



AVIT
AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY



VINAYAKA MISSION'S
RESEARCH FOUNDATION
(Deemed to be University under section 3 of the UGC Act 1956)



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DEPARTMENT OF MECHANICAL ENGINEERING



M.E/M.TECH - AUTOMATION LABORATORY MANUAL (REGULATION 2017)

Prepared by

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FACULTY OF MECHANICAL ENGINEERING, AVIT



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CERTIFICATE

NAME OF THE LAB : AUTOMATION LAB

MANUAL REFERENCE NO : W.I.

PREPARED BY : 

M.SARAVANAN
AUTOMATION LAB INCHARGE

APPROVED BY : 

PROF.L.PRABHU,
HEAD OF THE DEPARTMENT

SYLLABUS

AUTOMATION LAB

L T P C 0 0 4 2

AIM: To impart knowledge in the area of hydraulics and pneumatic components and its functions.

OBJECTIVE:

- To make the students to learn the basic concepts of hydraulics and pneumatics and its applications in the area of manufacturing process.

- To simulate the various hydraulics and pneumatics circuits.

1	Simulation of single and double acting cylinder circuits
2	Simulation of Hydraulic circuits
3	Simulation of electro pneumatic circuits
4	Simulation of electro hydraulic circuits
5	Simulation of PLC circuits
6	Exercises on linear and angular measurements
7	Exercises on speed measurements
8	Exercises on Vibration measurements
9	Exercises on Motion controller using servo motors, encoders, etc.
10	Exercises on fiber optics transducers.
11	Exercises on stepper motor
12	Exercises on microprocessor based data acquisition system.
13	Software simulation of fluid power circuits using Automation studio.

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EX.NO:1

DATE:

INTRODUCTION OF AUTOMATION SYSTEM AND SYMBOLS

AIM:

To study about the important features ,about Automation system and symbols

Introduction to Automation system:

Introduction ELECTRICAL power is one of the most important infrastructure inputs necessary for the rapid economic development of a country. The ever-rising demand of electrical energy has led to the installation and incorporation of a large number of electrical power generation units, with increased capacities in a common power grid, making the operation of the entire system sensitive to the prevailing conditions. Therefore, the extensive and complex power systems have become unmanageable using the conventional instrumentation and control schemes. Intelligent systems based on microprocessors and computers have been employed for online monitoring and control of modern large-scale power systems, in generation, transmission and distribution, thereby overcoming the complexities and drawbacks of the conventional instrumentation schemes.

The term “Automation”

Automation is the use of scientific and technological principles in the manufacture of machines that take over work normally done by humans. This definition has been disputed by professional scientists and engineers, but in any case, the term is derived from the longer term “automatization” or from the phrase “automatic operation”. Delmar S. Harder, a plant manager for General Motors, is credited with first having used the term in 1935.

History of Automation Ideas for ways of automating tasks have been in existence since the time of the ancient Greeks. The Greek inventor Hero (fl. about A.D. 50), for example, is credited with having developed an automated system that would open a temple door when a priest lit a fire on the temple altar. The real impetus for the development of automation came, however, during the Industrial Revolution of the early eighteenth century. Many of the steam-powered devices built by James Watt, Richard Trevithick, Richard Arkwright, Thomas Savery, Thomas Newcomen, and their contemporaries were simple examples of machines capable of taking over the work of humans.

One of the most elaborate examples of automated machinery developed during this period was the draw loom designed by the French inventor Basile Bouchon in 1725. The instructions for the operation of the Bouchon loom were recorded on sheets of paper in the form of holes. The needles that carried thread through the loom to make cloth were guided by the presence or absence of those holes. The manual process of weaving a pattern into a piece of cloth through the work of an individual was

transformed by the Bouchon process into an operation that could be performed mindlessly by merely stepping on a pedal. Automation Applications Manufacturing companies in virtually every industry are achieving rapid increases in productivity by taking advantage of automation technologies. When one thinks of automation in manufacturing, robots usually come to mind.

The automotive industry was the early adopter of robotics, using these automated machines for material handling, processing operations, and assembly and inspection. Donald A. Vincent, executive vice president, Robotic Industries Association, predicts a greater use of robots for assembly, paint systems, final trim, and parts transfer will be seen in the near future. One can break down automation in production into basically three categories: fixed automation, programmable automation, and flexible automation. The automotive industry primarily uses fixed automation. Also known as "hard automation," this refers to an automated production facility in which the sequence of processing operations is fixed by the equipment layout. A good example of this would be an automated production line where a series of workstations are connected by a transfer system to move parts between the stations. What starts as a piece of sheet metal in the beginning of the process, becomes a car at the end.

Programmable automation is a form of automation for producing products in batches. The products are made in batch quantities ranging from several dozen to several thousand units at a time. For each new batch, the production equipment must be reprogrammed and changed over to accommodate the new product style. Flexible automation is an extension of programmable automation. Here, the variety of products is sufficiently limited so that the changeover of the equipment can be done very quickly and automatically.

The reprogramming of the equipment in flexible automation is done off-line; that is, the programming is accomplished at a computer terminal without using the production equipment itself. Computer numerical control (CNC) is a form of programmable automation in which a machine is controlled by numbers (and other symbols) that have been coded into a computer. The program is actuated from the computer's memory.

The machine tool industry was the first to use numerical control to control the position of a cutting tool relative to the work part being machined. The CNC part program represents the set of machining instructions for the particular part, while the coded numbers in the sequenced program specifies x-y-z coordinates in a Cartesian axis system, defining the various positions of the cutting tool in relation to the work part.

Automation tools:

- ANN – Artificial neural network
- DCS – Distributed Control System
- HMI – Human Machine Interface
- SCADA – Supervisory Control and Data Acquisition
- PLC – Programmable Logic Controller
- Instrumentation
- Motion control
- Robotics

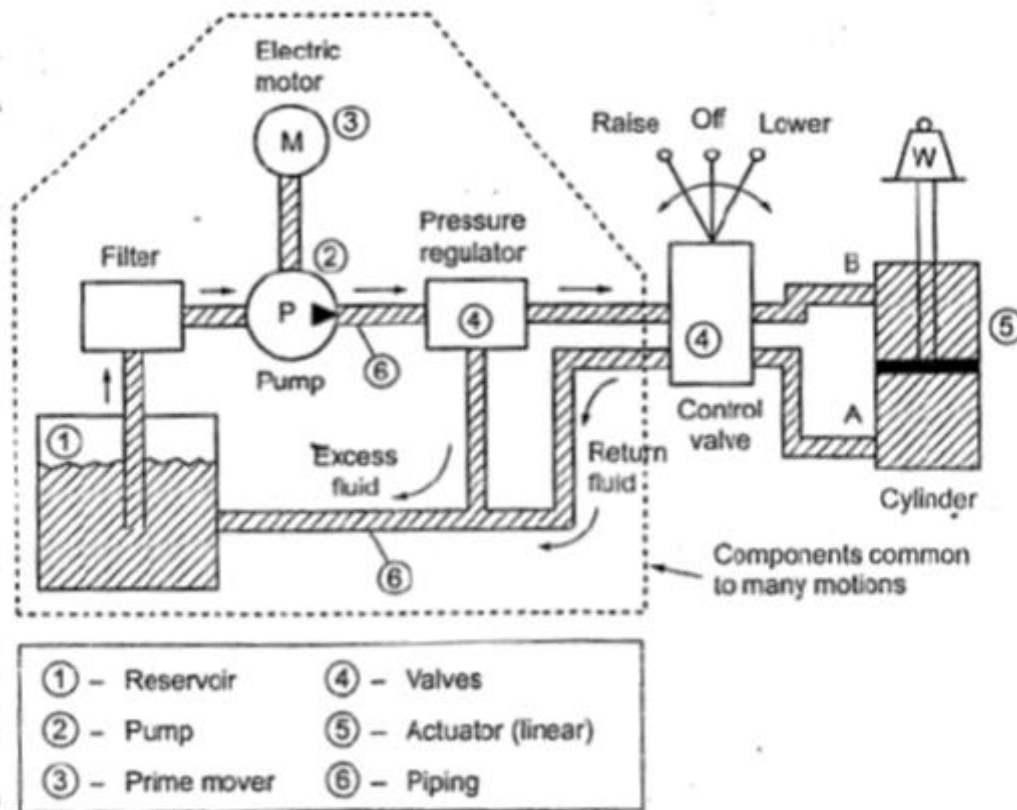
Advantages and Disadvantages:

- Increased throughput or productivity.
- Improved quality or increased predictability of quality.
- Improved robustness (consistency), of processes or product.
- Increased consistency of output.
- Reduced direct human labor costs and expenses.
- Installation in operations reduces cycle time.
- Can complete tasks where a high degree of accuracy is required.
- Replaces human operators in tasks that involve hard physical or monotonous work (e.g., using one forklift with a single driver instead of a team of multiple workers to lift a heavy object)^[43]
- Reduces some occupational injuries (e.g., fewer strained backs from lifting heavy objects)
- Replaces humans in tasks done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc.)
- Performs tasks that are beyond human capabilities of size, weight, speed, endurance, etc.
- Reduces operation time and work handling time significantly.
- Frees up workers to take on other roles.
- Provides higher level jobs in the development, deployment, maintenance and running of the automated processes.

The main disadvantages of automation are:

- Possible security threats/vulnerability due to increased relative susceptibility for committing errors.
- Unpredictable or excessive development costs.
- High initial cost.
- Displaces workers due to job replacement.
- Leads to further environmental damage and could compound climate change.

Hydraulic System



Schematic Layout of Hydraulic System

BASIC COMPONENTS OF A HYDRAULIC SYSTEM:

Reservoir (or air tank):

A reservoir is an oil supply tank. It is provided to hold the hydraulic liquid (usually oil).

Pump:

The pump is used to force the liquid into the system.

Prime mover:

A Prime mover, usually an electric motor, is used to drive the pump.

