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ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY
SCHOOL OF ELECTRICAL ENGINEERING AND COMPUTING
ELECTRICAL POWER AND CONTROL ENGINEERING PROGRAM
PCE -4203- ELECTRICAL POWER AND CONTROL LAB
LABORATORY EXPERIMENT-1

I) Direct on line starter of Motor (Full voltage across the line magnetic starter)

Objective – Direct operation of a three phase motor with a contractor, using the self holding circuit.

THEORY –The simplest form of motor starter for the induction motor is the direct on line starter .the DOL starter comprises a contactor and an overload protection relay .the contactor switches the supply to the motor .it is controlled by a start button and a stop button .the stop button is an integral part of the over load relay .An auxiliary contact on the contactor is used maintain the supply to the contactor coil after start button is released. If the supply to the contactor coil fails, the contactor is de-energized and the motor stop. The start must be pressed to energize the contactor again. The over load relay monitors the current being taken by the motor

Procedure

- A) Read the given technical drawing
- B) Prepare cables, wire and mounting rail
- C) Install, cables, wires mounting rail and pushbutton holder (if any) on the installation board according to the lay out drawing
- D) Fix or mount contactor, over load relay, circuit breaker, and pushbutton and block terminals according to drawing
- E) Perform the wiring of the circuit according to the drawing
- F) Connect the power supply cable
- G) Test the correct function of the circuit by operating it with push button
- H) Test the output on the motor terminals by use of multimeter
- I) Do commissioning of an electrical motor circuit
- J) Connect both the power and control circuit

Circuit Diagram

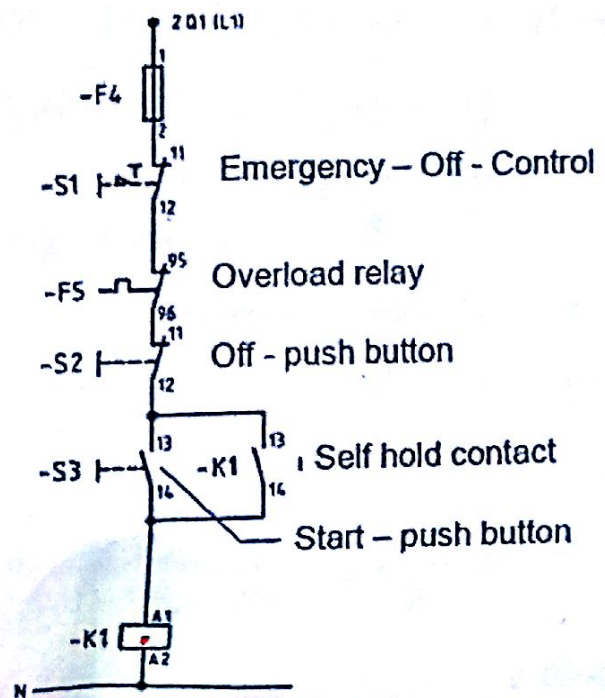
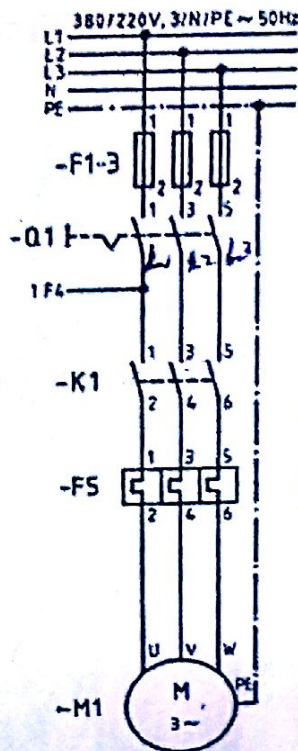


Fig.1 Power and control circuit of DOL starter

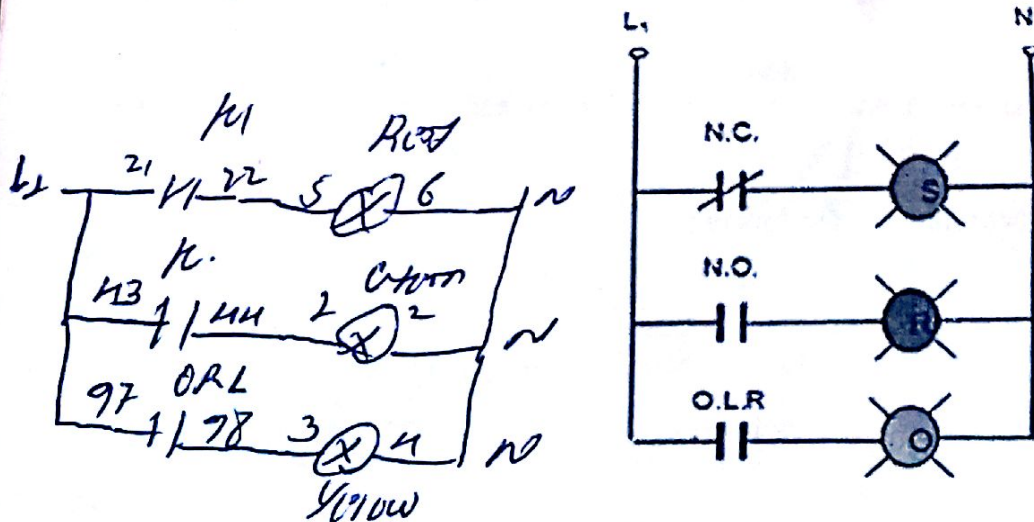
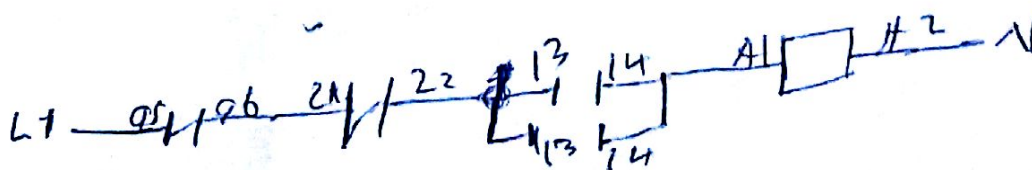


Fig.2 indicating lamp circuit



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LABORATORY EXPERIMENT-2

I) Motor controlled from two locations

Objective – To control a motor (a group of motors) from two or more different places.

