_2 .

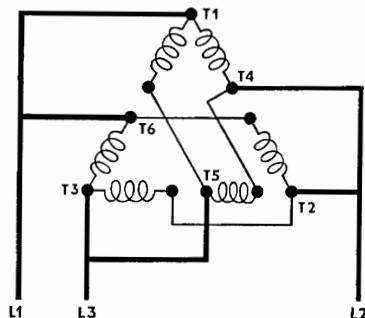


NEMA AND CEMA CONNECTIONS FOR AMERICAN AND CANADIAN MOTORS WITH LOOSE LEADS

THREE PHASE — Single voltage — Across-the-line starting
STATOR WINDING
Three wires out

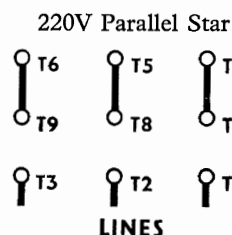
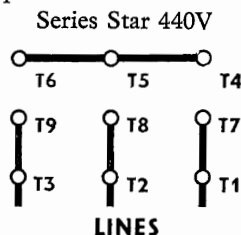


STATOR WINDING
Delta connected — six wires out



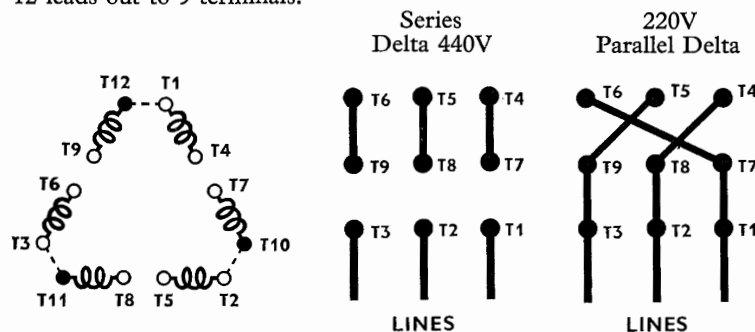
To reverse rotation — interchange any two lines.

THREE PHASE — Series Parallel Star for motors up to an including 10 h.p.



To reverse rotation — interchange any two lines.
220V motors are usable on 208V network systems. Current at 208V is $1.06 \times$ current at 220V.

THREE PHASE — Series Parallel Delta for motors above 10 h.p.
12 leads out to 9 terminals.



To reverse rotation — interchange any two lines.
220V motors are usable on 208V network systems. Current at 208V is $1.06 \times$ current at 220V.

For across-the-line starting connect as below —

Voltage	Line connections			Link together
	L1	L2	L3	
High	T1	T2	T3	T4-T7, T5-T8, T6-T9
Low	T1	T2	T3	T1-T6-T7, T2-T4-T8 T3-T5-T9

For Wye-Delta starting, remove leads T10, T11 and T12 from terminals T2, T3 and T1 respectively and connect as below —

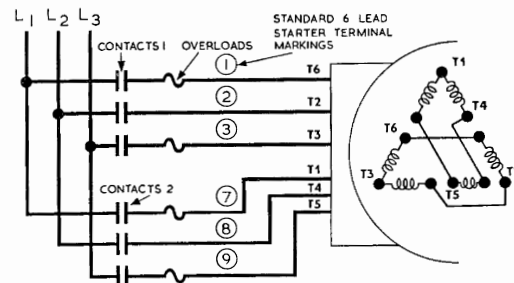
Voltage	Connect to starter			Link together
	T1	T2	T3	
High	T1, T2, T3, T10, T11, T12			T4-T7, T5-T8, T6-T9
Low	T1, T2, T3, T10, T11, T12			T1-T7, T2-T8, T3-T9 T10-T4, T11-T5, T12-T6

THREE PHASE

Increment start motor with six leads from stator winding

Note — The current rating of the overload heaters should be half the motor F.L.C.

Contacts 1 are closed first, followed shortly by contacts 2

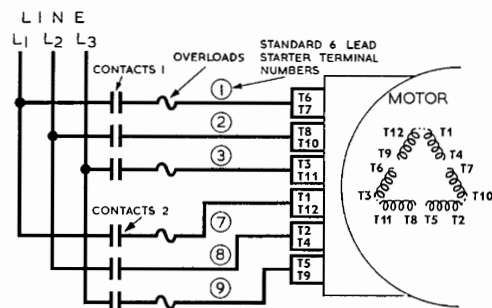


THREE PHASE

Increment start motor with 12 leads from stator winding

A standard Brook motor connected delta with 12 leads out to 9 terminals may be connected for part winding starting on low voltage. Leads T10, T11 and T12 should be removed from terminals T2, T3 and T1 respectively and the motor connected to the starter as shown.

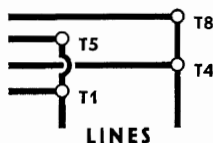
Note — The current rating of the overload heaters should be half the motor F.L.C.