Valves:

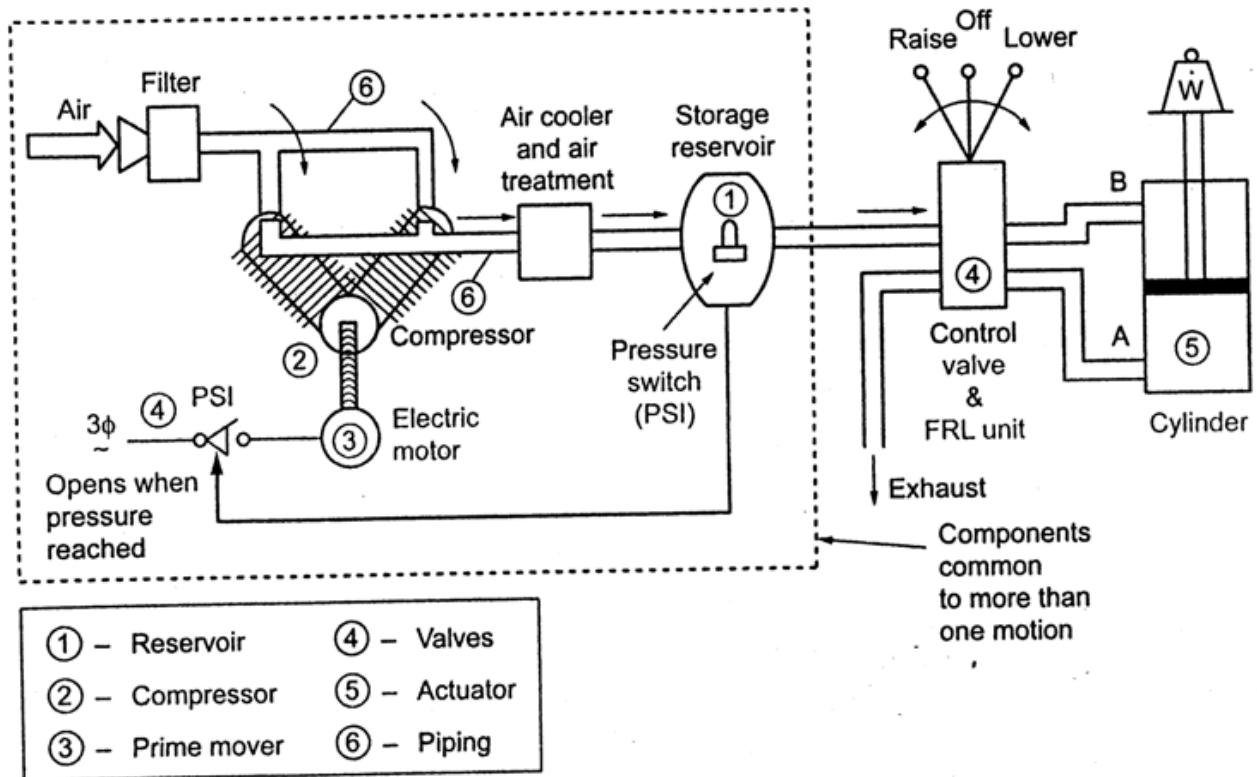
Valves are refitted in the system to control liquid direction, pressure, and flow rate.

Actuator:

An actuator is provided to convert the liquid energy into mechanical force or torque to do useful work. The actuator is the actual working element of the system. The actuators can be either cylinders (to provide linear motion) or hydro motors (to provide rotary motion).

Fluid-transfer piping:

The hydraulic Piping is provided to carry the compressed liquid from one place to another.



Schematic Layout of Pneumatic System

Compressor:

The compressor is used to compress the atmospheric air so as to increase the pressure of the air.

Prime mover:

A Prime mover, usually an electric motor, is used to drive the compressor.

Valves:

Valves are refitted in the system to control air direction, pressure, and flow rate.

Actuator:

An actuator is provided to convert the air energy into mechanical force or torque to do useful work.

Fluid-transfer piping:

Piping is provided to carry the compressed air from one place to another.

BASIC COMPONENTS OF A PNEUMATIC SYSTEM:**Reservoir (or air tank):**

An air tank is provided to store the compressed air required for the operations.

Compressor:

The compressor is used to compress the atmospheric air so as to increase the pressure of the air.

Prime mover:

A Prime mover, usually an electric motor, is used to drive the compressor.

Valves:

Valves are refitted in the system to control air direction, pressure, and flow rate.

Actuator:

An actuator is provided to convert the air energy into mechanical force or torque to do useful work.








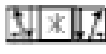






Fluid-transfer piping:


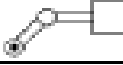













Piping is provided to carry the compressed air from one place to another.















BASIC SYMBOLS USED IN HYDRAULIS AND PNEUMATIC SYSTEM:



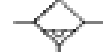




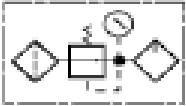

Symbols	Description
LINES	
—————	-continuous line - flow line
- - - - -	-dashed line - pilot, drain
— · — · —	-envelope - long and short dashes around two or more component symbols
CIRCULAR	
○	-large circle - pump, motor
○	-small circle - Measuring devices
D	-semi-circle - rotary actuator
SQUARE	
□	-one square - pressure control function -two or three adjacent squares - directional control
DIAMOND	
◇	-diamond - Fluid conditioner (filter, separator, lubricator, heat exchanger)
MISCELLANEOUS SYMBOLS	
N	-Spring
X	-Flow Restriction
TRIANGLE	
▼	-solid - Direction of Hydraulic Fluid Flow
▽	-open - Direction of Pneumatic flow
PUMPS AND COMPRESSORS	
Fixed Displacement Hydraulic Pump	
⦿	-unidirectional
⊗	-bidirectional
Variable Displacement Hydraulic Pump	
⦿	-unidirectional
Compressor	
⦿	-Compressor

Symbols	Description
MOTORS	
Fixed Displacement Hydraulic Motor	
	-unidirectional
	-bidirectional
Variable Displacement Hydraulic Motor	
	-unidirectional
	-bidirectional
Pneumatic Motor	
	-unidirectional
	-bidirectional
Rotary Actuator	
	- hydraulic
	- pneumatic
CYLINDERS	
Single Acting Cylinder	
	-returned by external force
	-returned by spring or extended by spring force
Double Acting Cylinders	
	-single piston rod (fluid required to extend and retract)
	-double ended piston rod
Cylinders With Cushions	
	- single fixed cushion
	- double fixed cushion
	- single adjustable cushion
	- double adjustable cushion

Symbols	Description
DIRECTIONAL CONTROL VALVES	
Directional Control Valve (2 Ports / 2 Positions)	
	-Normally closed directional control valve with 2 ports and 2 finite positions.
	-Normally open directional control valve with 2 ports and 2 finite positions.
Directional Control Valve (3 Ports / 2 Positions)	
	-Normally closed directional control valve with 3 ports and 2 finite positions.
	-Normally open directional control valve with 3 ports and 2 finite positions.
Directional Control Valve (4 Ports / 2 Positions)	
	-directional control valve with 4 ports and 2 finite positions
Directional Control Valve (4 Ports / 3 Positions)	
	-directional control valve with 4 ports and 3 finite positions ±-(center position can have various flow paths)
Directional Control Valve (5 Ports / 2 Positions) Normally A Pneumatic Valve	
	-directional control valve with 5 ports and 2 finite positions
Directional Control Valve (5 Ports / 3 Positions) Normally A Pneumatic Valve	
	-directional control valve with 5 ports and 3 finite positions
CONTROL METHODS	
Manual Control	
	-general symbol (without showing the control type)
	-pushbutton
	-lever
	-foot pedal
Mechanical Control	
	-plunger or tracer
	-spring

Symbols	Description
	-roller
	-roller(one direction only)
Electrical Control	
	-Solenoid (the one winding)
Pilot Operation	
	-pneumatic
	-hydraulic
Pilot Operated Two-Stage Valve	
	-Pneumatic: Sol first stage
	-Pneumatic: Air pilot second stage
	-Hydraulic: Sol first stage
	-Hydraulic: Hyd pilot second stage
CHECK VALVES, SHUTTLE VALVES, RAPID EXHAUST VALVES	
	-check valve -free flow one direction, blocked flow in other direction
	-pilot operated check valve, pilot to close
	-pilot operated check valve, pilot to open
Shuttle Valve	
	-to isolate one part of a system from an alternate part of circuit
Rapid Exhaust Valve/Pneumatic	
	-installed close to an actuator for rapid movement of the actuator
PRESSURE CONTROL VALVES	
Pressure Relief Valve(Safety Valve) Normally Closed	
	- Line pressure is limited to the setting of the valve, secondary part is directed to tank

Symbols	Description
Proportional Pressure Relief	
	- line pressure is limited to and proportional to an electronic signal
Sequence Valve	
	- When the line pressure reaches the setting of the valve, valve opens permitting flow to the secondary port. The pilot must be externally drained to tank.
Pressure Reducing Valve	
	- pressure downstream of valve is limited to the setting of the valve
FLOW CONTROL VALVES	
Throttle valve	
	-adjustable output flow
Flow Control Valve	
	-with fixed output (variations in inlet pressure do not affect rate of flow)
	-with fixed output and relief port to reservoir with relief for excess flow (variations in inlet pressure do not affect rate of flow)
	-with variable output
	-fixed orifice
	-metered flow toward right free flow to left
	-pressure compensated flow control fixed output flow regardless of load
	-pressure and temperature compensated
	-with variable output and relief port to reservoir
Flow Dividing Valve	
	-flow is divided equally to two outputs
SHUT-OFF VALVE	
	-Simplified symbol

Symbols	Description
FILTERS, WATER TRAPS, LUBRICATORS AND MISCELLANEOUS APPARATUS	
Filter or Strainer	
	-filter
Water Trap	
	-with manual drain
	-with automatic drained
Filter With Water Trap	
	-with manual drain
	-automatic drain
Air Dryer	
	- refrigerant, or chemical removal of water from compressed air line
Lubricator	
	-oil vapor is inducted into air line
Conditioning unit	
	-compound symbol of filter, regulator, lubricator unit
	-Simplified Symbol

RESULT:

Thus the important feature Automation system was studied.

EX.NO:2

DATE:

INTRODUCTION OF PROGRAMMABLE LOGIC CONTROLLER (PLC)

The programmable logic controller (PLC) is a solid state electronic device designed to replace electromechanical relays, timers, counters and sequences, by using a programmable memory for the internal storage of user oriented instructions for implementing specific functions such as logic sequencing timing, counting and arithmetic control through digital or analog inputs and outputs, various types of machines or processes.

Major advantages of using PLC are as follows:

1. The PLC is a hardened industrial computer designed to withstand the harsh factory environment.
2. PLCs are reusable they contain a changeable program that eliminates extensive and component changes and that makes them cost effective
3. PLCs offer easy troubleshooting
4. PLCs feature easy installation and small size.
5. Increase productivity.
6. Ease of programming.
7. Ability to communicate with computer.