Equipment Required

- | | | |
|----------------------|-------------------------------|----------------------|
| - Pushbutton (4) | -Emergency switch (1) | - 220V contactor (1) |
| - Overload relay (1) | - 3Phase Induction motor (1). | - Connectors |

Procedure

- a) Read the given technical drawing
- b) Prepare materials required and check their functionalities.
- c) Install, cables, wires mounting rail and pushbutton holder (if any) on the installation board according to the lay out drawing
- d) Fix or mount contactor, over load relay, circuit breaker, and pushbutton and block terminals according to drawing
- e) Perform the wiring of the circuit according to the drawing
- f) Connect the power supply cable
- g) Test the correct function of the circuit by operating it with push button
- h) Test the output on the motor terminals by use of multimeter
- i) Do commissioning of an electrical motor circuit
- j) Connect both the power and control circuit

Circuit Diagram

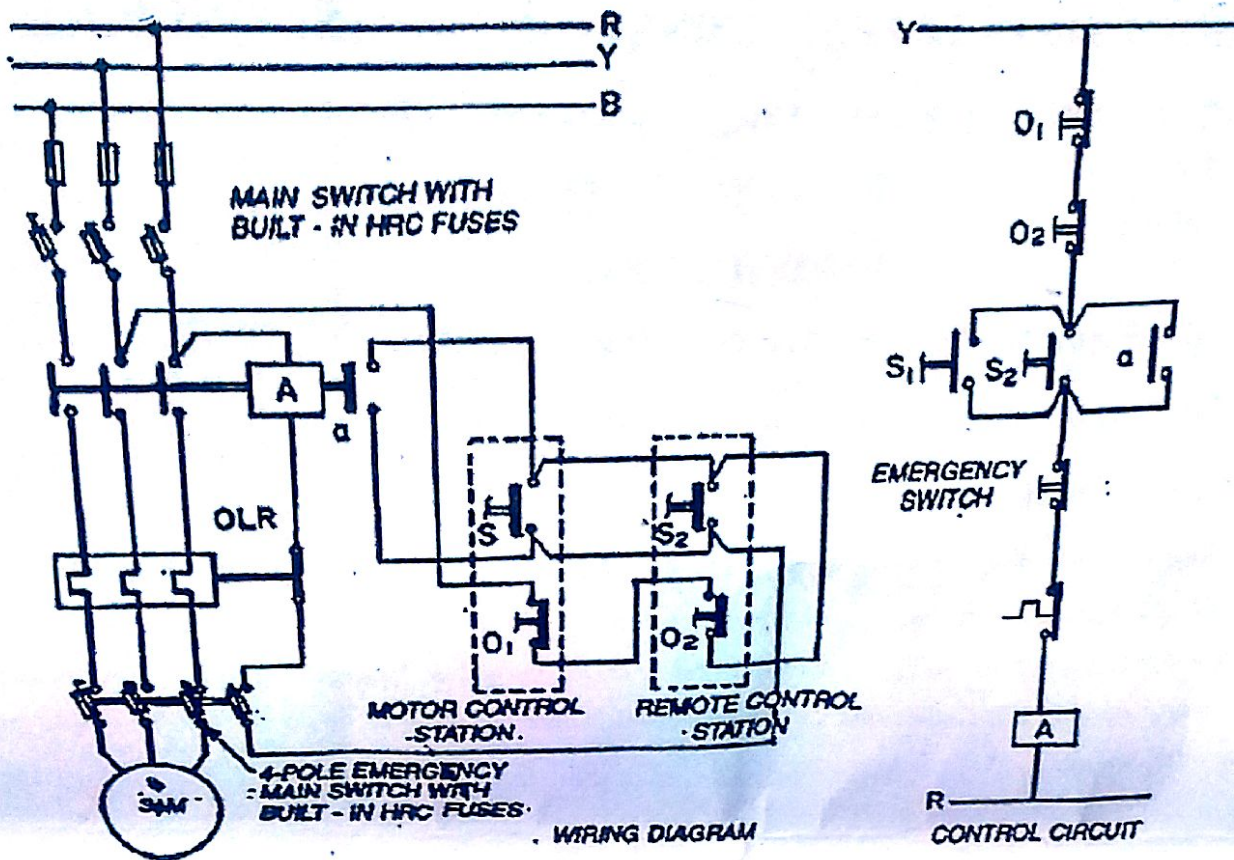


Fig.1 Wiring and control circuit of one motor controlled from two different places

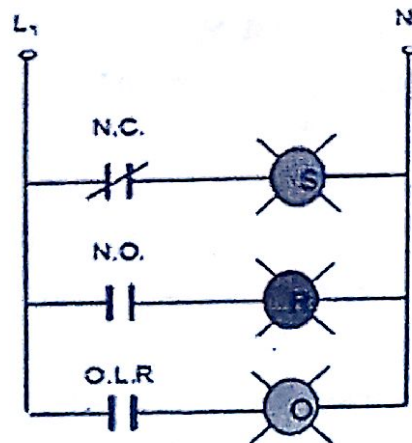
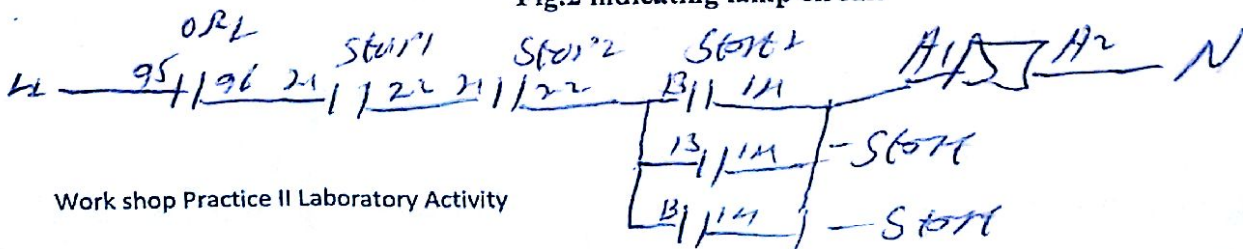