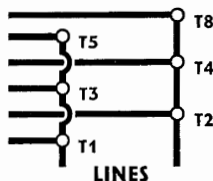
Contacts 1 are closed first, followed shortly by contacts 2

SINGLE PHASE

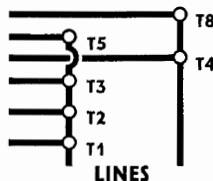
Single voltage



Dual voltage LOW



Dual voltage HIGH



To reverse rotation — interchange leads T5 and T8.

CHAPTER 15

CONTROL GEAR

ILLUSTRATIONS AND GENERAL SPECIFICATIONS

Modern contactors give improved performance in much smaller space. They can be mounted on or very near to the machines they control, saving conduit, wiring and installation costs.



Direct on Line — Type HAT

A remarkably small, yet robust starter for the control of one, two or three-phase A.C. motors up to 0.5 h.p. where I.E.E. regulations apply and when no-volt release is not required. Can be used up to a maximum of 2 h.p. where regulations permit.

Direct on Line — Type AT3. A small compact air break contactor type automatic starter designed to give maximum service while occupying the minimum space. It can easily be mounted on the machine at the most convenient point for the operator.



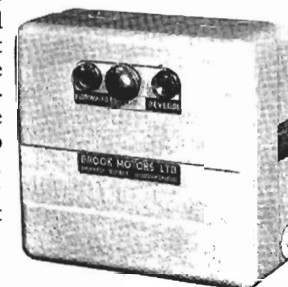
Flush Mounting Type ATF

A similar starter built for flush cavity mounting is also manufactured. Both starters are for single- or three-phase supply. Maximum ratings for three-phase at various voltages are 1.5 to 6 h.p. and for single-phase 1.0 to 3 h.p. Carries CSA approval No. 10778.



Reversing — Type ART

For automatically reversing the rotation of cage induction motors, this compact starter is mounted in a small dust-protecting, die-cast enclosure which can easily be mounted on the machine at the most convenient point. Forward and reverse contactors are both electrically and mechanically interlocked. Maximum ratings for three-phase are 1.5 to 6 h.p. and for single-phase 1.0 to 3 h.p., dependent upon supply voltage. (Carries CSA approval). Derate by 50 per cent if this starter is to be used for frequent 'inching' (jogging) or 'plugging' duties.