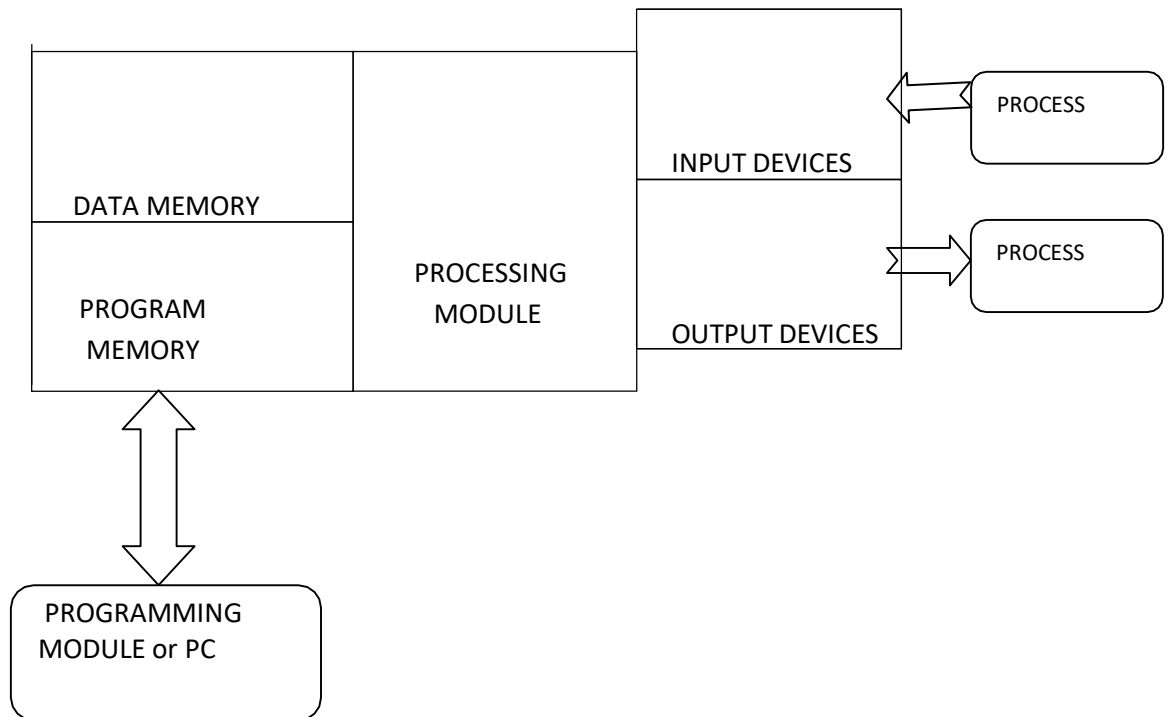


Fig.1.1 ARCHITECTURE OF PLC

Some of the used Instructions Bit

Instructions

The following instructions are used with fixed, SLC 5/01, SLC 5/02, SLC 5/03, and SLC 5/04 processors.

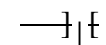
If you want to:	Use this Instruction:
Examine a bit for an On conditions	XIC
Examine a bit for an Off conditions	XIO
Turn a bit On or Off	OTE
Turn a bit On	OLT
Turn a bit Off	OUT
Trigger a one time event	OSR

Examine if Closed (XIC)



Use the XIC instruction in your ladder to determine if a bit is on. When the instruction is executed, if the bit addressed is on (1), then the instruction is evaluated as true. When the instruction is executed, if the bit addressed off (0), then the instruction is evaluated as false.

Examine if Open (XIO)



Use an XIO instruction in your ladder program to determine if a bit is off. When the instruction is executed, if the bit addressed is off (0), then the instruction is evaluated as true. When the instruction is evaluated as false.

Output Energize



Use an OTE instruction in your ladder program to turn on a bit when rung conditions are evaluated as true.

Output Latch (OTL)



The OTL instruction is a retentive output instruction that can only turn on a bit. It cannot turn off a bit. This instruction is traditionally used in pairs with an Output Unlatch (OUT) instruction, with both instructions addressing the same bit. You can also use this to initialize data values at the bit level.

Output Unlatch (OTU)



The OTU instruction is a retentive output instruction that can only turn off a bit. It cannot turn on a bit. This instruction is traditionally used in pairs with an Output Latch (OTL) instruction, with both instructions addressing the same bit. You can use this to initialize data values at the bit level.

One Short Rising (OSR)

The OSR instruction is a retentive input instruction that triggers an event to occur one time. Use the OSR instruction when an event must start based on the change of state of the rung from false to true, not on the resulting status. Applications include starting events triggered by a pushbutton switch. An example is freezing rapidly displayed LED values.

Timer and Counter Instructions

Timers and counters are output instructions. Use the following instructions with fixed, SLC 5/01, SLC 5/02, SLC 5/02, SLC 5/03, and SLC 5/04 processors.

If you want to:	Use this instruction:
Count time base intervals when the instruction is true	TON
Count time base intervals when the Instruction is false	TOF
Count time base intervals when the instruction is true and retain the accumulated value when the instruction goes false	RTO
Increment the count at each false-to-true transition.	CTU
Decrement the count at each false-to-true transition	CTD
Count high-speed pulses from a fixed Controller High-speed input	HSE
Reset the accumulated value and status bits of a timer or counter. Do not use with TOF timers.	RES

Timer On-Delay (TON)

TON	
Timer	T4: 0
Timer Base	0.01

Use the TON instruction to turn an output on or off after the timer has been on for a preset time interval. The TON instruction begins to count time base intervals when rung conditions become true. As long as rung conditions remain true, the timer adjusts its accumulated value (ACC) each evaluation until it reaches the preset value (PRE). The accumulated value is reset when rung conditions go false, regardless of whether the timer has timed out.

Timer Off-Delay (TOF)

TOF	
TIMER OFF DELAY	
Timer	T4:1
Time base	0.01

Use the TOF instruction to turn an output on or off after its rung has been off for a preset time interval. The TOF instruction begins to count time base intervals when the rung makes a true-to-false transition. As long as rung conditions remain false, the timer increments its accumulated value (ACC) each scan until it reaches the preset value (PRE). The accumulated value is reset when rung conditions go true the timer has timed out.

RTO	
RETENTIVE TIMER ON	
Timer	T4: 2
Time base	0.01

Retentive Timer (RTO)

Use the RTO instruction to turn an output on or off after its timer has been on for a preset time interval. The RTO instruction is a retentive instruction that begins to count time base intervals when rung conditions become true. As long as rung conditions remain true, the timer increments its accumulated value (ACC) until it reaches the preset value (PRE).

Using counters

Counter instructions have three word data file elements. Word 0 is the control word, containing the status bits of the instructions. Word 1 is the preset value; word 2 is the accumulated value.

How Counters Work: The figure below demonstrates how a counter works. The count value must remain in the range of –32768, a counter status overflow (OV) or underflow (UN) bit is set.

Count Up (CTU)

CTU COUNT	
UP	
Prese	120

The CTU is a retentive output instruction that counts false-to-true rung transitions. Rung transitions can be caused by events occurring in the program such as parts traveling past a detector or actuating a limit switch.

Count Down (CTD)

CTD	
COUNT DOWN	
Counter	C5:1
Preset	120

The CTD is a retentive output instruction that counts false-to-true rung transitions. Rung transitions can be caused by events occurring in the program such as parts traveling past a detector or actuating a limit switch.

High-Speed Counter (HSC)

HSC	
HIGH SPEED COUNTER	
Counter	C5:0
Preset	120

The High-Speed Counter is a variation of the CTU counter. The HSC instruction is enabled when the rung logic is true and disabled when the rung logic is false.

Reset (RES)

Use a RES instruction to reset a timer or counter. When the RES instruction is enabled, it resets the retentive on-delay timer, count up, or countdown instruction having the same address as the RES instruction.

Math Instruction

The following output instruction allows you to perform computation and math operations on individual words. Use these instructions with fixed. SLC 5/01, SLC 5/02, SLC 5/03, and SLC 5/04 processors, except where noted.

If you want to:	Use this instruction
Add two values	ADD
Subtract two values	SUB
Multiply one value from another	MUL
Divide one value by another	DIV
Perform a double divide	DDV
Change the sign of the source value and place it in the destination	NEG
Set all bits of a word to zero	CLR
Convert an integer to BCD	TOD
Convert a BCD value to an integer value	FRD
Multiplex data	DCD
Find the square root of a value	SQR
Scale a value	SCL

Add (ADD)

ADD
Source
A
Source

Use the ADD instruction to add one value (source A) to another value (source B) and place the result in the destination.

Subtract (SUB)

SUB

Subtract

Source A

Use the SUB instruction to subtract one value (Source B) from another (Source A) and place the result in the destination.

Multiply (MUL)

MUL

Multipl

y

Source

Use the MUL instruction to multiply one value (source A) by another (source B) and place the result in the destination.

Divide (DIV)

DIV

Divide

Source

A

Source

Use the DIV instruction to divide one value (source A) by another (source B). The rounded quotient is then placed in the destination. If the remainder is 0.5 or greater, round up occurs in the destination. The unrounded quotient is stored in the most significant word of the math register. The remainder is placed in the least significant word of the math register.

Scale Data (SCL)

SCL

Scale

Rate

[/10000]

When this instruction is true, the value at the source address is multiplied by the rate value. The rounded result is added to the offset value and placed in the destination. Use this instruction with SLC 5/02, SLC 5/03, and SLC 5/04 processors.

Comparison Instructions

Following input instructions allow you to compare values of data, Use these instructions with fixed, SLC 5/01, SLC 5/02, SLC 5/03, and SLC 5/04 processors.

If you want to:	this instruction:
Test whether two value is not equal	EQU
Test whether one value is not equal to	EQ
Test whether one value is less than a second value	LES
Test whether one value is less than or equal to a second value	LEQ
Test whether one equal to second value is greater than another	GRT
Test whether one value is greater than or equal to a second value	GEQ
Test portions of two values to see whether they are equal	MEQ
Test whether one value is within the limit range of two other values	LIM

Equal (EQU)

EQU

EQUAL

Source A

Source B

Use the EQU instruction to test whether two values are equal. If source A and source B are equal, the instruction is logically true. If these values are not equal, the instruction is logically false.

Not Equal (NEQ)

NEQ

NOT EQUAL

Source A

Source B

Use the NEQ instruction to test whether two values are not equal. If source A and source B are not equal, the instruction is logically true. If the two values are equal, the instruction is logically false.

