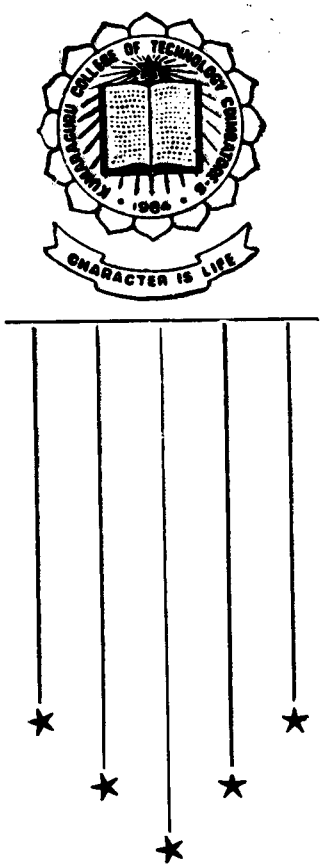
Control Panel For Automatic Gear Hobbing Machine



1996 - 97

Project Report

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Submitted In partial fulfilment of the requirements for the award of the degree of BACHELOR OF ENGINEERING in ELECTRICAL AND ELECTRONICS ENGINEERING Branch of Bharathiar University Coimbatore

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CERTIFICATE

This is to certify that the Project Report entitled

CONTROL PANEL FOR AUTOMATIC GEAR HOBBING MACHINE

has been submitted by

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Branch of the Bharathiar University

During the academic year 1996-97

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TO WHOMSOEVER IT MAY CONCERN

This is to certify that the following Final year BE (Electrical & Electronics), Students of Kumaraguru College of Technology, Coimbatore have done their project work entitled "**Control Panel for Automatic Gear Hobbing Machine**" in Plant Maintenance Department, in our organisation from July 1996 to March 1997.

1. **Ms V Amudha**
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4. **Mr K Vinod**

During this period, their attendance and conduct were found to be **good.**

We wish them the very best in their future endeavours.

ANTHONY THIAGARAJAN
ASST. MANAGER - HRD

ACKNOWLEDGEMENT

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SYNOPSIS

Gear hobbing is a process in which the tooth flanks of the constantly moving work piece are formed by equally spaced cutting edges of the hob. For completion of the above process a lot of operations such as job feeding, job holding, threading and finished job removing must be done correctly. For controlling the above operations and for monitoring whether they are carried out sequentially, there is the need for a control panel.

Electromagnetic contacts and electronic timers are used in this control panel. The use of electromagnetic devices is justified by the fact that they are cheaper and that this panel does not require a skilled person for monitoring its operation.

In this project it is proposed to design and fabricate such a control panel. This unit is fabricated and tested at, 'PREMIER INSTRUMENTS AND CONTROLS LIMITED', Perianaickenpalayam, Coimbatore-20.

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CHAPTER 1

INTRODUCTION

Gears are used in many kinds of machines from wrist watches to bridge lifters. In day to day life, we come across many kinds of gears for speed transmission, torque transmission and for changing the direction of rotation. There are many types of gears available for performing these operations.

Gear hobbing machines are used for cutting or threading the gears. Various types of cuts can be had by using different types of hobs for cutting.

The need for the gear is increasing day by day because of the high growth in automobile and mechanical industries. To meet the constantly increasing market requirements, the production efficiency of the machine has to be increased. For this we need the automation of the machines. This will also result in reduction of cost considerably.

The manually operated machine can be automised by installing a few accessories and also by connecting a proper control unit. This

control panel not only helps the machine to run in automised mode but also has a lot of advantages. Some of them are increase in production efficiency, quality maintenance, time saving, labour saving, etc.

Conventional method of fabricating a control panel is to do it in an electromagnetic, solid state or microprocessor modes. Each of these methods possess their own advantages and disadvantages. Modern trend is to mix these techniques to provide a relatively higher advantage in an economical way.

We present here a control panel realised with electromagnetic devices for contacts and electronic devices for timing control.

CHAPTER 2

GEAR HOBBING MACHINE

2.1 MACHINE TERMINOLOGIES USED

The various machine terminologies related to the gear hobbing machine are described below.

2.1.1 Loader

Loader is a conveying rail which has an attachment for loading the blank pieces individually. Loader is hydraulically operated.

2.1.2 Disloader

Disloader is a clamping unit which unloads the threaded pieces from the work base. The piece is thrust out of the collect by an incorporated ejector.

2.1.3 Head Stock

Head stock is mounted on the left side of the working base.

It receives power from main motor for rotation. It mounts the live centre and the collect.

2.1.4 Live Centre

Live centre is the centering pin mounted on the head stock. It is mostly used for holding the work piece. This acts as solid bearings to support the work piece during operation. This rotates with the work piece.

2.1.5 Collet

Collet is mostly used for holding bars of small sizes. These are normally used where mass production work is required. The front portion of the collet is splitted. This provides a springy action and hence the grip.

2.1.6 Tail Stock

Tail stock is mounted on the right side of the work base. This supports the work piece using a dead centre. The tail stock can be

moved along the work table horizontally for supporting different lengths of work pieces.