CHAPTER 17

CONTROL GEAR CONNECTION DIAGRAMS

Graphical Symbols for Electrical Purposes

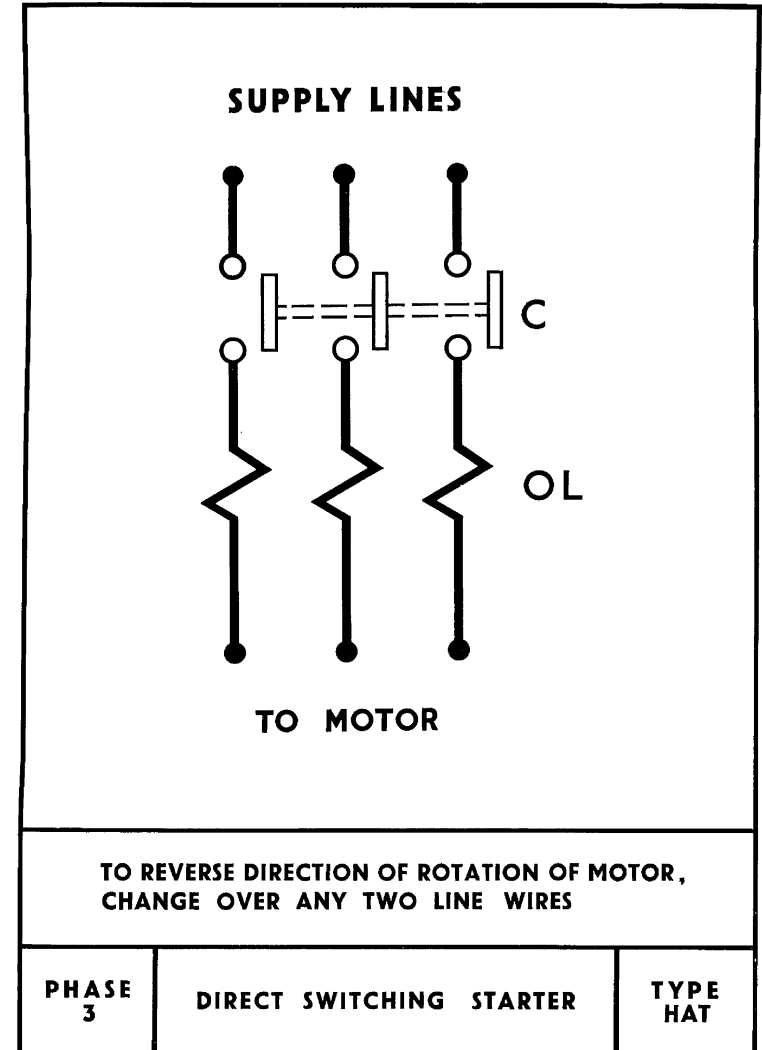
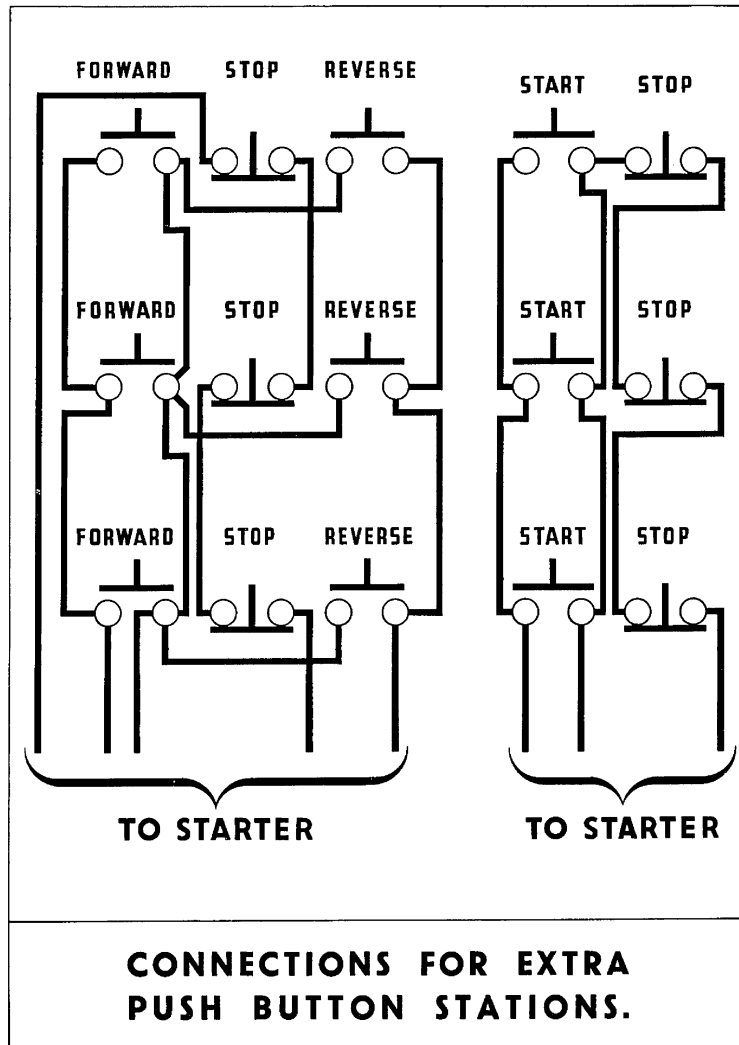
Based on British Standard and International Electro-Technical Commission specifications. Each symbol is placed in the approximate position of the part it represents on the starter

DESCRIPTION	GRAPHICAL SYMBOL	CODE LETTER	DESCRIPTION	GRAPHICAL SYMBOL	CODE LETTER
CONTACTOR: Single Break Single & Triple Pole		C.	ISOLATING SWITCH: Double Break		IS.
CONTACTOR: Double Break Single & Triple Pole		C.	EARTH (GROUND) CONNECTION		E OR GRD
AUXILIARY SWITCH: Normally Open Single and Double		C ₂ , C ₃ etc.	CAPACITOR		CAP.
AUXILIARY SWITCH: Normally Closed Single & Double Break		C ₂ , C ₃ etc.	RESISTOR		RES.
MECHANICAL INTERLOCK		MI.	ELECTRONIC TIMER		ETD.
PUSH BUTTONS: Normally Open & Normally Closed		PB.	LINK: With Bolted Contacts		LK.
PUSH BUTTON: Inching & Similar		IN. PB.	CUT-OUT (FUSIBLE) With Separable Contacts		FU.
TUMBLER SWITCH: Single & Double Pole		TS.	INCANDESCENT LAMP DISCHARGE		IL. WITH COLOUR PREFIX e.g.: RED: RIL.

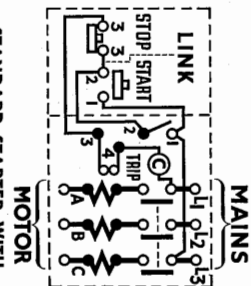
DESCRIPTION	GRAPHICAL SYMBOL	CODE LETTER	DESCRIPTION	GRAPHICAL SYMBOL	CODE LETTER
ROTARY SWITCH: Single & Double Pole		S.	MOVEABLE CONTACT General Symbol		MC.
ROTARY SWITCH: 2 Way as "Hand Off, Auto"		S.	FACE PLATE RHEOSTAT: General Symbol		RH.
LIMIT OR FLOAT SW: (Single Pole) Single & Double Break		LS.	AMMETER		AM.
LIMIT SWITCH: Double Break Change Over Type		LS.	VOLTMETER		VM.
ISOLATING SWITCH: Single Break		IS.	TERMINAL BOARD: Terminals shown in same Relative Place As On Gear		T.B.
HALF WAVE RECTIFIER		S. REC.	FULL WAVE RECTIFIER		F.REC.

