Cairo University
Faculty of Engineering
Mech. Power Department

دبلوم تطبيقات التحكم الأوتوماتيكى
فى نظم القوى الميكانيكية

MEP 599 Diploma Design Project- Summer Term 2015

PLC Plastic Forming Machine (Automatic High Speed Vacuum Forming Machine)

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Supervised by

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Mechanical Power Engineering Department

Abstract:

The project is to apply the methodology of PLC control in the industrial field of machine automatic control whereas the PLC solution in order to achieve the automatic control objectives:

1- **Safety:** Where the plant or process will be more safe by eliminating the human contact with the machine components like moving parts , welding and cutting tools

2- **Stability:** Where the plant or process will be more stable, predictably and repeatable without variations , fluctuations nor unplanned shutdowns

3- **Accuracy:** Where the plant or process will be more accurate results to prevent spoilage which will increases quality

Increasing quality, productivity and maintain comfort are the fundamentals of economic efficiency

Project Description:

Vacuum Forming, Commonly Known As Vacuforming, Is A Simplified Version Of Thermoforming, Whereby A Sheet Of Plastic Is Heated To A Forming Temperature, Stretched Onto Or Into A Single-Surface Mold, And Held Against The Mold By Applying Vacuum Between The Mold Surface And The Sheet. The Vacuum Forming Process Can Be Used To Make Most Product Packaging, Speaker Casings And Even Car Dashboards.

Feature

1. By Relay Under Automatic Mode.
2. The Sheet Moving By Air Cylinder: Its Speed Can Be Adjustable, The Torque Is Large And High Precision.
3. It Is Reliable In Thick Sheets.
4. Digital Display Pressure Regulating Module Control Oven Temperature: Voltage Stabilization, Temperature Stabilization And Beautiful And Graceful.
5. The Customer Must Offer The Sample Or Drawing, Then We Can Design And Produce The Forming Mold And Cutting Mold

The main component:

Timer and relay: "CKC" Taiwan

Pneumatic components: "Airtac" Taiwan

Infrared ceramic heater: "SME" China

Temperature control: "TCL" stepless fine-tuning

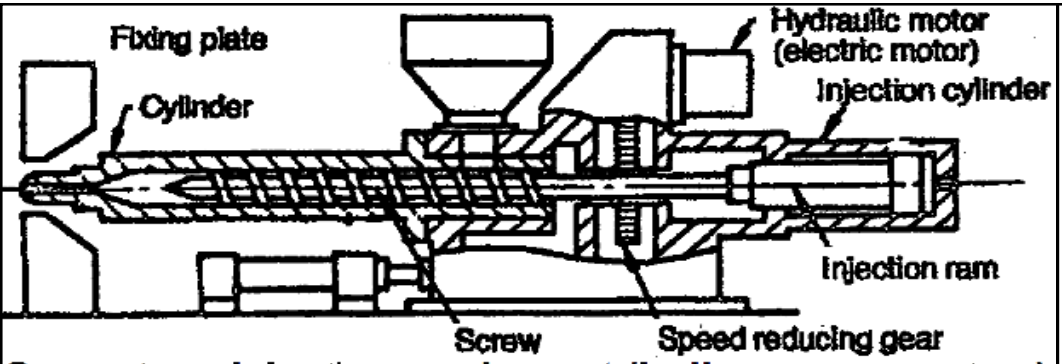
Vacuum pump: made in China

Increase of the function:

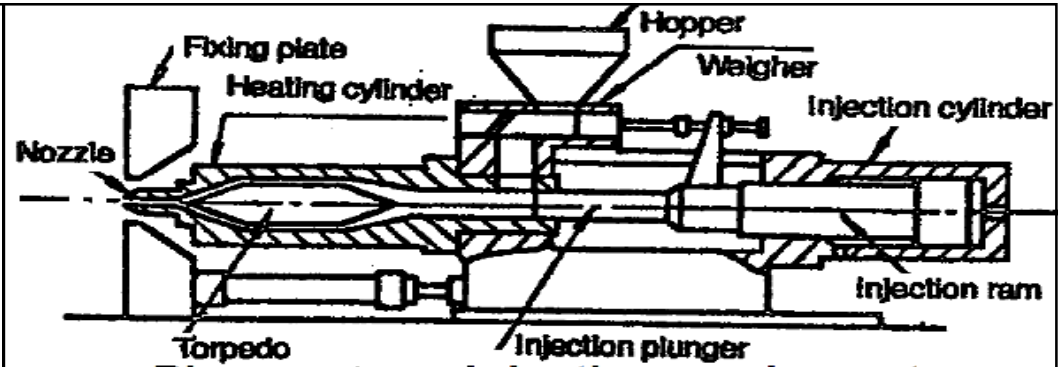
° Function automatically take the mill furnace;

°Pneumatic collection material function;

° Pneumatic pull-chip functions;

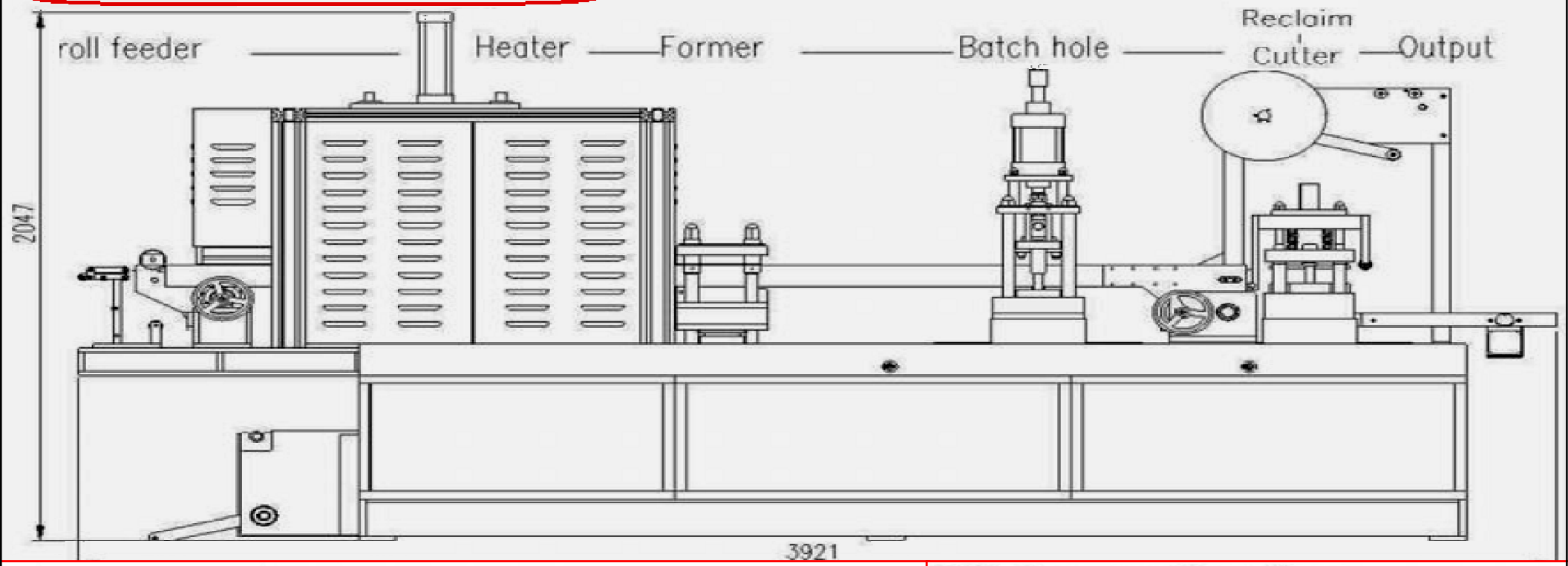


Screw type injection equipment (In-line screw system)