Less Than (LES)

LES

LESS THAN

Source A

Source B

Use the LES instruction to test whether one value (source A) is less than another (source B). If source A is less than the value at source B the instruction is logically true. If the value at source A is greater than or equal to the value at source B, the instruction is logically false.

Less Than or Equal (LEQ)

LEQ

LESS THAN OR
EQUAL

Source A

Use the LEQ instruction to test whether one value (source A) is less than or equal to another (source B). If the value at source A is less than or equal to the value at source B, the instruction is logically

true. If the value at source A is greater than the value at source B, the instruction is logically false.

Greater Than (GRT)

GRT
GREATER THAN
Source A
Source B

Use the GRT instruction to test whether one value (source A) is greater than another (source B). If the value at source A is greater than the value at source B. The instruction is logically true. If the value at source A is less than or equal to the value at source B, the instruction is logically false.

Greater Than or Equal (GEQ)

GEQ
GREATER THAN
OR EQUAL
Source A
Source B

Use the GEQ instruction to test whether one value (source A) is greater than or equal to another (source B). If the value at source A is greater than or equal to the value at source B, the instruction is logically true. If the value at source A is less than the value at source B, the instruction is logically false.

Masked Comparison for Equal (MEQ)

MEQ
MASKED EQUAL
Source
Mask

Use the MEQ instruction to compare data at a source address with data at a reference address. Use of this instruction allows portions of the data to be masked by a separate word.

Limit Test (LIM)

LIM
LIMIT TEST
Test
High Lim

Use the LIM instruction to test for value within or outside a specified range, depending on how you set the limits. Use this instruction with 5/02 and 5/03 processors.

Move and Logical Instructions

The following output instructions allow you to perform move and logical operations on individual words. Use these instructions with fixed. SLC 5/01, SLC 5/02, SLC 5/03, and SLC 5/04 processors.

If you want to:	Use this instruction:
Move the source value to the destination	MOV
Move data from a source location to a selected portion of the destination	MVM
Perform an AND operation	AND
Perform an inclusive OR operation	OR
Perform an Exclusive Or operation	XOR
Perform a NOT operation	NOT

Move (MOV)

MOV
MOVE
Source

This output instruction moves the source value to the destination location.

Masked Move (MVM)

MVM
MASKED MOVE
Source

The masked move instruction is a word instruction that moves data from a source location to a destination, and allows portions of the destination data to be masked by a separate word.

RESULT:

Thus the important feature Programmable Logic Controller was studied.

EX.NO:3

DATE:

**SIMULATION OF SINGLE ACTING CYLINDER BY USING
AUTOMATION SOFTWARE**

Aim

To construct a circuit to trigger the forward and return stroke by single acting cylinder using a lever operated dcv(direct method).

Apparatus required

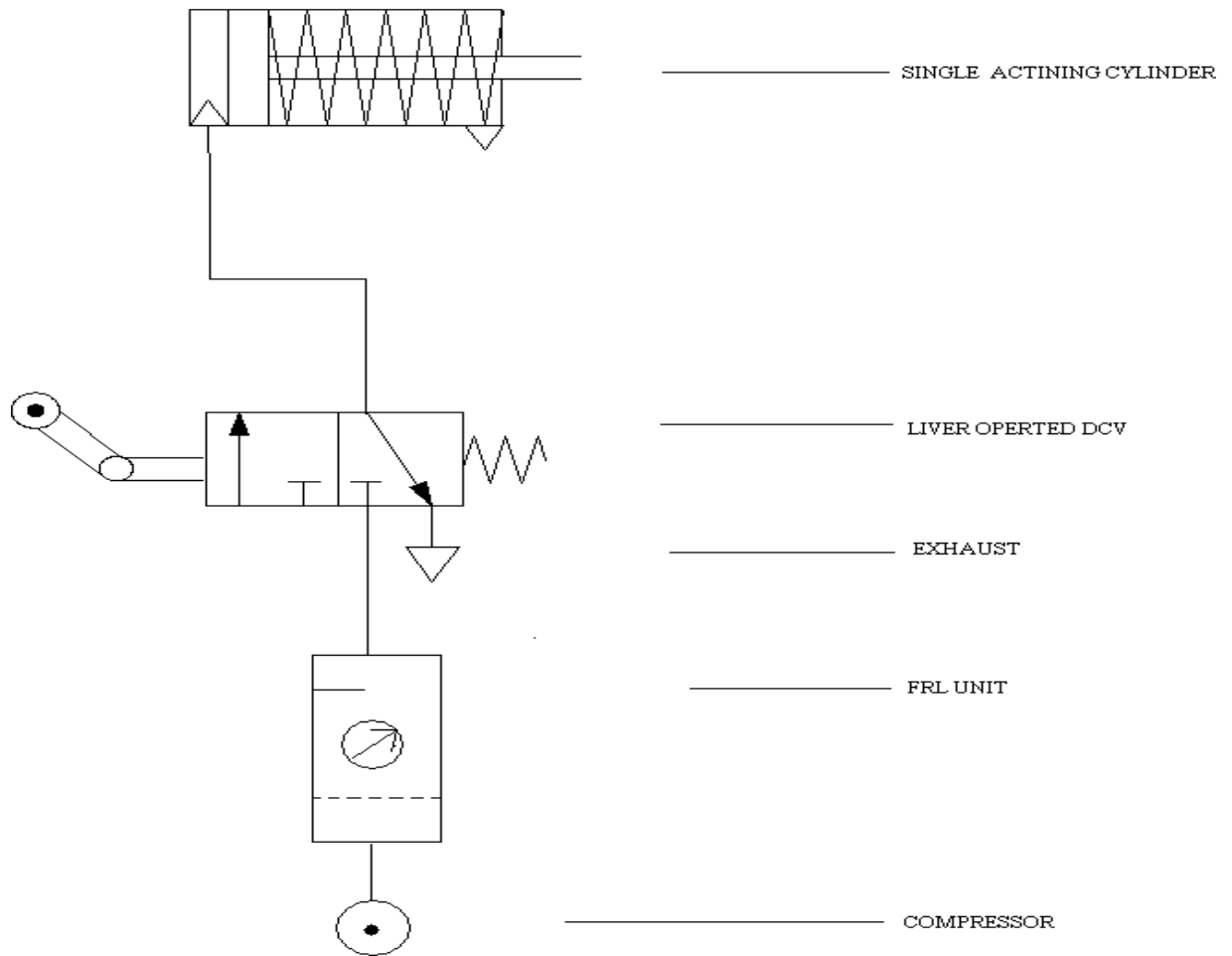
- 1.Automation software
- 2.Computer

Procedure

1. Open the file automation software and open a new file.
2. Then select the required circuit using the library tool bar.
3. Then pick the required cylinder and valves required.
4. Then drag it and place it in the file.
5. Then give the connections as given in the circuit.
6. Then save the circuit and then select the simulation option.

Diagram:

SINGLE ACTING CYLINDER USING LIVER OPERTED DCV



Result:

Thus the simulation operation of a single acting cylinder was done.

EX.NO:4

DATE:

**SIMULATION OF DOUBLE ACTING CYLINDER BY USING
AUTOMATION SOFTWARE**

Aim

To perform the simulation of double acting cylinder with use of automation software.

Apparatus required

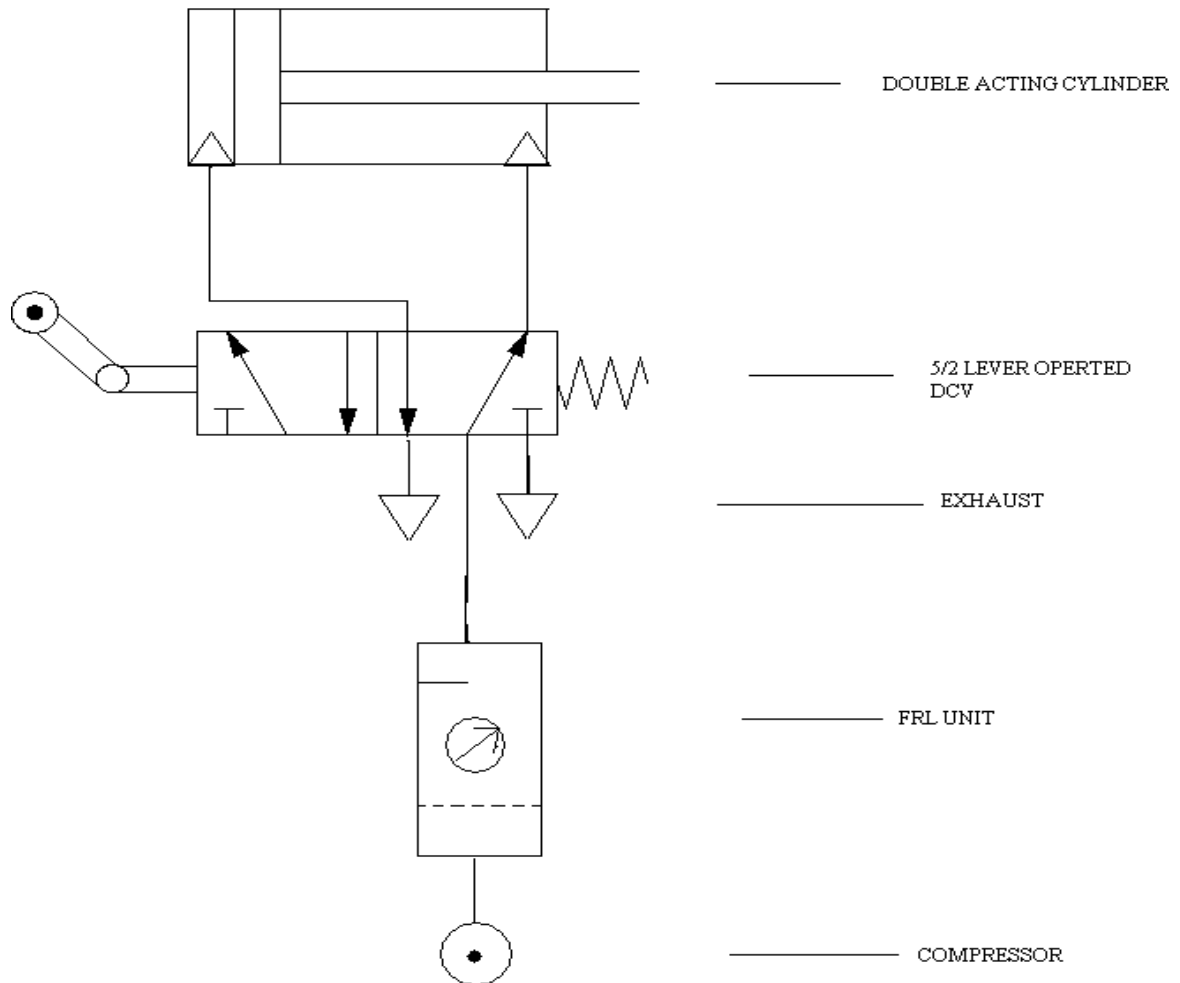
- 1.Automation software
- 2.Computer

Procedure

1. Open the file automation software and open a new file.
2. Then the select the required circuit using the library tool bar.
3. Then pick the required cylinder and valves required.
4. Then drag it and place it is the file.
5. Then give the connections as given in the circuit.
6. Then save the circuit and then select the simulation option.