Other Code Letters used on Brook Control Gear

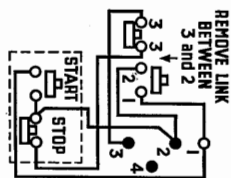
F.C.	Forward Contactor	R.R.1	} Switches on Rotor Regulator etc.
H.C.	High-speed Contactor	R.R.2	
L.C.	Low-speed Contactor		
O.L.	Overload Relay	R.R.S.	Rotor Resistance
R.C.	Reverse Contactor	R.S.C.	Rotor Starting Contactor
R.F.C.	Rotor Final Contactor	S.R.	Starting Resistance
R.N.	Run Contactor	S.T.	Start Contactor



MADE TO BSS 587
RATED FOR FREQUENT DUTY

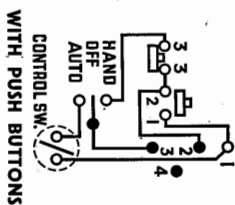


STANDARD STARTER WITH
PUSH BUTTONS IN COVER
(COVER OPEN)

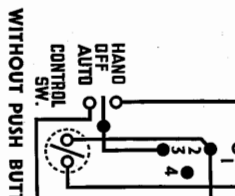


CONNECTIONS FOR REMOTE
PUSH BUTTON CONTROL

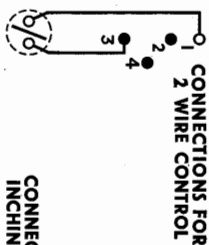
CONNECTION FOR HAND - OFF - AUTO



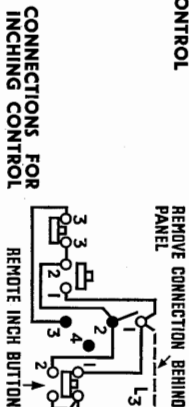
WITH PUSH BUTTONS



WITHOUT PUSH BUTTONS



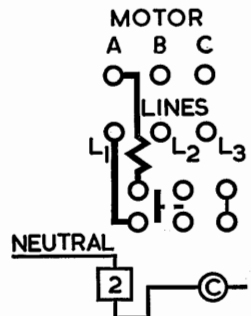
CONNECTIONS FOR
2 WIRE CONTROL



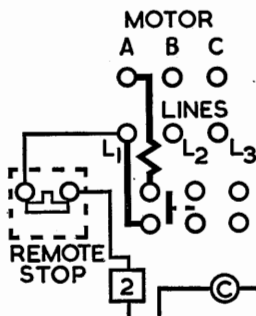
CONNECTIONS FOR
INCHING CONTROL

FOR SINGLE PHASE
CONNECT LINES TO L1 AND L3, AND MOTOR
TO A AND B. CONNECT TOGETHER C AND L2.
CONTROL WIRING UNALTERED.

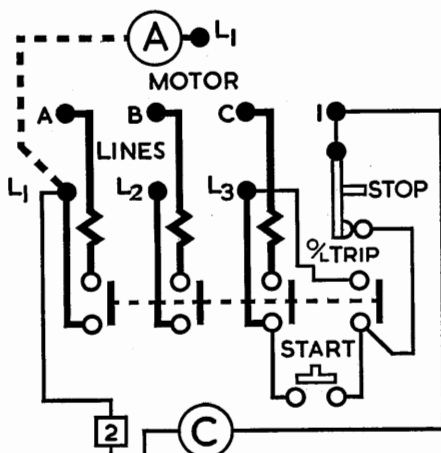
PHASE 1, 2, 3.	AUTOMATIC DIRECT SWITCHING STARTER	TYPE 2, 1, 3.
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**CONNECTIONS
FOR THREE
PHASE AND
NEUTRAL
SUPPLY**