Fig.2 indicating lamp circuit



Work shop Practice II Laboratory Activity

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LABORATORY EXPERIMENT-3

Full-voltage Reverse-Forward Magnetic Starter (mechanical & electrical interlock)

Objective – To work with one motors rotate in forward and reverse direction

Theory: Interlocking

Interlocking prevents some action from taking place until some other action has been performed. In the case of reversing starters, interlocking is used to prevent both contactors from being energized at the same time. This would result in two of the three phase lines being shorted together. Interlocking forces one contactor to be de-energized before the other one can be energized. There are three methods that can be employed to assure interlocking.

1. Mechanical Interlocking

Most reversing controllers contain mechanical interlocks as well as electrical interlocks. Mechanical interlocking is accomplished by using the contactors to operate a mechanical lever that prevents the other contactor from closing while one is energized. Mechanical interlocks are supplied by the manufacturer and are built into reversing starters.

2. Electrical Interlocking

Two methods of electrical interlocking are available. One method is accomplished with the use of double acting push buttons. The dashed lines drawn between the push buttons indicate that they are mechanically connected. Both push buttons will pushed at the same time. The normally closed part of the FORWARD push button is connected in series with R coil, and the normally closed part of the REVERSE push button is connected in series with F coil. If the motor should be running in the forward direction and the REVERSE push button is pressed, the normally closed part of the push button will open and disconnect F coil from the line before the normally open part closes to energize R coil. The normally closed section of either push button has the same effect on the circuit as pressing the STOP button.

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The second method of electrical interlocking is accomplished by connecting the normally closed auxiliary contacts on one contactor in series with the coil of the other contactor. Assume that the FORWARD push button is pressed and F coil energizes. This causes all F contacts to change position.

The three F load contacts close and connect the motor to the line. The normally open F auxiliary contact closes to maintain the circuit when the FORWARD push button is released, and the normally closed F auxiliary contact connected in series with R coil opens (Ill. 8).

If the opposite direction of rotation is desired, the STOP button must be pressed first. If the REVERSE push button were to be pressed first, the now open F auxiliary contact connected in series with R coil would prevent a complete circuit from being established.

Once the STOP button has been pressed, however, F coil de-energizes and all F contacts return to their normal position. The REVERSE push button can now be pressed to energize R coil. When R coil energizes, all R contacts change position. The three R load contacts close and connect the motor to the line. Notice, however, that two of the motor T leads are connected to different lines. The normally closed R auxiliary contact opens to prevent the possibility of F coil being energized until R coil is de-energized.

Equipment Required

- | | | |
|----------------------|------------------------------|--------------|
| - Pushbutton (3) | - 220V contactor (2) | - Connectors |
| - Overload relay (1) | - 3Phase Induction motor (1) | |

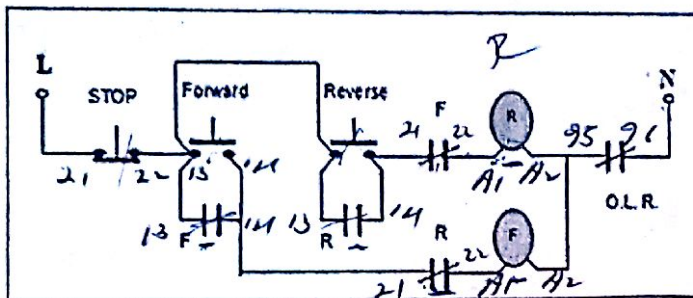
Procedure

- a) Read the given technical drawing
- b) Prepare materials required and check their functionalities.
- c) Install, cables, wires mounting rail and pushbutton holder (if any) on the installation board according to the lay out drawing
- d) Fix or mount contactor, over load relay, circuit breaker, and pushbutton and block terminals according to drawing
- e) Perform the wiring of the circuit according to the drawing
- f) Connect the power supply cable
- g) Test the correct function of the circuit by operating it with push button
- h) Test the output on the motor terminals by use of multimeter

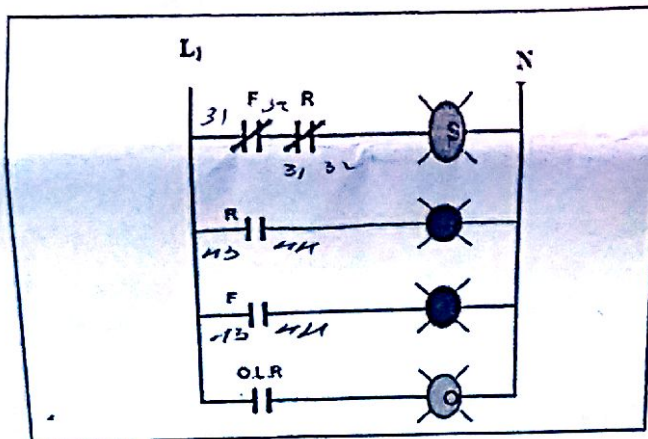
- i) Do commissioning of an electrical motor circuit
- j) Connect both the power and control circuit