2.1.7 Dead Centre

Dead centre is nothing but a centering pin mounted on the tail stock. This does not rotate with the work piece.

2.1.8 Hob

A gear cutting hob is basically a worm or screw. This is made into a generating tool by cutting a series of longitudinal slots to form the teeth. The rotation of hob is controlled by the main motor. Its vertical movement is hydraulically controlled.

2.1.9 Solenoid

A solenoid is an electromagnet. This when engaged applies a straight line force in a push or pull motion. It contains a winding of insulated conductor and a plunger.

2.1.10 Solenoid Valve

A solenoid valve is used in liquid lines and is electrically opened or

closed to control the flow of the hydraulic fluid. Solenoid coils open these valves when energised and allows these to close when deenergised.

2.1.11 Limit Switch

A limit switch is a control device that converts mechanical motion into an electrical control signal. Its main function is to limit movement usually by opening a control circuit when the limit of travel is reached.

2.2 PRINCIPLE OF OPERATION

The process of gear hobbing can be defined as forming uniform teeth on the blank pieces using the cutting edges of the hob. Gear hobbing machine performs the above mentioned process. This process requires an accurate co-ordination between the various elements of the machine to achieve the desired results.

The machine consists of four motors namely main motor, horizontal feed motor, hydraulic pump motor and coolant pump motor. The other accessories includes loader, disloader, hob, solenoids, hydraulic pump, coolant pump, head stock and tail stock.

The main motor is used for the rotation of the hob and the work piece. The main motor output is applied to a gear box unit and is then given to the hob. The speed of rotation of the hob is same as that of the main motor.

The output of the hydraulic pump motor is applied to the pump. This pump is in turn connected to the solenoid valves. The movement of loader, disloader, head stock, tail stock, collet and the vertical movement of the hob is controlled by the hydraulic pressure applied on them.

Horizontal feed motor is mainly used when there is the necessity of threading different types of blanks whose lengths vary. This horizontal feed motor is used for varying the length between the head stock and tail stock for accommodating the various type of blanks.

Coolant motor is coupled to a pump. This unit controls the flow of coolant. As soon as the machine is started, the coolant starts to flow. This coolant is reused.

The gear box unit in the machine controls the relative motion of the hob and the collet. As the speed of rotation of the hob is constant, the speed of rotation of the collect is varied.

Solenoids and solenoid valves are used for controlling the various accessories that are present in the machine. The solenoids have a plunger attached to them. When the solenoid is energised, the plunger moves and opens the valve of that solenoid. Hydraulic fluid under pressure is now allowed to flow through the pipe that is opened by that valve. This applies pressure on that particular device to which it is connected and initiates the necessary action. The power for energising the solenoids is supplied from the control panel.

The linear movement of the various accessories present in the machine are controlled by limit switches. This limits the movement by opening a control circuit and thereby stopping the motion when the limit of travel is reached.

The hobbing cycle can be carried out either with the thrust of the hob in the direction of head stock or tail stock. In either case the hobbing pressure must be oriented towards the head stock. The hob will be rotating continuously whether it is cutting or not. The hobbing cycle is controlled by a timer. The timer is switched on immediately when the cutting starts. After the preset time interval, the timer switches off and the hob moves downwards.

The specifications of the motors that are being used in the machine are given in the Appendix - A.

The Gear Hobbing Machine is shown in Fig. 2.1 with control panel.

2.3 SEQUENCE OF OPERATIONS

The sequence of operations that are carried out in the machine are as follows.

1. Loading of blank pieces
2. Hobbing
3. Removing the finished jobs

2.3.1 Loading of Blank Pieces

The blanks are inserted into the conveying rail or loader by hand. After the completion of the previous cycle and removal of the finished jobs, the loader is thrust forward. The hydraulically operated collet opens and clamps the blank piece. The tail stock comes forward and the dead centre presses against the blank. When the blank piece is clamped, the loader moves backward to its previous position. The point upto which the above said movements takes place is limited using limit switches.

2.3.2 Hobbing

After the job is being loaded, pressure is applied to the hob and it moves upwards. At first the movement is fast. Once it starts cutting, the upward movement becomes very slow. This upward movement is continued till the required depth of cutting is achieved. This whole cycle is controlled by using a timer. After the cutting is completed, the pressure on the hob is reduced and it moves downwards. Now the work piece stops rotating.

2.3.3 Removing the finished jobs

Now the disloader comes forward. The threaded pieces are thrust out of the collet by means of an incorporated ejector. The unloading spoon grabs the piece and places it in a container kept for that purpose. The head stock and the tail stock now moves backward. The disloader also moves backward and the loader comes forward for loading the next piece.

This is one complete cycle of operation. During this period, the coolant will be flowing continuously to absorb the heat produced.