Diagram:

DOUBLE ACTING CYLINDER USING LEVER OPERATED DCV



Result:

Thus the simulation operation of a double acting cylinder was done.

EX.NO:5

DATE:

DESIGN OF CIRCUITS WITH LOGICAL SEQUENCE (AND GATE) USING ELECTRO PNEUMATIC TRAINER KITS

Aim

To construct a pneumatic circuit to control the single acting cylinder control by Two-way pressure valve using electro pneumatic trainer kits.

Apparatus Required

- Compressor air
- FRL
- Two-way pressure valve
- Single acting cylinder

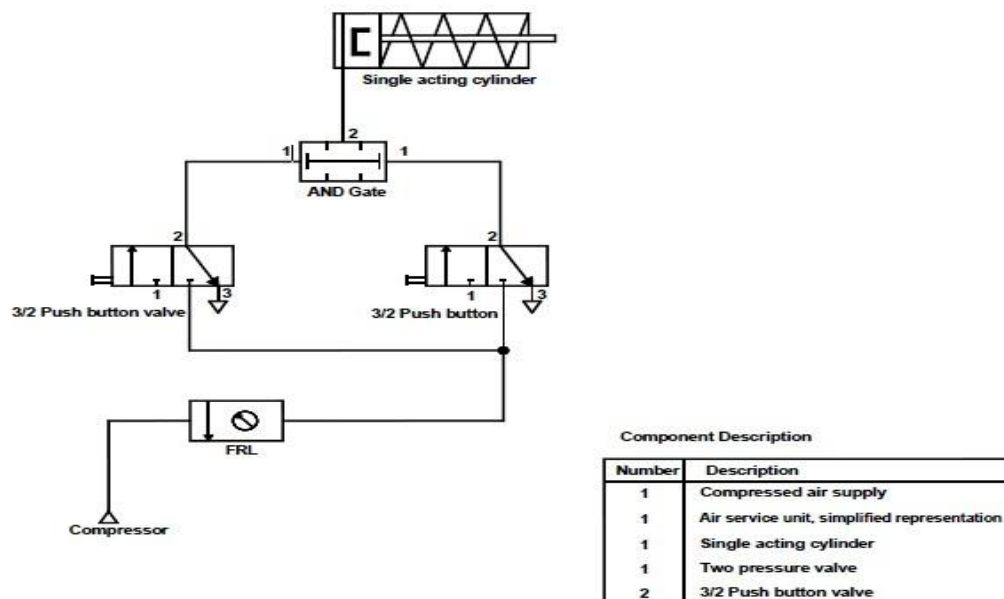


Figure. 1. Circuit Diagram of the AND Logic in the Single Acting Cylinder

Procedure

1. Draw the circuit diagram.
2. Connect the compressor air supply to FRL unit.
3. Any two of the outputs of FRL unit directly connected to **3/2 push button valve** inlet first and second.
4. Both 3/2 push button valves outputs to give **AND Gate input**.
5. Check the all circuit.
6. Open the hand slide valve. The air passes in both 3/2 pushbutton valves input port.
7. When both push buttons is press the cylinder should be activated.

Truth table

Input 1	Input 2	Output
ON	ON	ON
OFF	OFF	OFF
OFF	ON	OFF
ON	OFF	OFF

Result

The pneumatic circuit of two way pressure valve was simulated.

EX.NO:6

DATE:

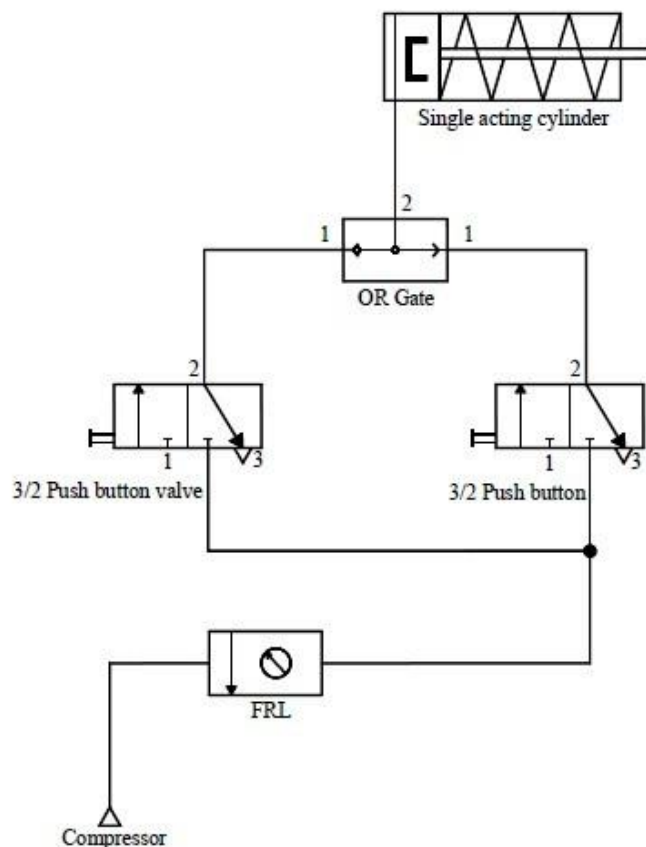
DESIGN OF CIRCUITS WITH LOGICAL SEQUENCE (OR GATE) USING ELECTRO PNEUMATIC TRAINER KITS

Aim

To construct a pneumatic circuit to control the single acting cylinder using electro pneumatic trainer kits.

Apparatus Required

- Compressor air
- Tube
- 3/2 push button valve
- Shuttle valve
- Single acting cylinder



Component Description

Number	Description
1	Compressed air supply
1	Air service unit, simplified representation
1	Single acting cylinder
2	3/2 Push button valve
1	Shuttle valve

Figure. 2. Circuit Diagram of the OR Logic in the Single Acting Cylinder.

Procedure

1. Draw the circuit diagram (Refer Fig. 2)
2. Connect the compressor air supply to FRL unit.
3. Any two of the output of FRL unit to first **3/2 push button valve inlet and second 3/2 push button valve inlet.**
4. Both 3/2 push button valves outputs to give shut the valve inlet ports.
5. Check the all circuits.
6. Open the hand slide valve. The air passes in both 3/2 push button valve inlets.
7. Press any one push button valve. The cylinder will be activated.

Truth table

Input 1	Input 2	Output
OFF	OFF	OFF
ON	OFF	ON
OFF	ON	ON
ON	ON	ON

Result

Thus the single acting cylinder controlled by OR Gate.

EX.NO:7

DATE:

AUTOMATION OF MULTIPLE CYLINDERS IN SEQUENCE (A+B+B-A-) USING PLC

Aim:

To perform sequencing of two pneumatic cylinders (A and B) in the order of A⁺B⁺B⁻A⁻ using PLC.

Apparatus Required:

1. FRL Unit
2. Flow Control valve
3. 5/3 solenoid operated directional control Valve
4. 5/2 solenoid directional control Valve
5. PLC pneumatic trainer
6. Double Acting Pneumatic Cylinder
7. Polyurethane Tubes and Electrical wires

ACTUATED POSITION

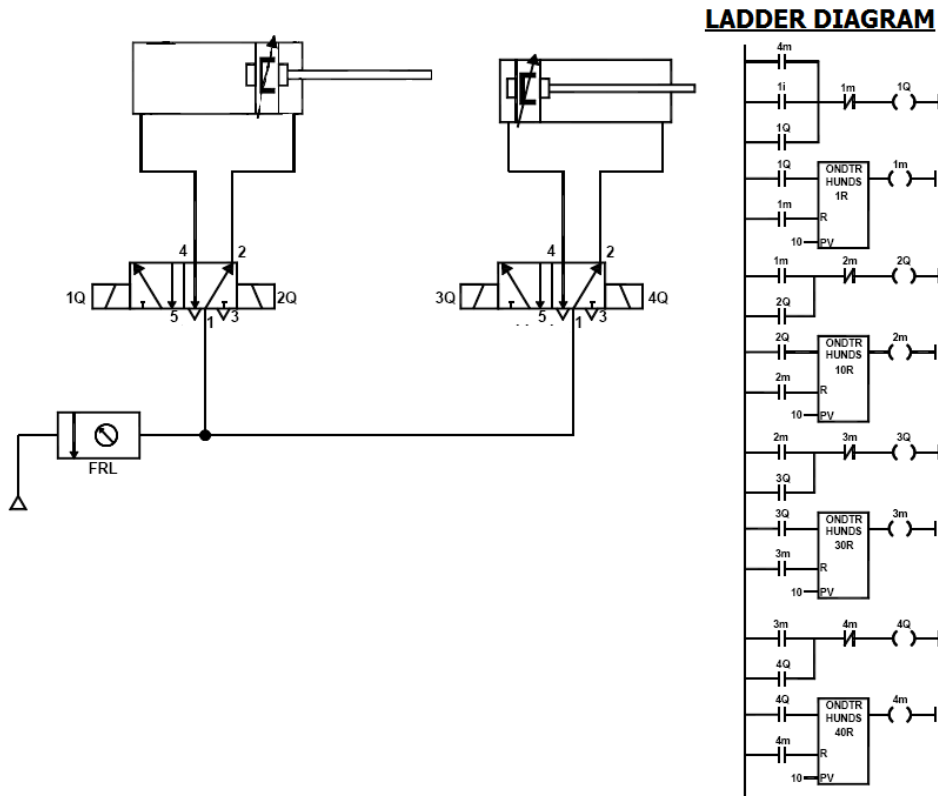


Figure. 3

Procedure:

1. Connect the FRL unit, Control valves, directional control valves and cylinders as shown in the circuit.
2. Draw the functional block diagram using PLC software and save it in the computer.
3. Give connections between PLC and PC using USB port and download the program to the PLC.
4. Give connections from the reed switches to the PLC input and from the PLC output to the respective solenoid valves.
5. Adjust the FRL and set the pressure as 6 bars.
6. Switch on the electric supply.
7. Execute the program from the PLC and observe the sequencing of cylinders being carried out automatically.