Circuit Diagram

I. Control Circuit



II. Indicating lamp Circuit



III. Power Circuit

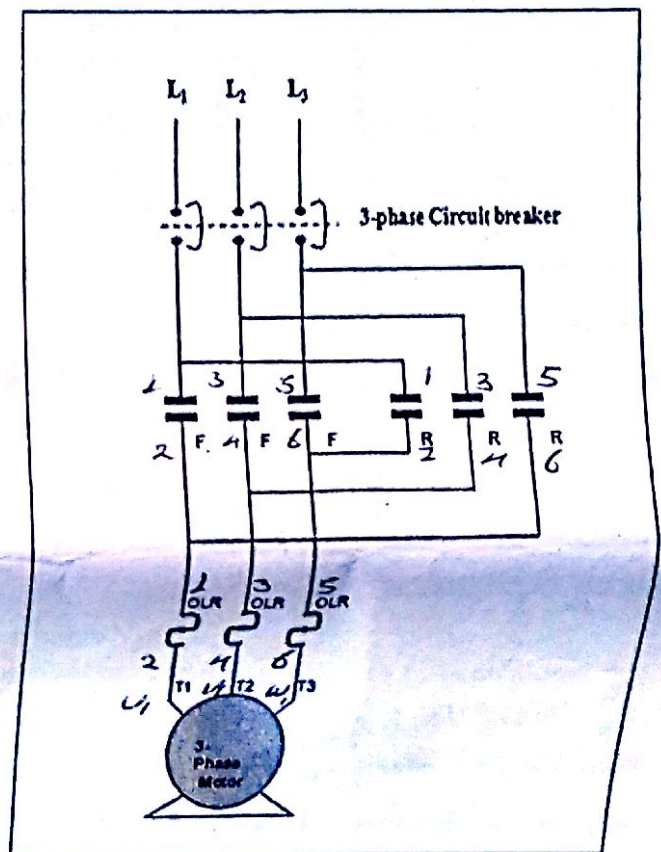


Fig.1 Forward -Reversing of motor (Electrical interlock)

$F = \text{NC}$
 NO

$R = \text{NC}$
 NO

VFD →
VVFD

Induction motor (starting)

① Full Voltage

② DOL

③ Reversed Voltage

④ YD

⑤ PR / SR

⑥ Star / Delta

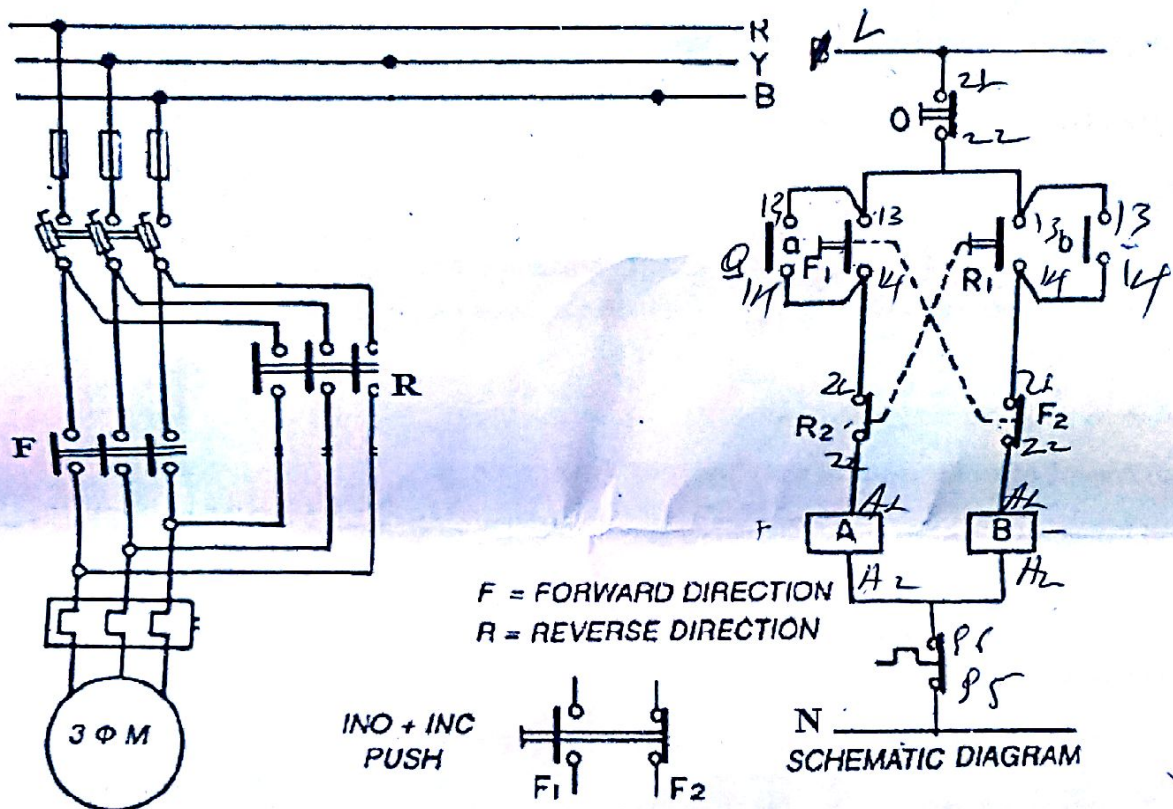
Work shop Practice II Laboratory Activity

Full-voltage Reverse-Forward Magnetic Starter (mechanical inter lock)

Objective – To work with one motors rotate in forward and reverse direction

Equipment Required

- Pushbutton (3)
- 220V contactor (2)
- Connectors
- Overload relay (1)
- 3Phase Induction motor (1)



Forward
NC
NO

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LABORATORY EXPERIMENT-5

Sequence Starting of Two Motors Manually

Objective – To rotate two/more motors sequentially

Equipment Required

- | | | |
|----------------------|------------------------------|--------------|
| - Pushbutton (4) | - 220V contactor (2) | - Connectors |
| - Overload relay (2) | - 3Phase Induction motor (2) | - |