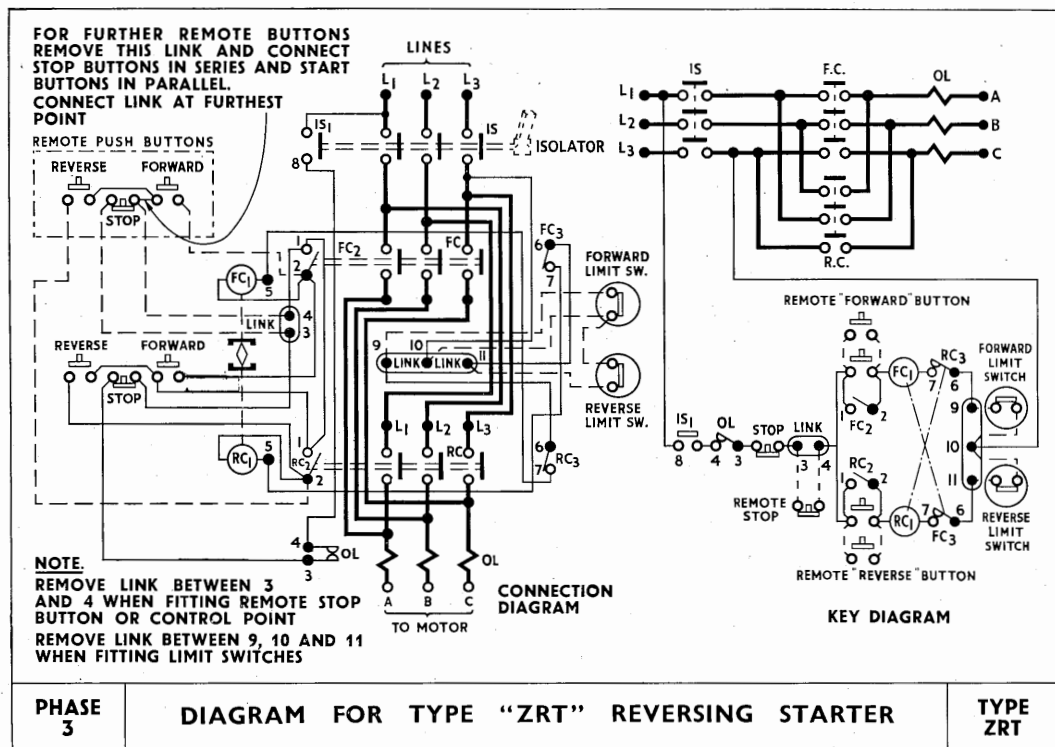
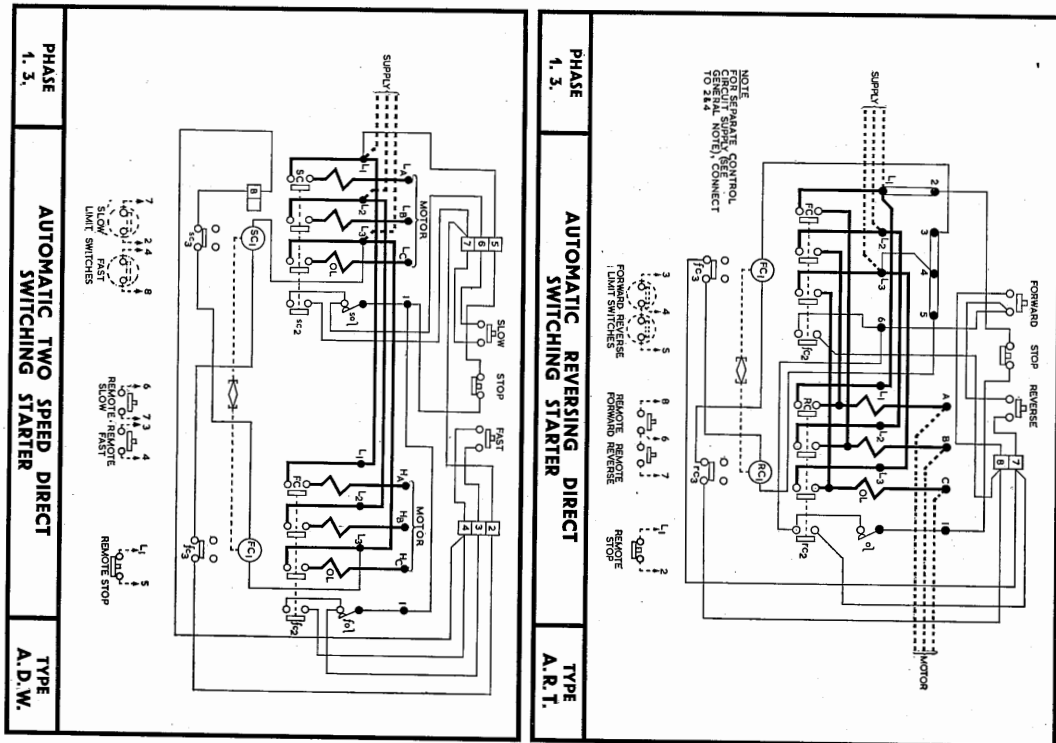
**CONNECTIONS
FOR REMOTE
STOP BUTTON
OR
LIMIT SWITCH**