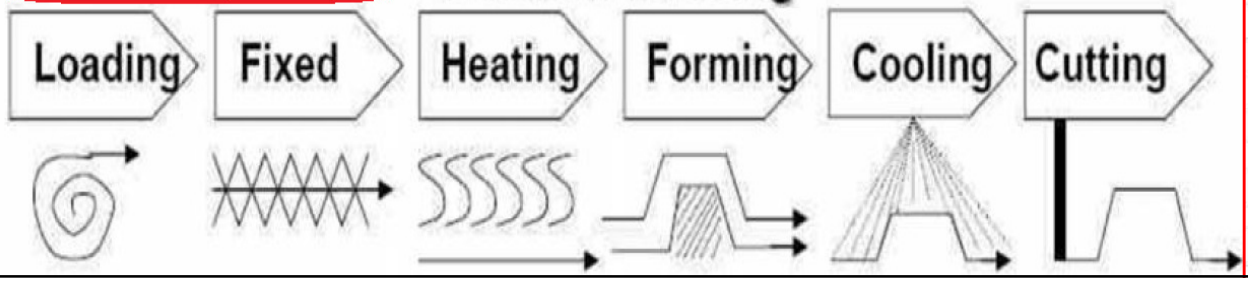
Plunger type Injection equipment

PROJECT LAYOUT:

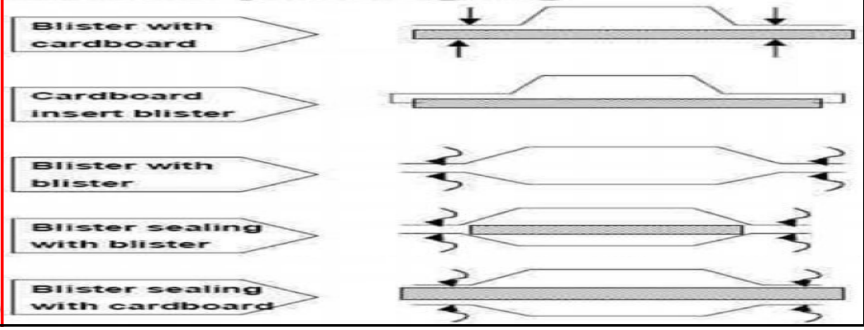


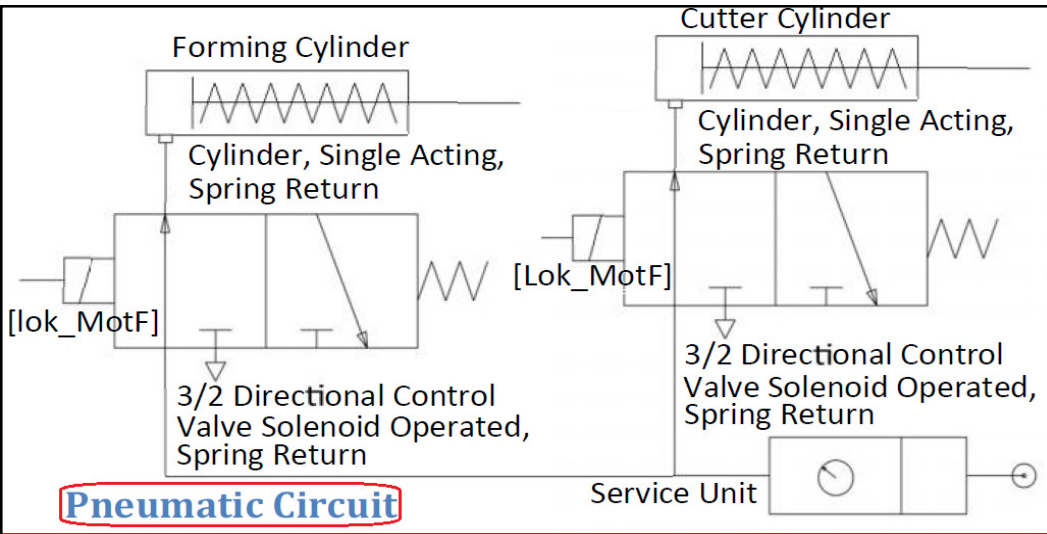
Technical process

Vacuum forming



Blister packaging





Pneumatic Circuit

Project Logic

The Program Should Perform The Tasks As Per The Below Steps:

1- User Press [Start] Button
2- Heater And Rollers Motor Should Start To Enter A Plastic Sheet Length Into The Machine
3- When The Plastic Sheet Reaches The Required Length
4- Roller Motor Should Stop, Actuating Signal Should Be Sent To The Directional Control Valve To Pressurize Locking Mechanism Piston, It Should Be Always Pressurized
5- Time Delay To Allow The Locking Mechanism To Hold The Plastic Sheet
6- Heater Make The Plastic Sheet Ready To Forming
7- Forming Process
8- Cutting Cylinder Should Go On
9- Cutting Cylinder Should Move Down To Start The Cutting, By Sending Actuating Signal To Directional Control Valve To Start The Pressurizing Mechanism Piston
10- After Completing All Steps, The Sequence Should Be Reversed
11- The Pressurizing Piston Should Return By Setting The Actuating Signal To Off And Let It Return By Its Spring
12- Time Delay To Allow The Cutting Tool To Be Far Enough From The Sheet
13- Cutting Cylinder Should Stop
14- The Locking Mechanism To Release The Sheet By Setting The Control Valve Locking Piston Actuating Signal To Off And Let It Return By Its Spring
15- Time Delay To Allow The Sheet To Be Completely Free
16- The Rollers Motor Should Be Reversed To Move The Sheet And The Cut Part Out Of The Machine
17- Time Delay To Make Sure The Sheet Is Out
18- Reset All Variables To Start Another Forming Process

Inputs

Name	Type	Function
Start	Push Button	To Start the operation
Stop	Push Button	To Cancel the operation
Done	Finish Button	Emergency Stop Operation

Outputs

Name	Type	Function
Rol_MotF	Motor Controller	To move the Plastic Sheet forward
Heater	Heater Controller	To Switch I.R Ceramic
Lok_MotF	Solenoid valve	To Move the locking piston forward
Former	Single Acting Cylinder	To Make Forming In Plastic Sheet
Cutter	Single Acting Cylinder	To run the cutting Process