Procedure

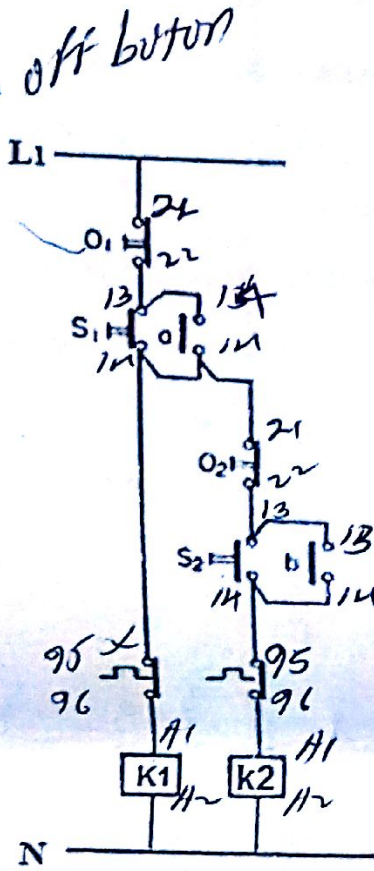
- Read the given technical drawing
- Prepare materials required and check their functionalities.
- Install, cables, wires mounting rail and pushbutton holder (if any) on the installation board according to the lay out drawing
- Fix or mount contactor, over load relay, circuit breaker, and pushbutton and block terminals according to drawing
- Perform the wiring of the circuit according to the drawing
- Connect the power supply cable
- Test the correct function of the circuit by operating it with push button
- Test the output on the motor terminals by use of multimeter
- Do commissioning of an electrical motor circuit
- Connect both the power and control circuit

INPUT

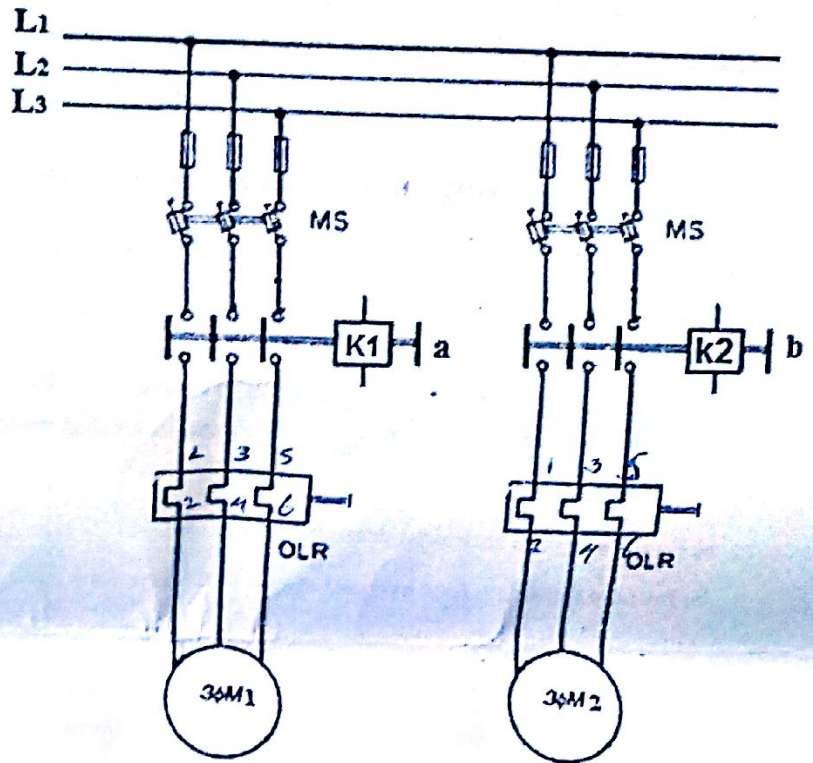
OUTPUT

200m

Circuit Diagram



a)



b)

Fig1. Control circuit (a) and Power circuit (b) of two motors start sequentially (manual)

Sequence 1, 2, 7

2

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LABORATORY EXPERIMENT-6

Sequence Starting of Two Motors Automatically with time delay

Objective – To rotate two/more motors sequentially with timer (automatic sequential motor control)

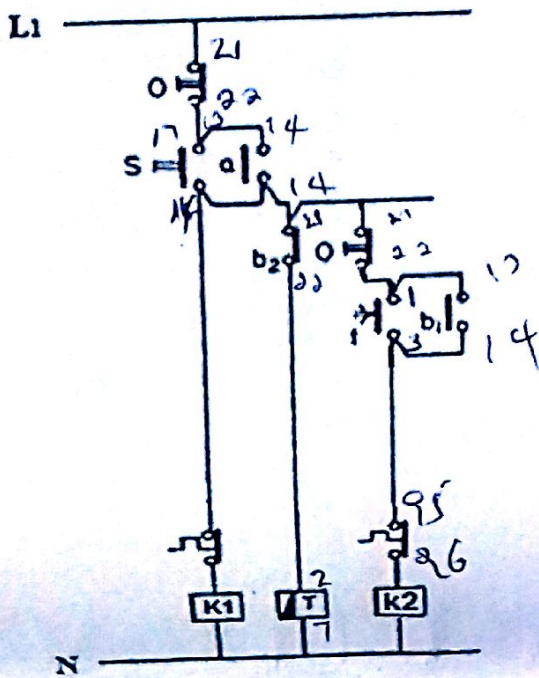
Equipment Required

- | | | |
|----------------------|------------------------------|--------------|
| - Pushbutton (3) | - 220V contactor (2) | - Connectors |
| - Overload relay (1) | - 3Phase Induction motor (2) | |