RESULT:

Thus the single cycle automation of multiple cylinders is operated in sequence (A+B+B-A-) using PLC.

EX.NO:8

DATE:

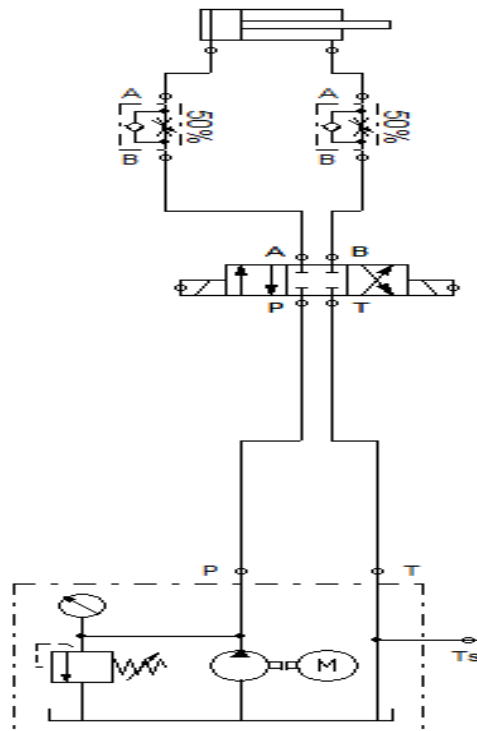
ACTUATION OF HYDRAULIC CYLINDER TO FIND OUT SPEED VS. DISCHARGE

Aim

To actuate the double acting hydraulic cylinder to find out speed vs. discharge

Apparatus required

Oil tank, single-phase motor, gear pump, pressure relief valve, 4/3 double solenoid valve, flow control valve, double acting cylinder, load cell, and data actuation card than lab view software.



Procedure

1. Switch on the electrical power supply with motor.
2. Switch on the power supply to the control unit.
3. Open the lab view software in the system.
4. Inter face hydraulic trainer with system using RS-232.
5. Open the speed. Go to operate, click the run then power on (below).
6. Now extend the system by pressing the up button.

7. Now regulate the flow control valve, contract the system by pressing down position after seen monitor in velocity cm/sec.
8. Now adjust the flow control valves and set the maximum flow, to find the up and velocity.
9. Repeat the velocity values for different flows

HYDRAULIC LINEAR ACTUATION TRAINER

Tabulation

S. No	Velocity in UP (cm/sec)	Velocity in DOWN (cm/sec)	Discharge in UP FLOW (L/sec)	Discharge in DOWN FLOW (L/sec)

Calculation

W. K. T.

- **VelocitySpeed = $\frac{\text{Flow}}{\text{Area}}$**
 - SPEED in 'cm/sec'
 - FLOW(DISCHARGE) in 'L/sec'
 - AREA in 'm²'

- **Area = $\frac{\pi}{4} D^2$**

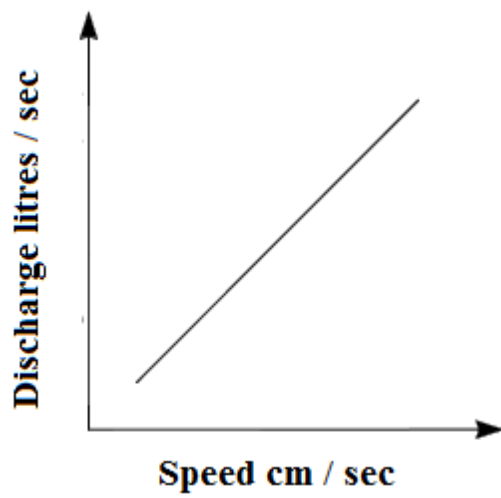
- **Flow = velocity × Area**

MODEL CALCULATION:

D Diameter of Cylinder cm
 Cylinder diameter = 50mm
 Cylinder rod diameter = 30mm
 Cylinder stroke length = 150mm

GRAPH:
Speed VS Discharge

MODEL GRAPH:



Result

The actuation of hydraulic cylinder was carried out.

EX.NO:9

DATE:

WATER LEVEL CONTROLLER USING PROGRAMMABLE LOGIC CONTROLLER

AIM:

To control the water level of a tank using programmable logic controller.

APPARATUS REQUIRED:

1. Level control trainer kit
2. PLC (Allen Bradley Micrologix 1500 LRP series C)
3. PC with RS Logix Software
4. RS232 cable
5. Patch chords

PROCEDURE:

1. Load the RS logix software to the PC
2. Open the RS logix software
3. Switch On the PLC trainer
4. Connect PLC with level control kit.
5. Open the New folder and draw the ladder logic program
6. Select the correct hardware configuration.
7. Store the Program to PLC
8. Run the program
9. Verify the performance of the water level control using PLC.

PROCESS DESCRIPTION:

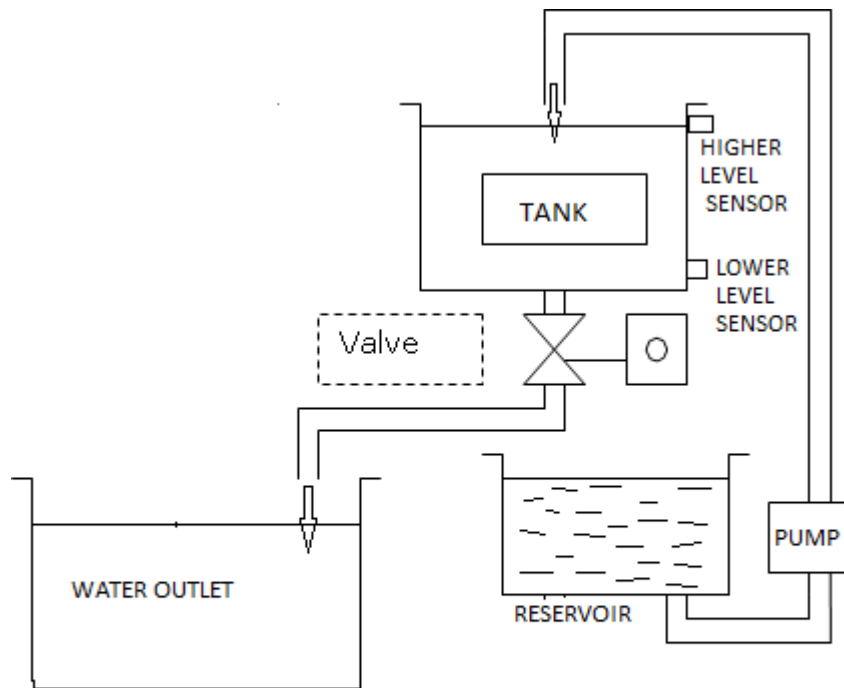
Liquid level control is a basic and necessary process for all the process industry. Here the level of liquid is to be maintained inside the tank to a specific height. Here there is a water reservoir from which the water needs to be pumped out to the process tank.

In the process tank there are two sensors connected around the edges of the tank according to the required heights i.e., one sensor is connected at the near bottom end of the tank called as lower level sensor and another one on the near top edge of the tank called as higher level tank. To let the water out of the tank there is a pipe connected at the bottom of the tank with a valve. This valve is to be used by user for the process application

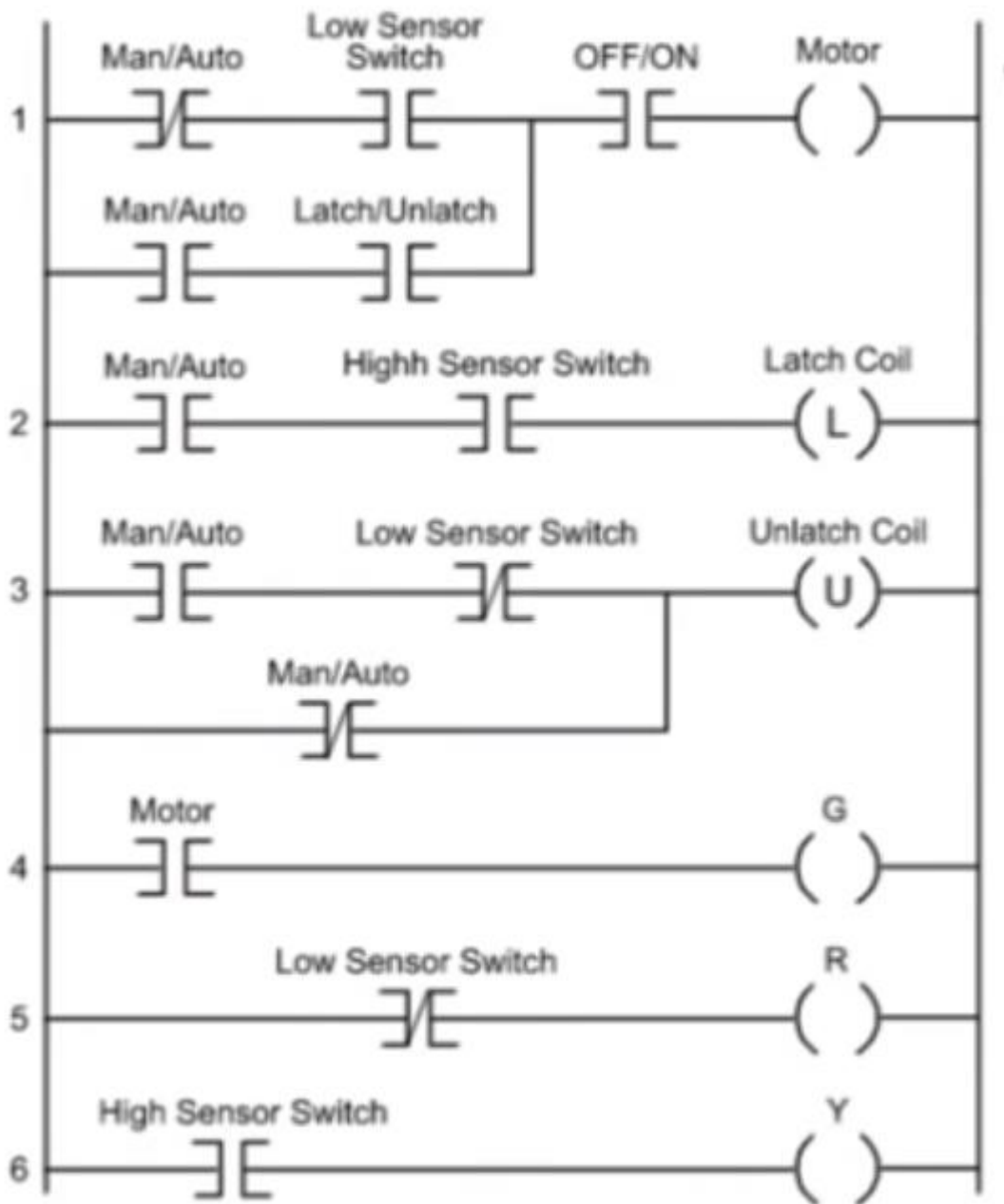
The level sensor is a magnetic sensor and when the liquid level is above the high level sensor a HL (high level) signal is send to the PLC. When the liquid level goes down the low level sensor LL (low level) signal is send to the PLC. The PLC checks the signals send by these sensors through its input port and give the proper signals through its output port as per the ladder logic program.