In the Fig. 2.1,

M_1 - HYDRAULIC PUMP MOTOR

M_2 - COOLANT PUMP MOTOR

M_3 - MAIN MOTOR

M_4 - RAPID RETURN HORIZONTAL FEED MOTOR

P_1 - HYDRAULIC PUMP

P_2 - COOLANT PUMP

L - LOADER

D.L - DIS LOADER

P.L - POWER LINE

C.L - CONTROL LINE

S - SOLENOID

H.S - HEAD STOCK

T.S - TAIL STOCK

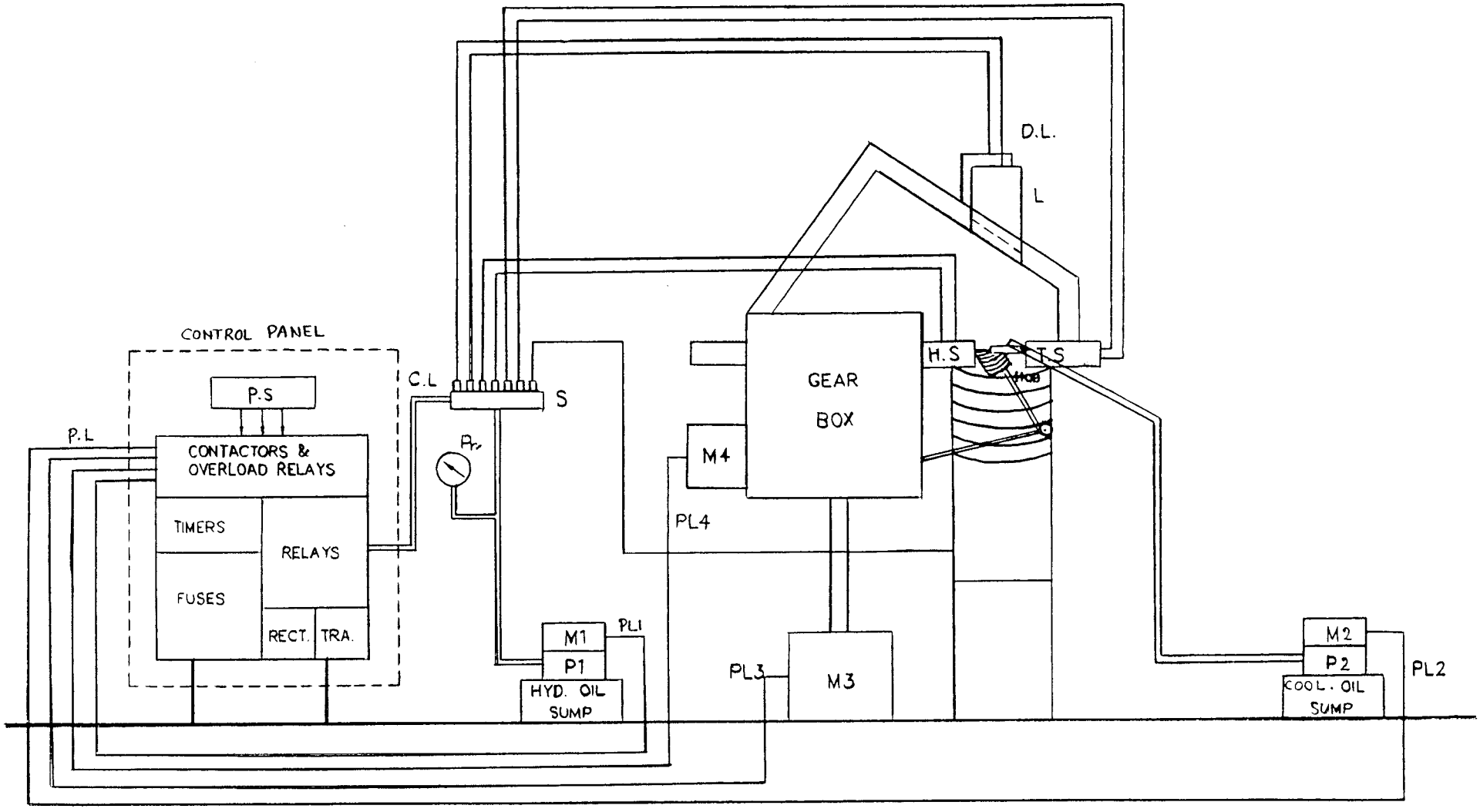


FIG 2.1 GEAR HOBBING MACHINE

CHAPTER 3

CONTROLS

3.1 NEED FOR CONTROL

The need for a proper control unit can be explained as follows.

1. To maintain uniformity in the finished product and a particular quality level.

2. To reduce the percentage of faulty products and thereby increase production efficiency.

3. To achieve a particular production level by reducing the working time considerably.

4. To obtain mass production.

5. To reduce the number of labours and thereby cost of production.

3.2 SELECTION OF CONTROL TECHNIQUES

There are various control techniques available. They are

techniques using,

a. Electromagnetic devices

b. Solid state devices

c. Programmable devices

To select a particular technique, it is necessary to analyse the advantages and disadvantages of using the devices specified above.

a. Electromagnetic devices

Advantages

1. Reliability of these devices is very high due to the fact that the construction of these devices is very simple. They use few reliable components in construction.