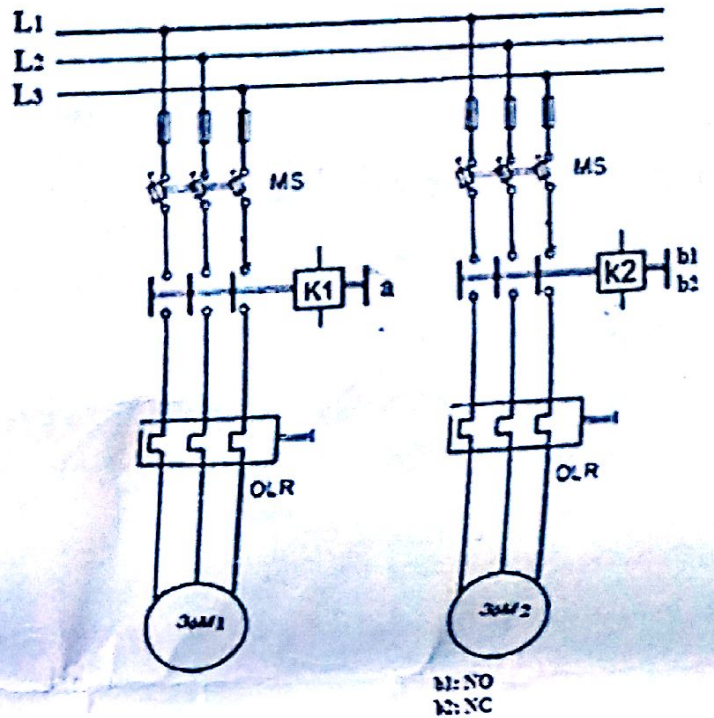
Procedure

- a) Read the given technical drawing
- b) Prepare materials required and check their functionalities.
- c) Install, cables, wires mounting rail and pushbutton holder (if any) on the installation board according to the lay out drawing
- d) Fix or mount contactor, over load relay, circuit breaker, and pushbutton and block terminals according to drawing
- e) Perform the wiring of the circuit according to the drawing
- f) Connect the power supply cable
- g) Test the correct function of the circuit by operating it with push button
- h) Test the output on the motor terminals by use of multimeter
- i) Do commissioning of an electrical motor circuit
- j) Connect both the power and control circuit

Circuit Diagram



a)



b)

Fig1. Control circuit (a) and Power circuit (b) of two motors start sequentially (Automatic)

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LABORATORY EXPERIMENT-7

Star delta starter manually

Objective – To work with start delta motor start method (manually)

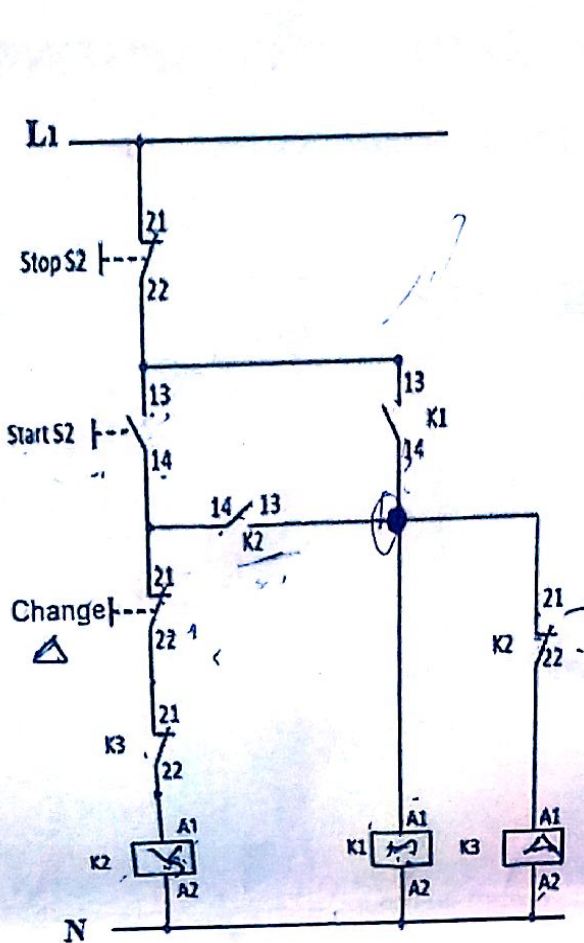
Equipment Required

- | | | |
|----------------------|------------------------------|--------------|
| - Pushbutton (3) | - 220V contactor (3) | - Connectors |
| - Overload relay (1) | - 3Phase Induction motor (1) | |

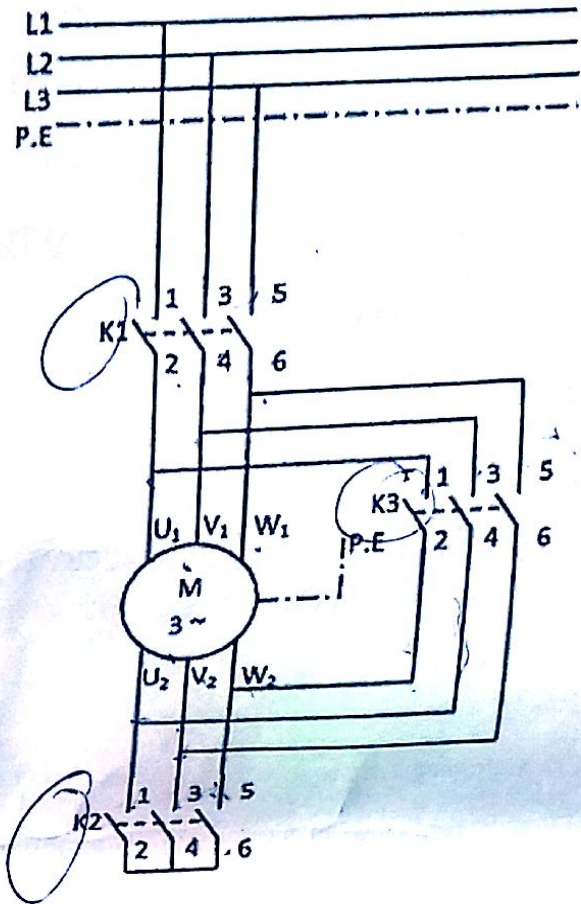
Procedure

- a) Read the given technical drawing
- b) Prepare materials required and check their functionalities.
- c) Install, cables, wires mounting rail and pushbutton holder (if any) on the installation board according to the lay out drawing
- d) Fix or mount contactor, over load relay, circuit breaker, and pushbutton and block terminals according to drawing
- e) Perform the wiring of the circuit according to the drawing
- f) Connect the power supply cable
- g) Test the correct function of the circuit by operating it with push button
- h) Test the output on the motor terminals by use of multimeter
- i) Do commissioning of an electrical motor circuit
- j) Connect both the power and control circuit