LAD Program

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i- TRiLOGI program is used to create and simulate the control program
1  LAD PROGRAM TO PLC FOR CONTROL PLASTIC MACHINE
   CREATED BY IBRAHIM AHMED
   2015 AUTOMATIC CONTROL DIPLOMA
   SUPERVISOR :Dr MOHSEN SOLIMAN
2  Following Line Is To Latch The Auto Internal Relay When (Stop)Button is Pressed Or
   the (finished) Internal Relay is ON i.e Sequence Finished
3  start i1  stop i2  finish i3  Auto r1 (RLY)
   Auto r1
4  Following Line is To Set (SEQ1)SEQUENCER To 1 i.e. STEP 1
5  start i1  Seq c1  Seq1:1 [StepN]
6  Step 1 Set (Rol-MotF)output to ON,That Will Start Rolling motorto heating Zone
   Step 2 set (Heater)OutPUT to ON,That Will Make The Plastic Sheet Ready to Forming
   Step 3 Set (Delay 1)Will Start to Counting To LOCK Mechanism
7  Seq1:1  Auto r1  rol_Motor o1 (OUT)
                    o2 (OUT) heater
                    t1 (TIM) delay1
8  Seq1:1  Auto r1  delay1 t1  Seq1:2 [StepN]
9  Next Step, Forward Sequence
   Set(lok_MotF) to ON that Will Start the Locking Motorin the locking Direction
   to Hold The Sheet in Position,the(Lok-MotF)is Latched to make Sure
   the Locking Motor is Holding downthe Plastic Sheet in all next Steps
   (Stop&Emergency)internal Relay is provided to Unlatch (lok-MotF)in order to
   Release the Sheet
   Also The (Delay) On-Delay Timer Will Start Allow For Time Space
   For locking Machanism to hold The Sheet before Start the Next Step
10 Seq1:2  Auto r1  lok_mot o3 (OUT)
   lok_mot o3  stop i2  delay2 t2 (TIM)
11 Seq1:2  Auto r1  delay2 t2  Seq1:3 [StepN]
12 Next Step, Forward Sequence Set(Former)Single Acting Cylinder
   to On that make the Plastic Sheet Forming As Required
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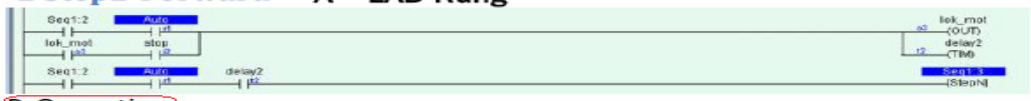
13  Seq1:3   Auto                                          former
    |  |     |  |r1                                    o4 (OUT)
    former   stop
    |  |o4   |  |i2
14  Next Step, ForWard Sequence
    Set(Cutter)Single Acting Cylinder to ON That Make Cutting Cylinder ,The(Cutter)
    is Latched to make Sure the Cutting Cylinder is Running in The Next Steps
    (Stop&EMERGENCY)internal Relayis Providedto Unlatch(Cutter)in order to stop
    the Cutting Cylinder
15  Seq1:3   Auto                                          cutter
    |  |     |  |r1                                    o5 (OUT)
    cutter   stop
    |  |o5   |  |i2
16  (Rol-Motor)output will take the same state as the (Former) to Start Single Acting Cylinder on the Sheet