2. The cost of these devices is very less when compared to the others.

3. Maintenance of these devices is very easy due to the simplicity in construction.

4. Fixing these devices and wiring are very easy. The circuits are simple.

5. The operation of control panel using these devices don't need a skilled person.

Disadvantages

1. Accuracy is less.

2. They involve moving contacts. So there is the risk of wear and tear.

3. Space required is more.

4. Power consumption is high.

b. Solid state devices

Advantages

1. Power consumption is less.

2. These are compact in size. So space required is less.

3. These do not contain any moving contacts. So wear and tear is less.

Disadvantages

1. Since these involve complex circuitry, trouble shooting is difficult.

2. Cost of these devices is more. So they involve heavy investments.

3. They are less reliable.

4. The characteristics of these devices vary with the change in temperature and ageing.

5. For operating this type of control panel, skilled labours are needed.

c. Programmable devices

Advantages

1. Accuracy of these devices is very high.

2. Because of the fact that they are compact, the space required is less.

3. They provide greater flexibility.

4. The power consumed by these devices is very less.

5. They are precise.

Disadvantages

1. For using these devices the servo mechanisms used in the machine must match the precision of these devices.

2. These are costly. So they involve large investments.

3. For operating the control panel a skilled labour is necessary.

By analysing the above, we arrived at the conclusion that it is better to use a mixed technique than any one of the above. So in this panel we have used electromagnetic devices for contacts and Solid state devices for time control.

3.3 COMPONENTS OF CONTROL PANEL

3.3.1 Contactor

Contactors are mechanical switching devices. They consist of current carrying contacts. The contactors are capable of making or

breaking circuits as the need arises. The contacts used here are normally engaged but under predetermined conditions open to interrupt the circuit.

The contactor has one main contact and two auxiliary contacts. The main contacts are used in switching ON and OFF the power circuits. Auxiliary contacts are used in control circuit.

The contactor contains a coil to which the supply is given. This coil gets energised and attracts the armature towards it. This action changes the position of the contacts. Fig. 3.1 shows the details of a contactor.

3.3.2 Thermal Overload Relay

These relays work along with the contactors for the protection of power circuit against overload. These give signal to the contactors for tripping or isolating the faulty system.

These relays consist of a bimetallic strip which is heated by means of a heater coil. This coil is supplied through a current transformer. An insulated arm carrying a contact is pivoted and is held in contact with

the strip through a spring S. The tension of the spring is varied by sector shaped plate A.

Under normal working condition the strip remains straight but when the strip is heated above a predetermined temperature, it bends. The tension of the spring is released and the contacts are closed. Thus the trip circuit is energised.

These relays have inverse time limit feature. Thus the greater the overload, the shorter the time of tripping. These provide excellent protection against overloads and momentary surges.

The thermal overload relay is shown in Fig. 3.2.

These relays are connected in series with the contactors to provide effective protection. When the relay senses the overload, it sends signal to the contactor which opens its contacts. The thermal overload relay is to be used in association with a contactor as shown in Fig. 3.3 for motor protection.

3.3.3 Control Relays

In general the purpose of a control relay is to energise or de-energise

an electrical circuit to obtain a specific operation of a component. In this project we use these relays to control solenoid valves and other relays.

The relay that we use here is a D.C. relay. This relay consists of an electromagnet which is energised using a 24 volts D.C. supply. This relay has 8 contacts which can be used either as normally opened contact or normally closed contact. When the coil is energised the position of the contacts reverse.

While selecting a control relay, determine the voltage and current characteristics of the load to be controlled. Also find out the type of the load whether it is resistive or inductive. Then determine the power rating of the circuit. This is especially important when low voltage systems are to be controlled. Then a relay is selected to meet the requirements of the system. The control relay is as shown in Fig. 3.4.

3.3.4 Timer or Timing Relay

This relay is similar to a contact relay except that its contacts are designed to operate at a preset time interval after the relay coil is energised or de-energised. A delay on energisation is referred to as "ON delay". A delay on de-energisation is referred to as "OFF delay". The type of relay that we use in our project is the "ON delay" timers.

While selecting a timer relay, consideration must be given to the following.

1. Time range required
2. Type of contacts
3. Coil voltage
4. Enclosures

The functional diagram of a programmable timer is shown in Fig. 3.5.

3.3.5 Control Circuit Transformer

These transformers are specially designed for industrial control applications to provide good transformer regulation, when high inrush currents are drawn. They are used for stepping down voltages for control purposes. The reasons for reducing control circuit voltages are as follows :

1. Operator safety is increased by the use of low voltage in the control panel. Also because of reduced potential, there is less chance of a fault occurring between lines of control circuit wiring to ground.

2. Reduced voltage simplifies voltage change overs of control panel.

Good transformer regulation characteristics are essential in order that transformer selection can be made on the basis of volt ampere rating which is always the most economical choice. Maximum temperature rise is limited to 55°C.

The voltage tappings taken are,

1. 24 v - for control relays
2. 32 v - for clutches
3. 110 v - for timer

The primary voltage given to the transformer here is 380 v.

3.3.6 Rectifier

A rectifier converts an A.C. component into a D.C. component. Here we use bridge rectifier which is a full wave rectifier.

We use two rectifiers in our project. One is used for converting 24 volts A.C. to D.C. for the control relays. The other is used for converting 32 volts A.C. to D.C. for the clutches.