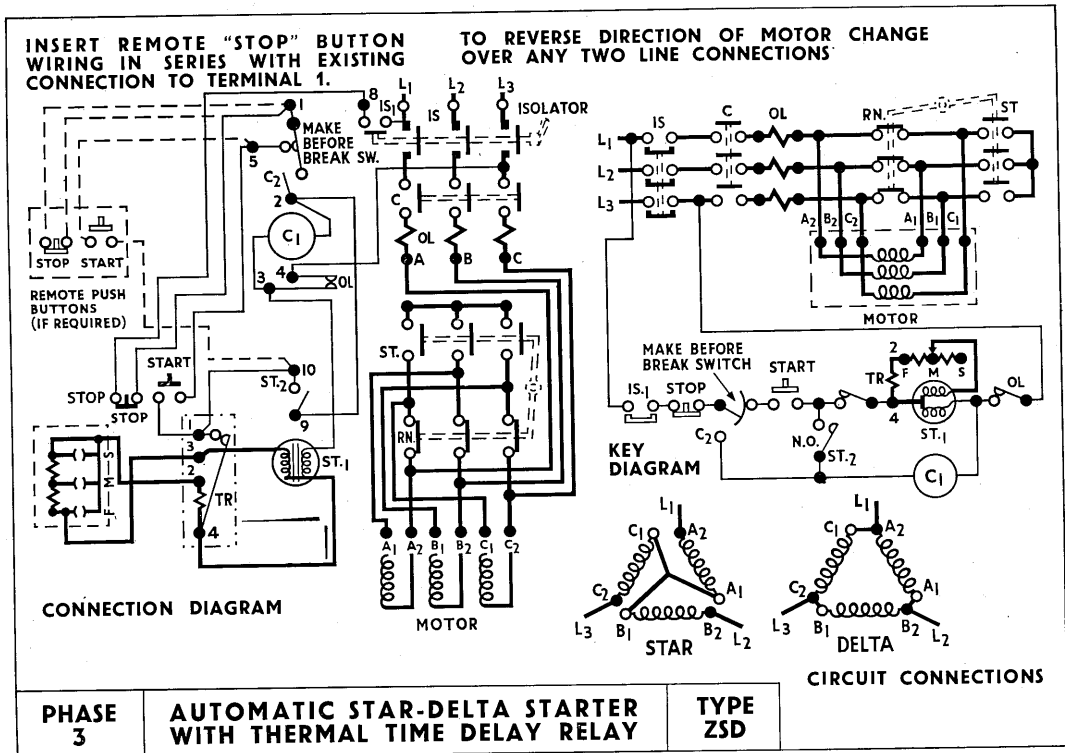
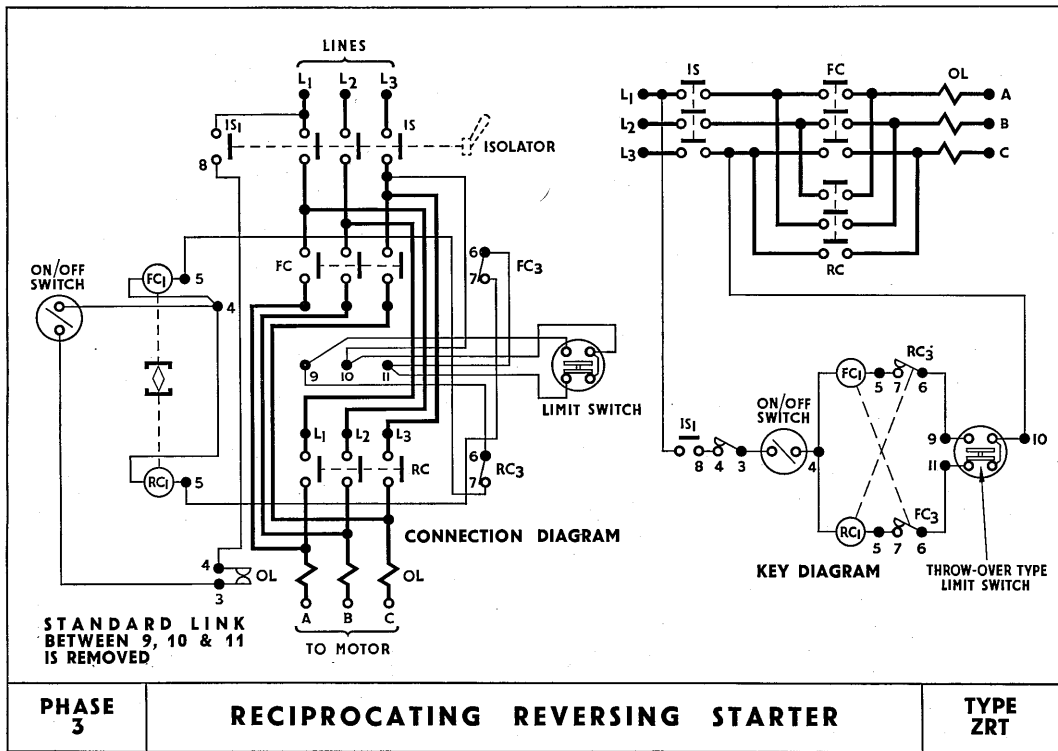