Sequence of process control actions done by the PLC:

1. When the water level in the tank is less than the lower level then the lower level sensor senses and turns the motor on to fill the tank.
2. Then the tank is filled up until it reaches the higher level where the higher level sensor senses and makes the motor off and filling of water stops.



[BLOCK DIAGRAM OF LIQUID LEVEL SET UP]



RESULT:

The liquid level trainer kit was set up and liquid level was controlled by using PLC ladder logic program.

Exp No:10

Date:

LIFT CONTROL SYSTEM using PLC

Aim:

To control the lift plant model using programmable logic controller.

Apparatus required:

1. Lift control system
2. PLC (Allen Bradley micrologix 1500 LRP series C)
3. PC with RXlogix Software
4. RS232 cable
5. Patch chords

Procedure:

1. Load the RXlogix software to the PC
2. Open the RXlogix software
3. Switch on the PLC trainer and lift controls system
4. Connect PLC with Lift control system kit.
5. Open the New folder and draw the ladder logic program
6. Select the correct hardware configuration.
7. Store the Program to PLC
8. Run the program
9. Verify the performance to the lift control system

Program description:

I1, I2, I3 - Requisition switch.

I4, I5, I6 - Sensor Inputs.

Q2, Q3, Q4, Q5 - Output for stepper motor.

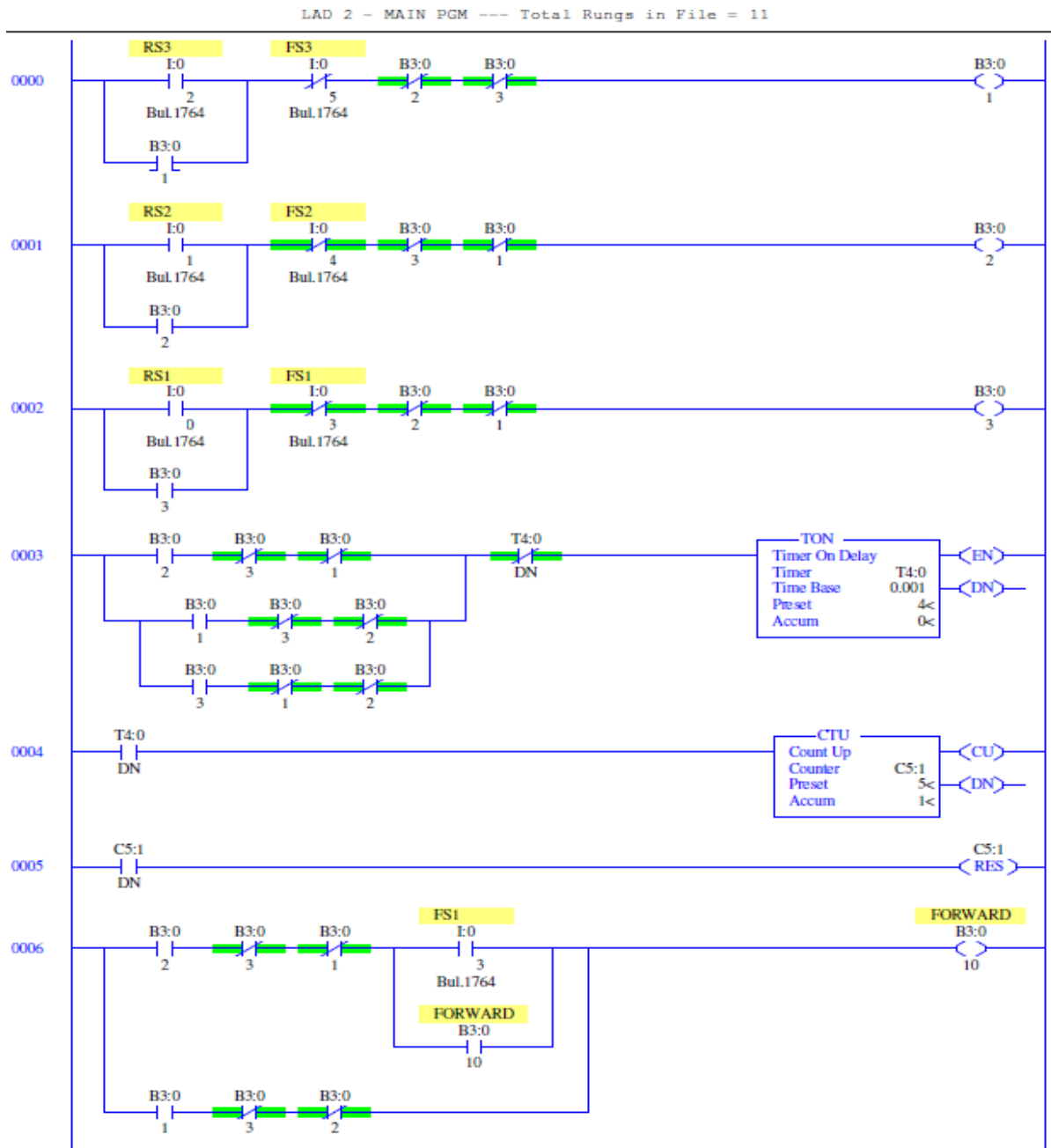
1. I1, I2, I3 are requisition switches I4, I5, I6 are the sensor placed in each floor. The other coils used in the program are the set coil, reset coil, positive transition coil, negative transition coil are in memory location.
2. The timer functions are used to produce the required time delay.
3. Bit sequence functions used to drive the stepper motor.
4. Whenever the requirement switch I1, is pressed the set coil M1 is energized and bit sequence outputs are enabled then the stepper motor rotates.
5. When the motor reaches the respective floor, the switch I4 gets closed and energizes both positive transition coil & negative transition coil.
6. The positive transition coil energizes one more set coil, which is used to enable the timer.
7. This is used to give time delay for the lift in each floor.

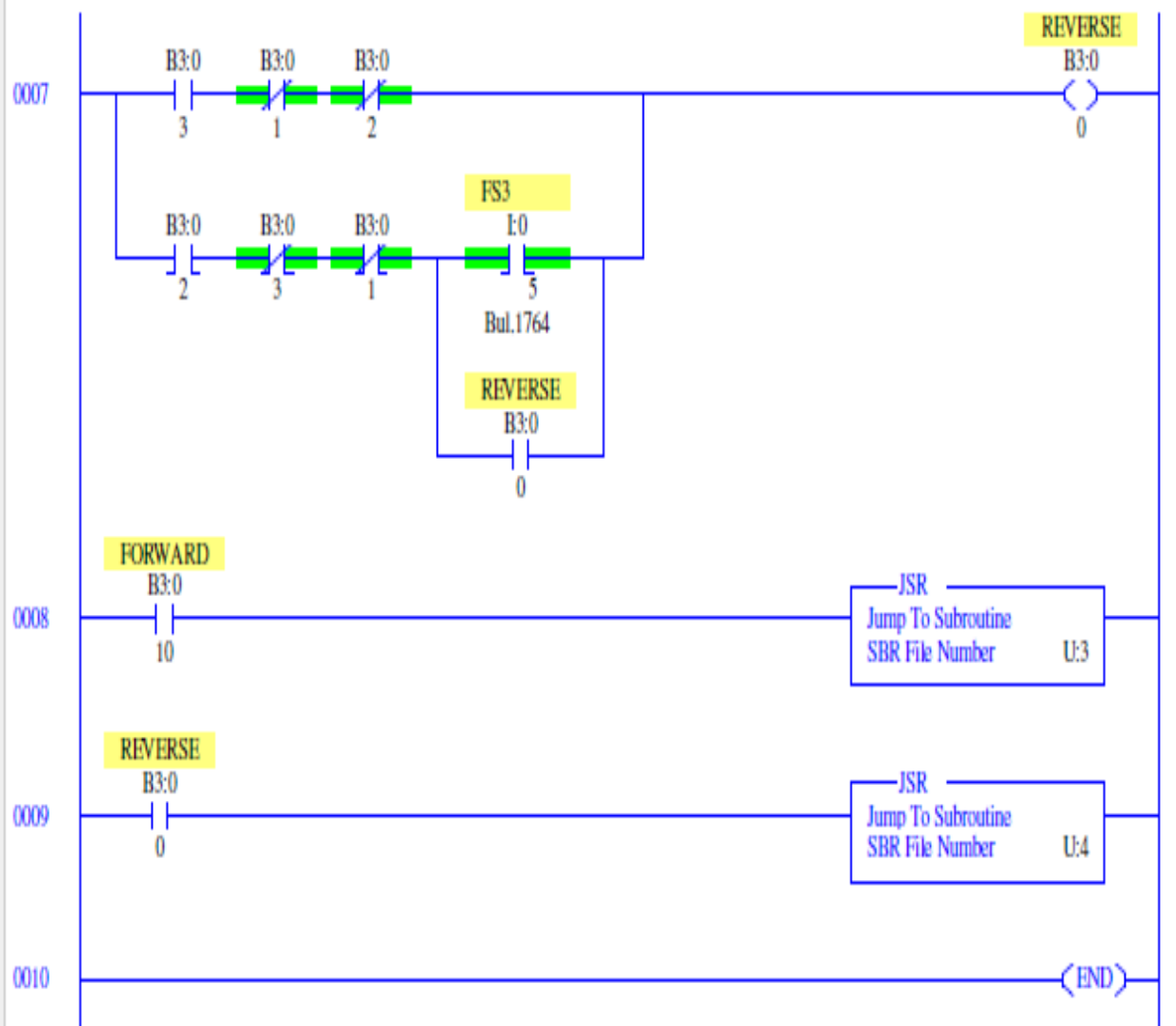
8. The negative transition coil, which was energized, is used to reset the requisition.
9. The above functions are repeated in each floor.