17  Seq1:3   Auto                                          rol_motor
    |  |     |  |r1                                    o1 (OUT)
18  Seq1:3   Auto    delay2                              Seq1:2
    |  |     |  |r1  |  |t2                             [StepN]
19  (Rol-Motor)output will take the same state as the (Cutter), to Start Single Acting Cylinder on the Sheet
20  Seq1:1   Auto                                          rol_Motor
    |  |     |  |r1                                    o1 (OUT)
21  Seq1:2   auto                                        Seq1:1
    |  |     |  |r1                                    [StepN]
```

2 Step2-Forward A- LAD Rung



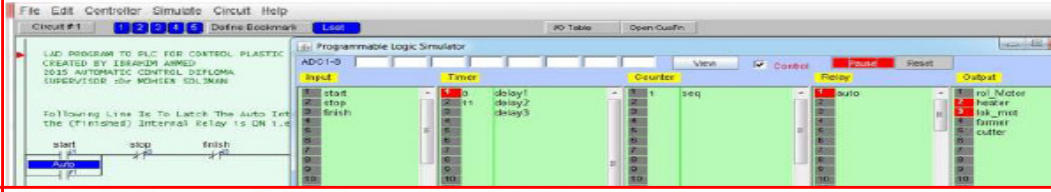
B-Operation

Next Step, Forward Sequence

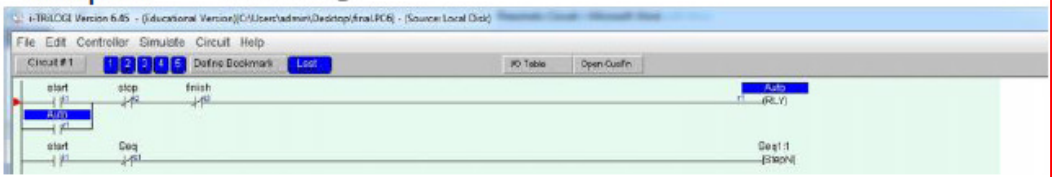
Set(lok_MotF) to ON that Will Start the Locking Motorin the locking Direction to Hold The Sheet in Position,the(Lok-MotF)is Latched to make Sure the Locking Motor is Holding downthe Plastic Sheet in all next Steps (Stop&Emergency)internal Relay is provided to Unlatch (lok-MotF)in order to Release the Sheet

Also The (Delay) On-Delay Timer Will Start Allow For Time Space For locking Machanism to hold The Sheet before Start the Next Step

C-Simulation



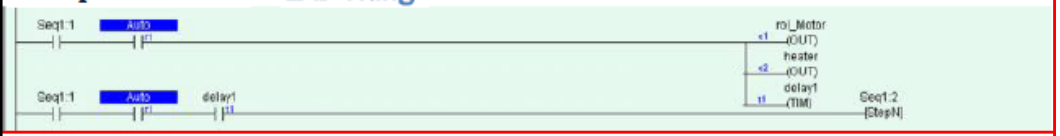
Step 0: LAD Rung



B-Operation

This step is to start the sequencer and to Latch [Auto] internal relay which will be used in all next steps to indicate the current sequence of steps if it is forward or Backward. The [Stop] Push Button or [Finished] Internal Relay is to un-latch the [Auto] Internal Relay which will tell the program to reverse the sequence

1 Step1-Forward LAD Rung



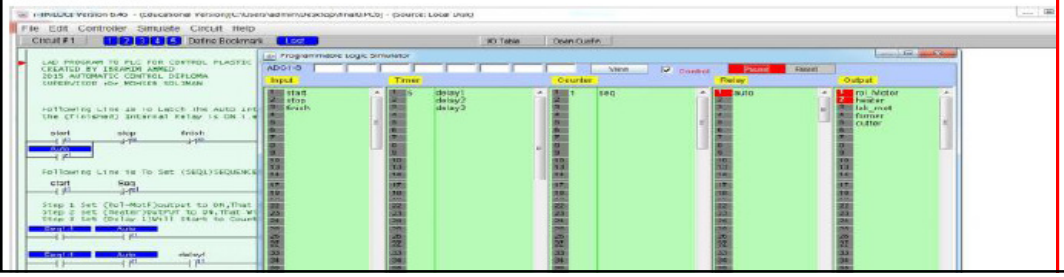
B-Operation

Step 1 Set (Rol-MotF)output to ON,That Will Start Rolling motorto heating Zone

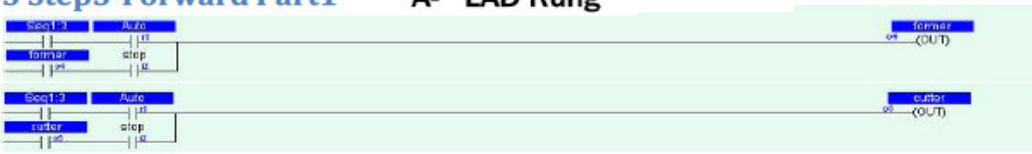
Step 2 set (Heater)OutPUT to ON,That Will Make The Plastic Sheet Ready to Forming

Step 3 Set (Delay 1)Will Start to Counting To LOCK Mechanism

C-Simulator



3 Step3-Forward Part1 A- LAD Rung

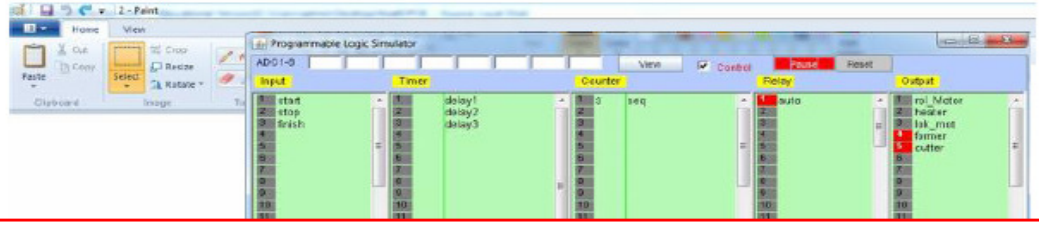


B-Operation

Next Step, Forward Sequence

Set(Former)Single Acting Cylinder to On that make the Plastic Sheet Forming As Required

Next Step, ForWard Sequence

Set(Cutter)Single Acting Cylinder to ON That Make Cutting Cylinder ,The(Cutter) is Latched to make Sure the Cutting Cylinder is Running in The Next Steps (Stop&EMERGENCY)internal Relayis Providedto Unlatch(Cutter)in order to stop the Cutting Cylinder

C-Simulator