Circuit Diagram



a) Control circuit



b) power circuit

Fig1. Control circuit (a) and Power circuit (b) of star delta start of 3phase motor (Manual)



$U_1 - W_2$

$V_1 - U_2$

$W_1 - V_2$

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LABORATORY EXPERIMENT-8

Star delta starter

Objective – To work with start delta motor start method (Automatically)

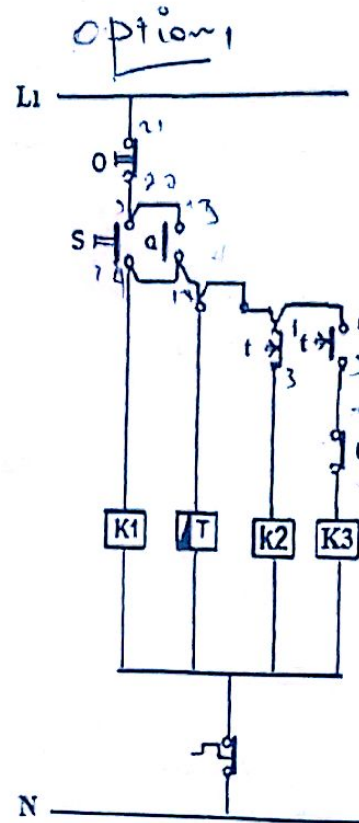
Equipment Required

- | | | |
|----------------------|------------------------------|--------------|
| - Pushbutton (2) | - 220V contactor (3) | - Connectors |
| - Overload relay (1) | - 3Phase Induction motor (1) | |

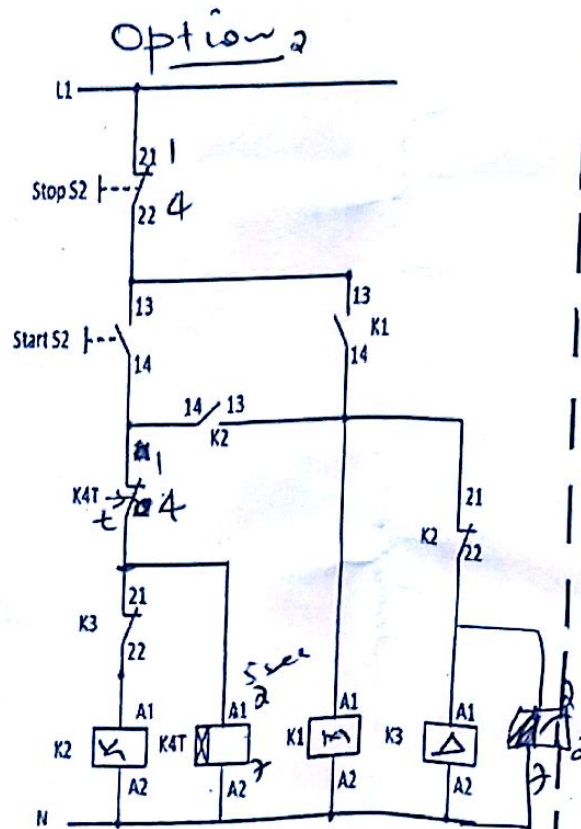
Procedure

- a) Read the given technical drawing
- b) Prepare materials required and check their functionalities.
- c) Install, cables, wires mounting rail and pushbutton holder (if any) on the installation board according to the lay out drawing
- d) Fix or mount contactor, over load relay, circuit breaker, and pushbutton and block terminals according to drawing
- e) Perform the wiring of the circuit according to the drawing
- f) Connect the power supply cable
- g) Test the correct function of the circuit by operating it with push button
- h) Test the output on the motor terminals by use of multimeter
- i) Do commissioning of an electrical motor circuit
- j) Connect both the power and control circuit