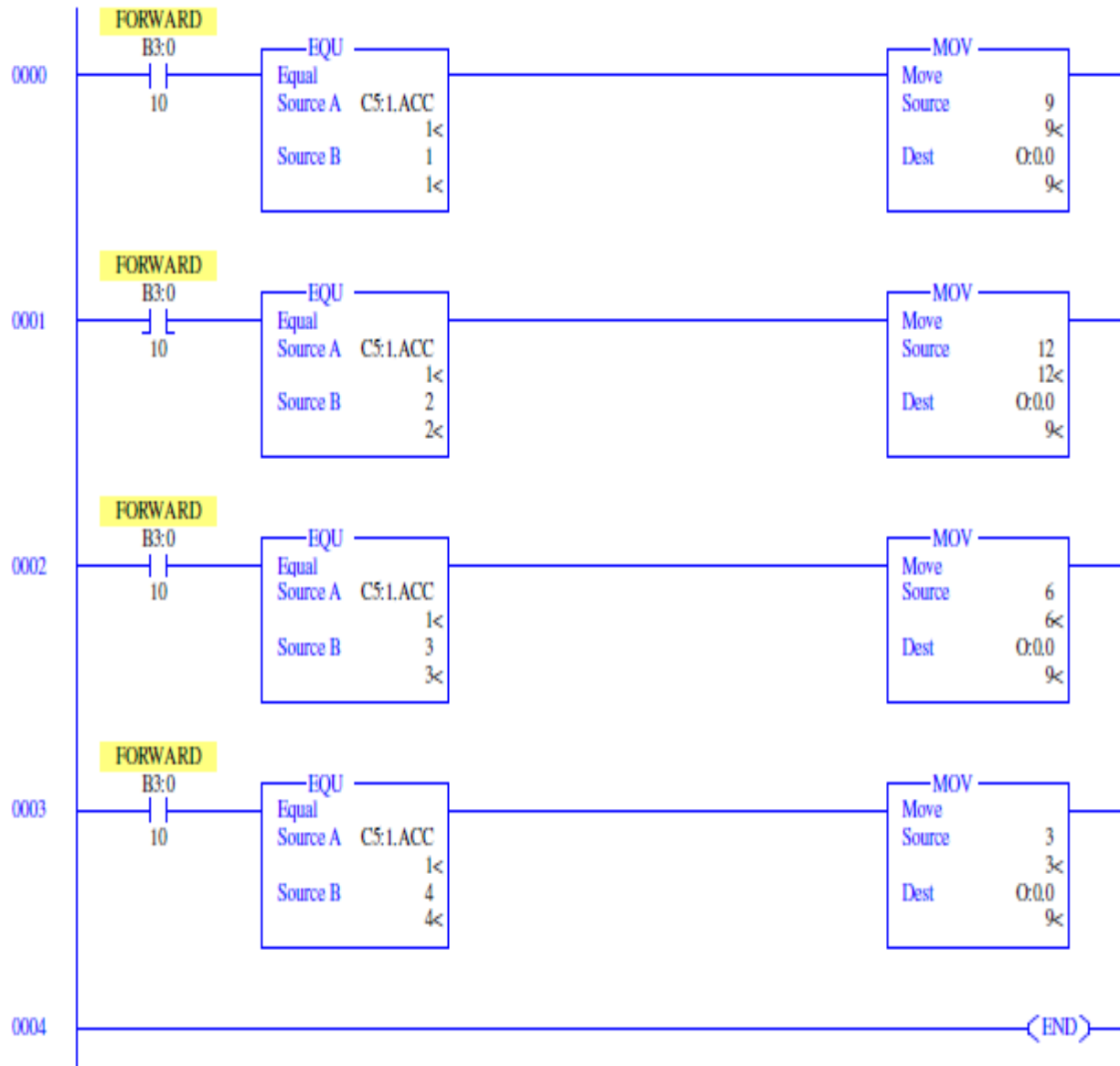
Conditions for rotation of Motor:

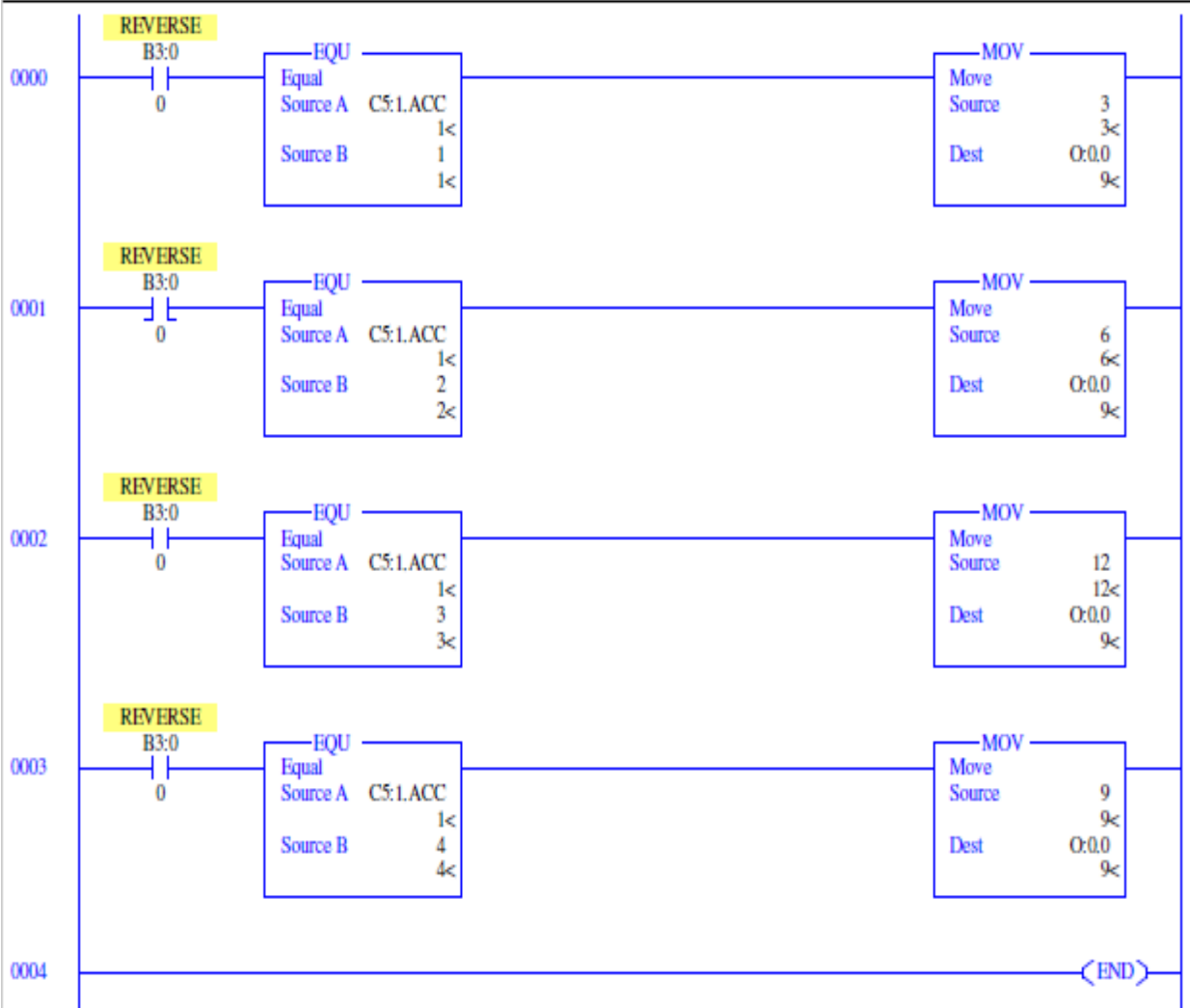
1. Consider the lift is in ground floor, when the requisition is given from first floor or second floor the motor has to move forward.
2. If the lift is in top floor then it has to move in the reverse direction.
3. If the lift is in middle floor then according to the requisition, lift will move in forward or reverse direction.

Program









Result:

It is observed that lift is controlled smoothly by using programmable logic controller.

VIVA - VOCE

1. What is meant by sensor?
2. What are the various types of control system?
3. Distinguish between closed loop system and open loop system.
4. What are the types of strain gauges?
5. Define - LVDT
6. What is meant by fluid power?
7. What is a check valve?
8. What is a solenoid valve?
9. Define – FRL unit
10. Define – DCV
11. Differentiate between meter-in and meter-out controls.
12. What is the function of an unloading valve?
13. What is the function of a sequence valve?
14. What is the function of a shuttle valve?
15. What is the function of a spool valve?
16. What is the function of a process control valve?
17. What is the function of a 2-way pressure valve?
18. Why hydraulic power is especially used in heavy works?
19. Where are pneumatic systems preferred?
20. Name the basic components of a hydraulic system.
21. What is the function of a relief valve in a hydraulic system?
22. Draw the symbols for a pressure relief valve and a pressure reducing valve.
23. What is meant by NC and NO contacts?
24. What is meant by an actuator?
25. What are the types of actuators?
26. What is a control valve?
27. What are the types of control valves?
28. What is a circuit control valve?
29. What is the function of flow control valve?

30. Distinguish between flow control and needle valve.
31. What is the function of time delay valve?
32. What is the function of pilot operated valve?
33. What is a quick exhaust valve?
34. What is the difference between a strainer and a filter?
35. Distinguish between hydraulics and pneumatics?
36. What is the purpose of a pressure regulator?
37. Why lubricator is used in pneumatic systems?
38. What are the advantages of hydro- pneumatics?
39. What is meant by logic control?
40. Name the different pneumatic position sensors.
41. How do you rate a compressor?
42. What is a programmable logic controller?
43. What are the basic elements of a PLC?
44. What are the various approaches for entering the program for PLC?
45. What is a ladder diagram?
46. What is the purpose of an electrical timer?
47. Draw the general ladder rungs to represent a latch circuit.
48. How does a PLC differ from relay logic?
49. What are the features of a PLC?
50. What is the function of proximity switch?



HOD