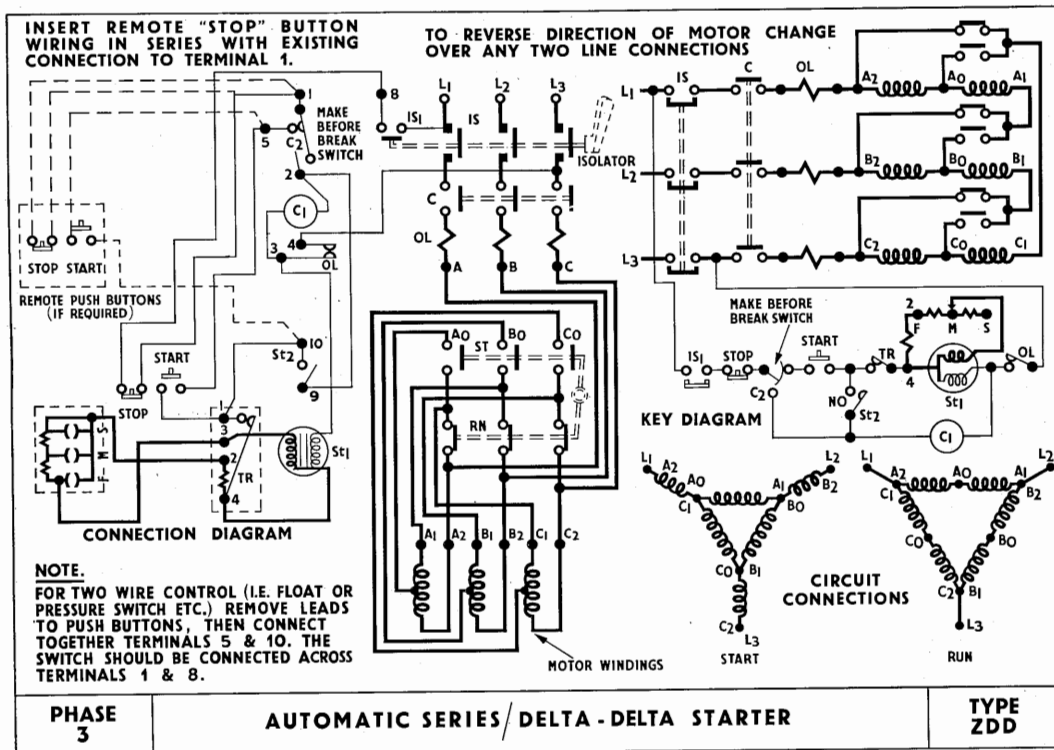
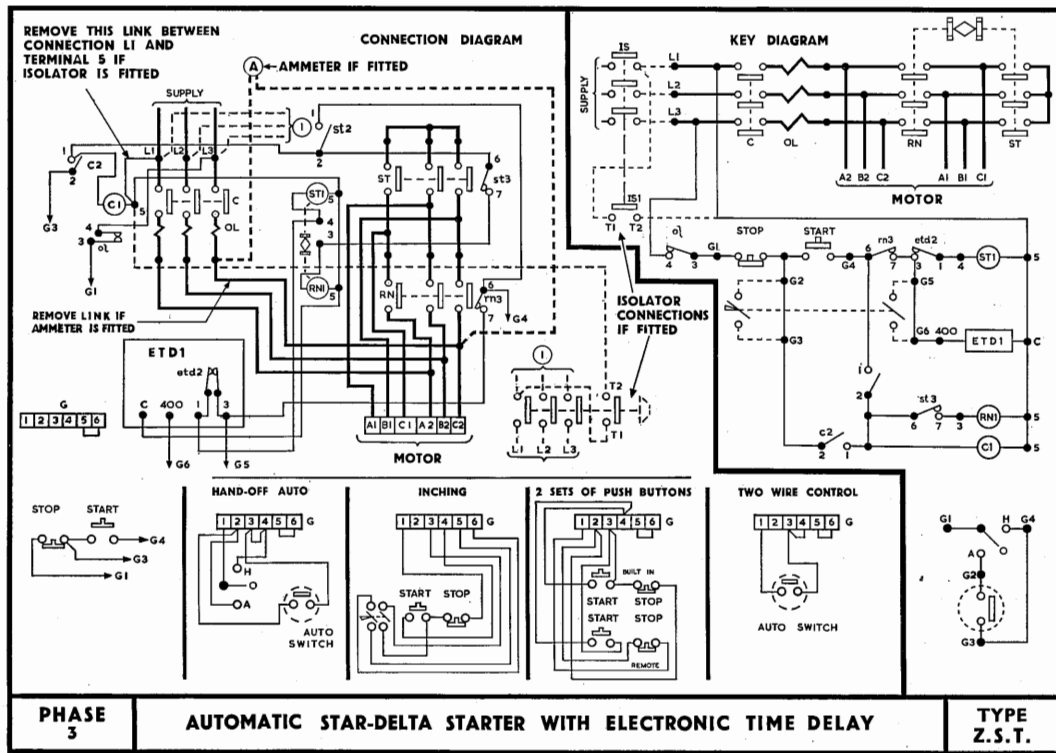
CONNECTION DIAGRAM