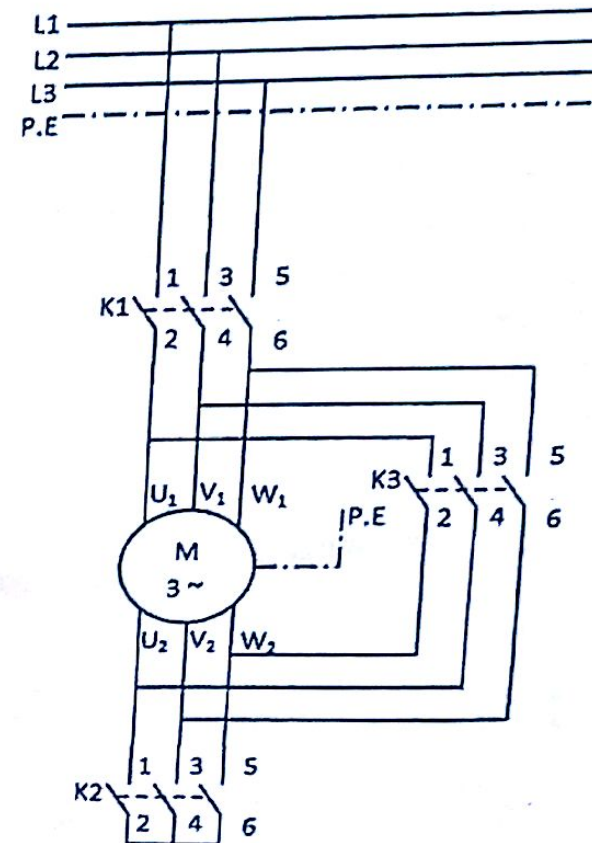
Circuit Diagram



a) Control circuit option1



b) Control circuit option2

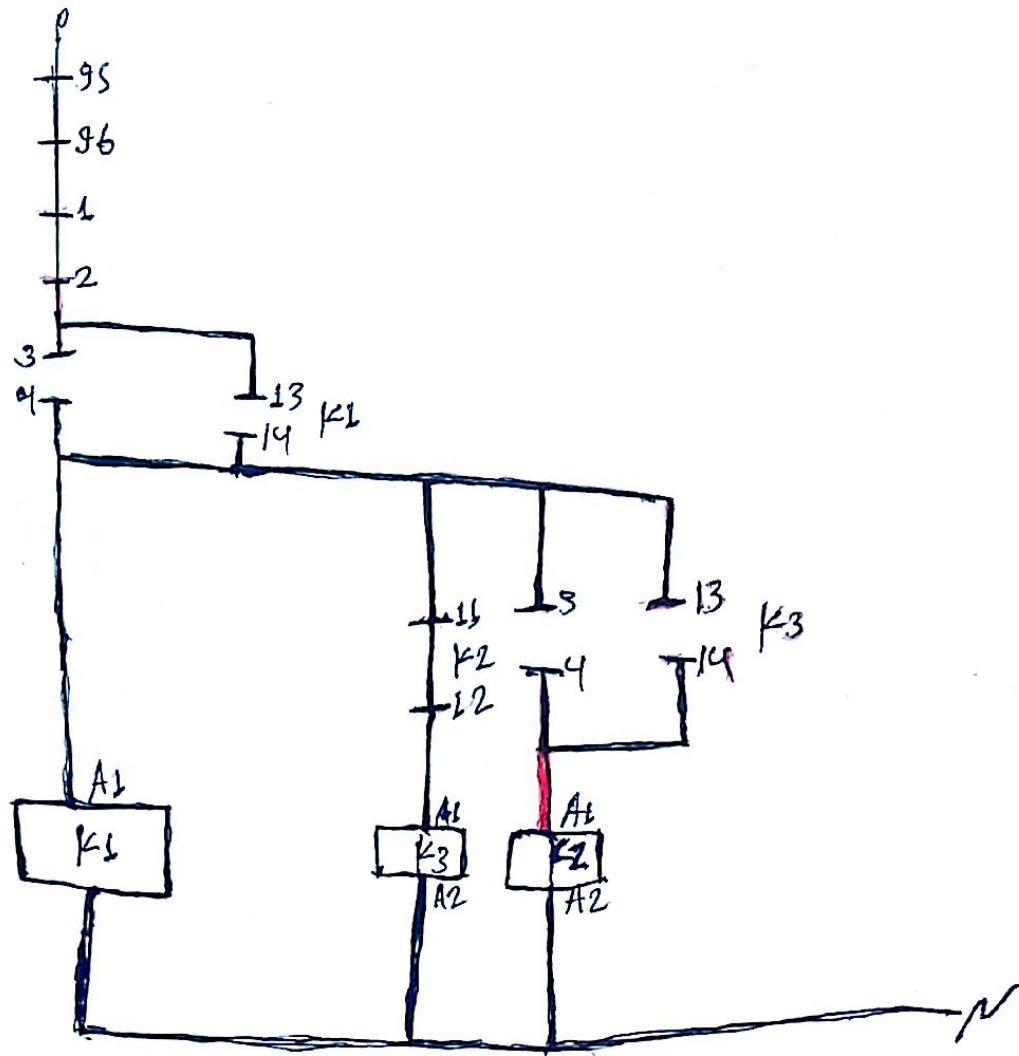


c) power circuit

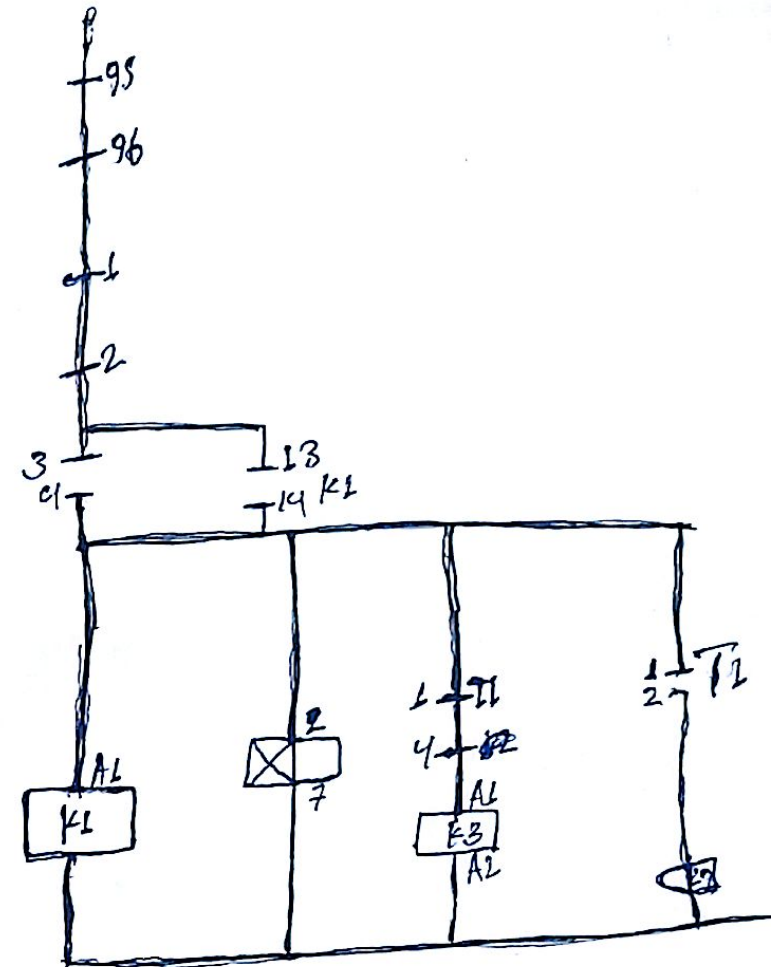
Fig1. Control circuit (a&b) and Power circuit (b) of star delta start of 3phase motor (Automatic)

➤ Select either of the two control circuit and practice

Work shop Practice II Laboratory Activity



MANUALLY CONTROL CKT



AUTOMATICALLY CONTROL
SYSTEM OR WITH TIMER
CONTROL SYSTEM