**FOR SINGLE PHASE — CONNECT LINES TO L1 & L3 AND
MOTOR TO A & B. CONNECT TOGETHER C & L2.**

PHASE 1, 2, 3.	DIRECT SWITCHING CONTACTOR STARTER	TYPE AT3
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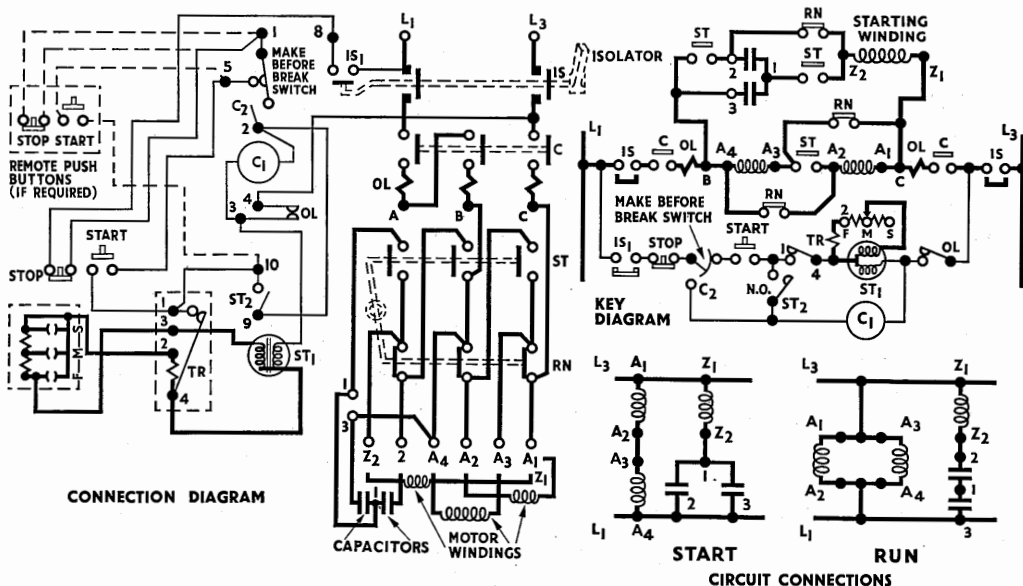






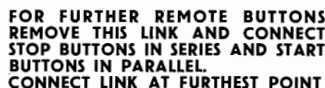


TO REVERSE DIRECTION OF ROTATION
CHANGE OVER LEADS FROM STARTING
WINDING TO TERMINALS Z1 AND Z2.

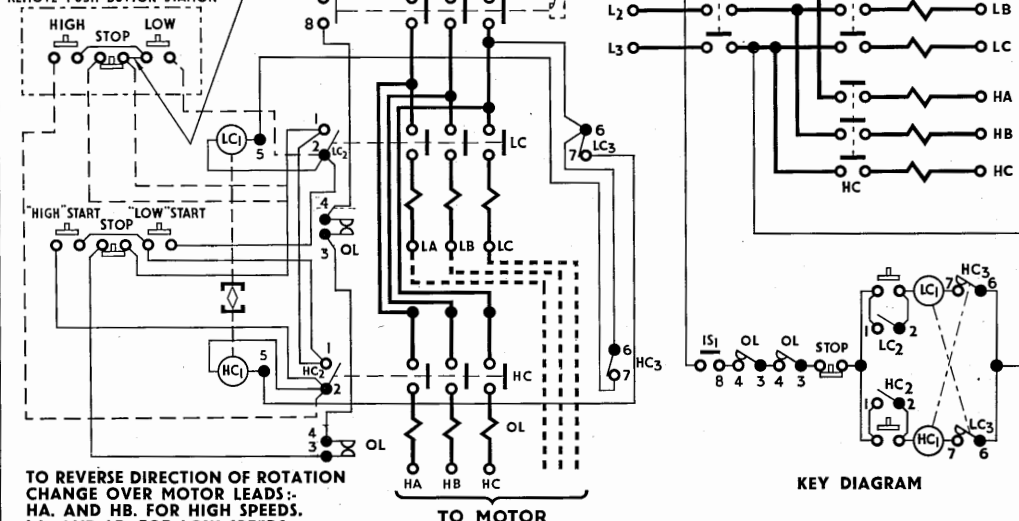


CIRCUIT CONNECTIONS

PHASE 1	STARTER WITH THERMAL TIME DELAY RELAY	TYPE ZLA
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REMOTE PUSH BUTTON STATION



KEY DIAGRAM

PHASE 3	TWO SPEED DUAL WOUND STARTER	TYPE ZDW
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