3.3.7 Solenoid

Solenoid is an important component in this machine. This is used for control purposes. A solenoid is an electromagnet that applies a straight line force in a push or pull motion. Typical applications of the solenoids include use on brakes, conveyors, gates, safety devices, punch presses, clutches, machine tools etc.

While selecting a solenoid for a machine the following should be considered.

1. Type of operation

This includes push or pull motion, motion with or against gravity or the plane of action required whether it is horizontal or vertical.

2. Amount of force required

This should be given greater consideration because under rating or over rating will result in the reduction in life of the component.

3. The stroke required

4. Coil voltage required

5. Type of mounting required

3.3.8 Solenoid Valve

Solenoids are operated along with solenoid valves. In selecting the solenoid valve the following points must be considered.

1. Hydraulic fluid to be controlled.
2. Quantity of fluid the valve must allow.
3. Allowable pressure drop.
4. Maximum operating and working pressure.
5. Electrical characteristics for coil operation.

3.3.9 Miscellaneous Components

Apart from the components given above we have also used a lot of other components such as fuses, push buttons, isolators, program switches and termination blocks.

The type of the various components used and their ratings are given in the Appendix - B.

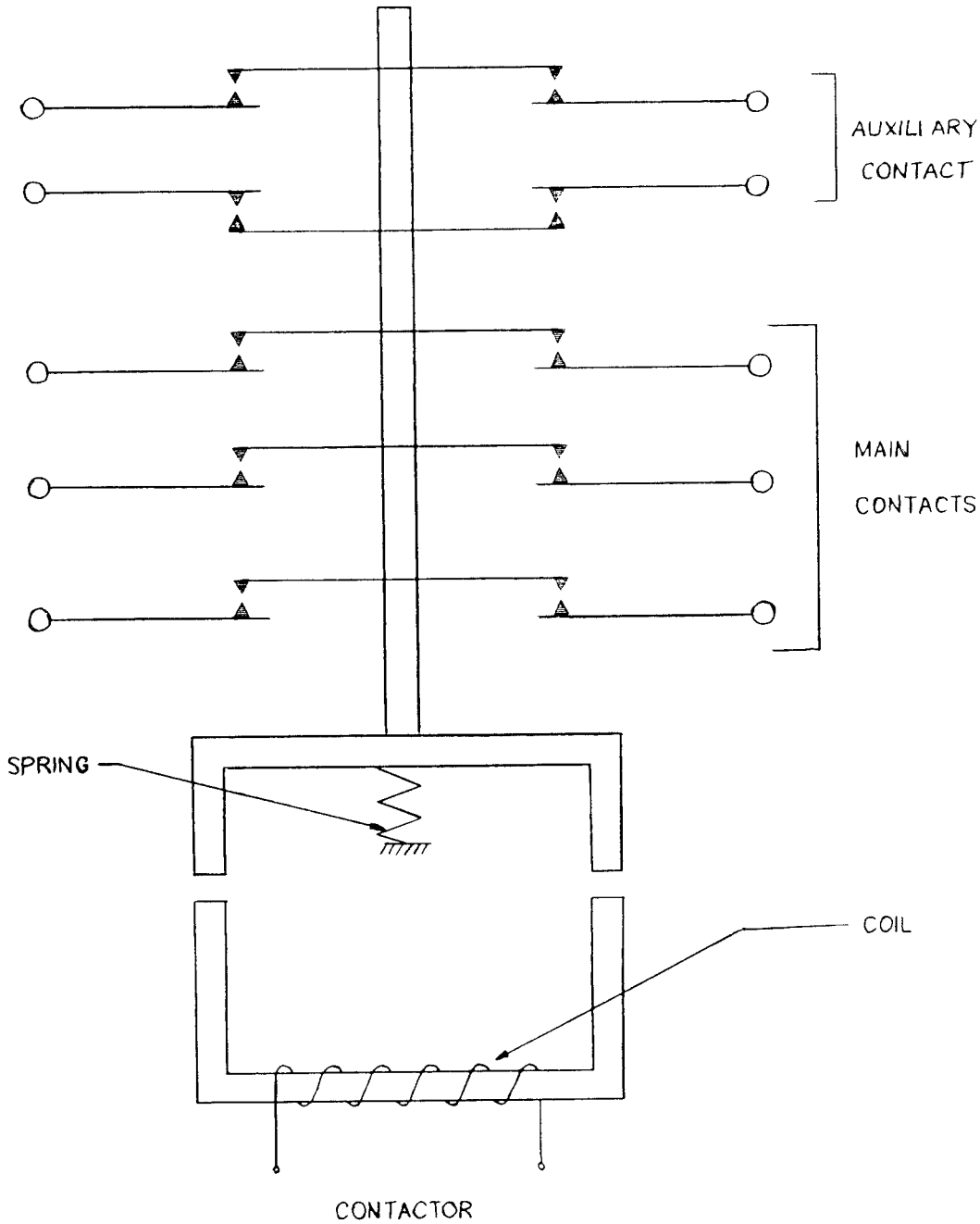


FIG 3.1 CONTACTOR

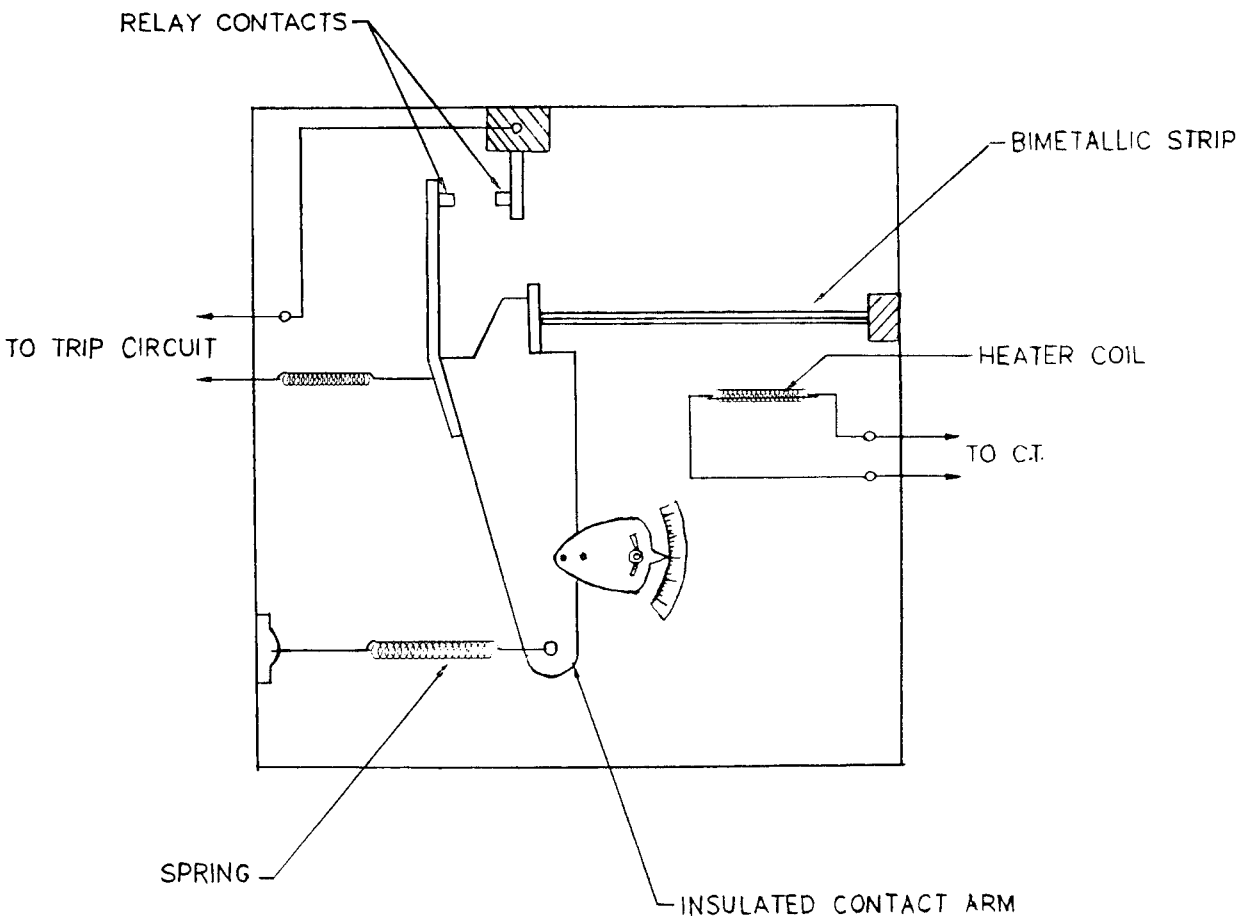


FIG 3.2 THERMAL OVERLOAD RELAY

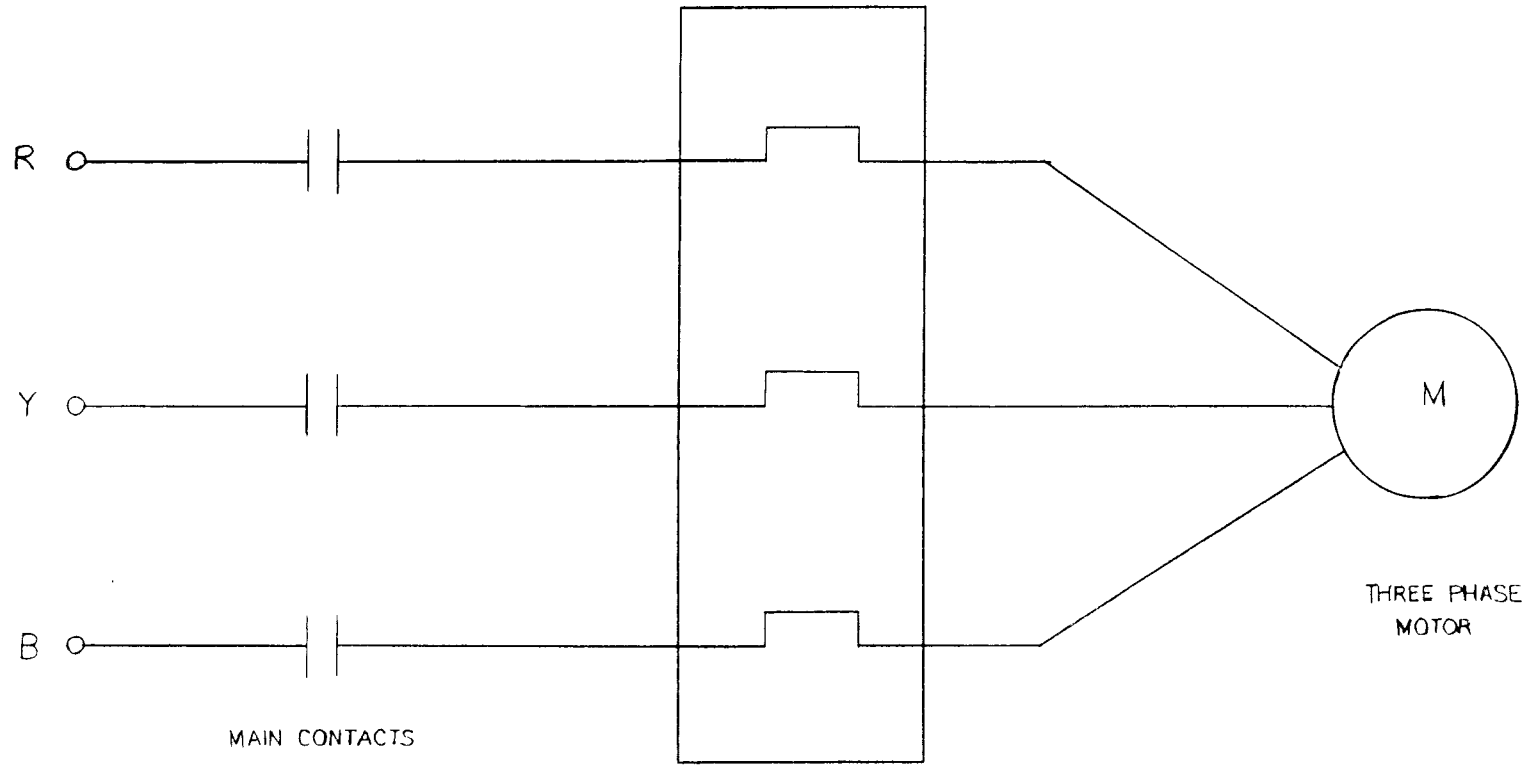


FIG 3.3 CONNECTION DIAGRAM FOR CONTACTOR AND OVERLOAD RELAY

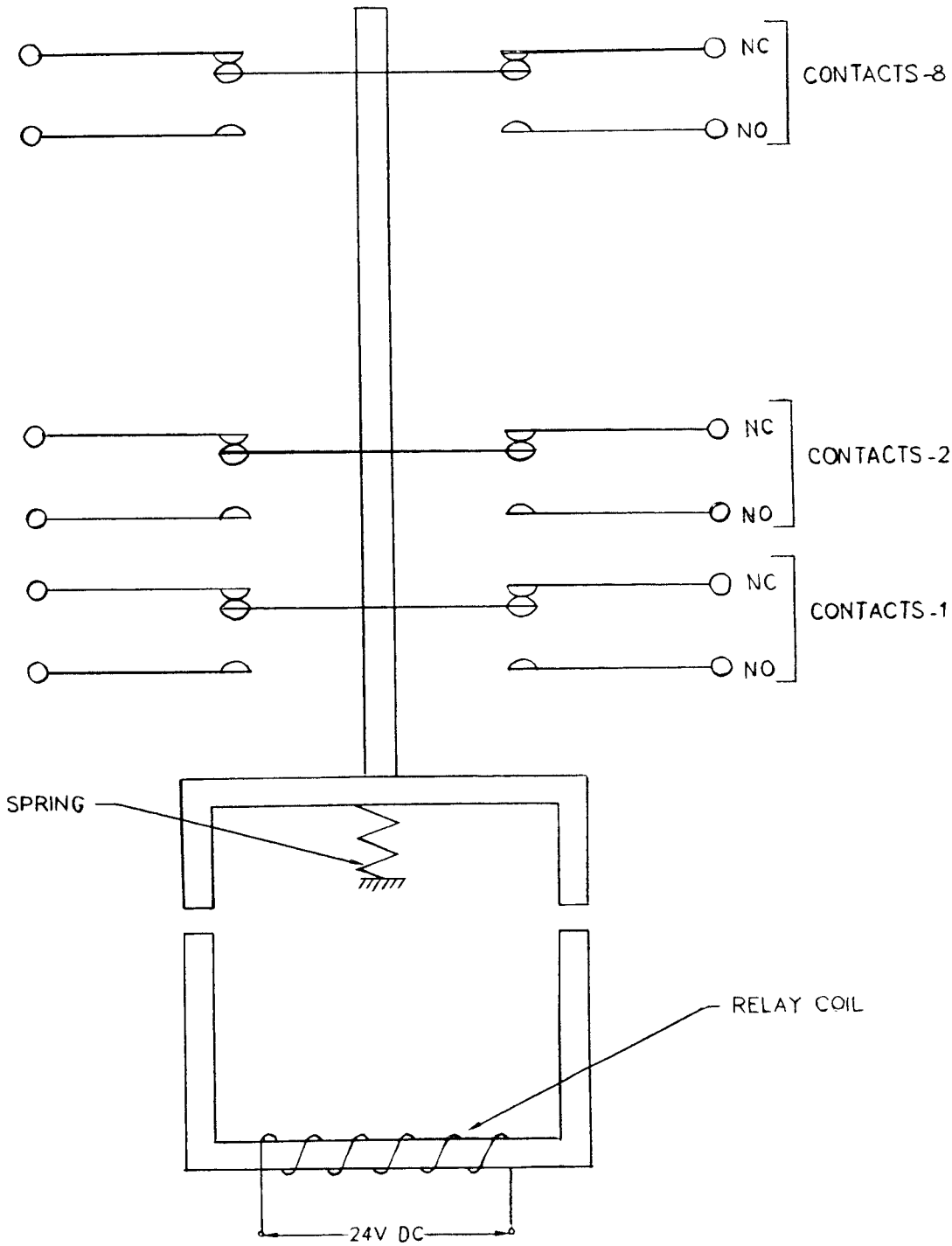


FIG 3.4 CONTROL RELAY

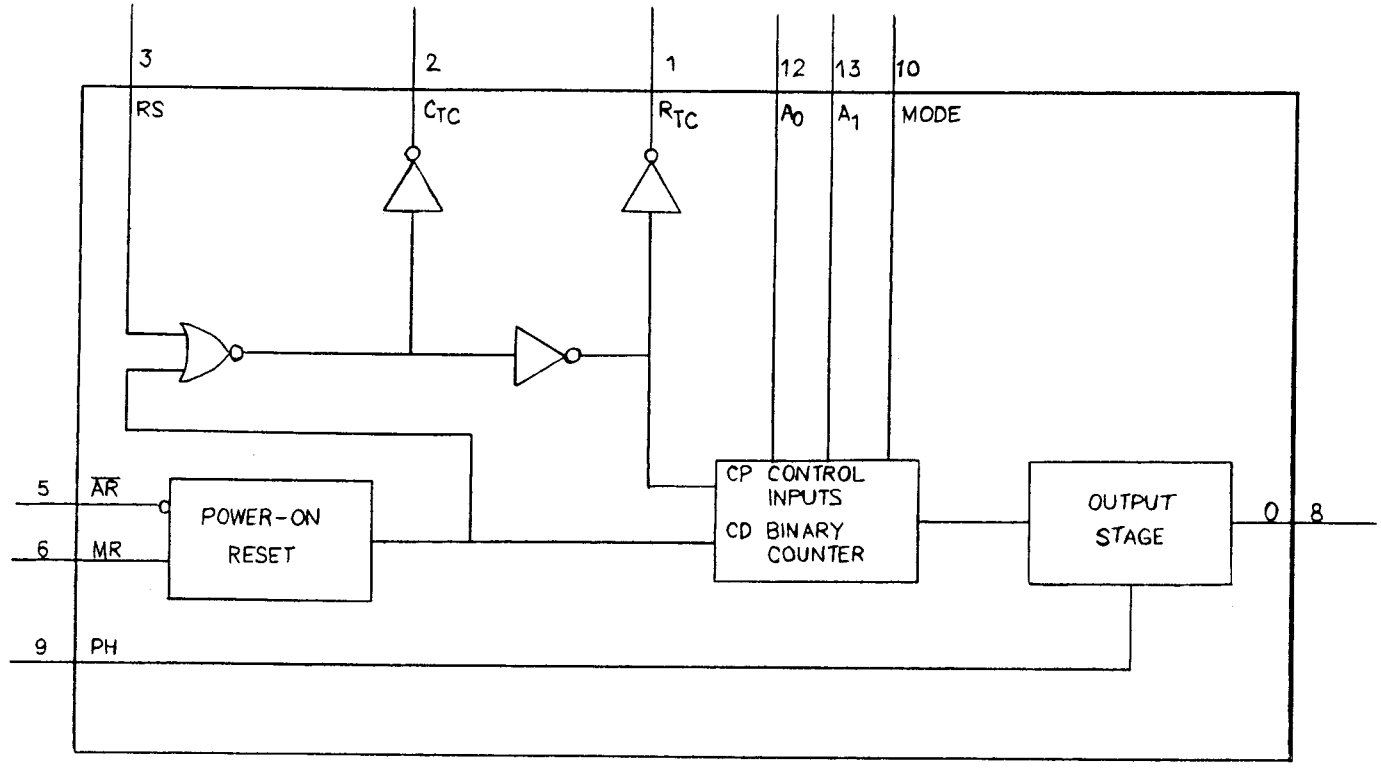


FIG 3.5 FUNCTIONAL DIAGRAM OF PROGRAMMABLE TIMER

A_0, A_1	–	ADDRESS INPUTS
MODE	–	MODE SELECT INPUT
AR	–	AUTO RESET INPUT
MR	–	MASTER RESET INPUT
PH	–	PHASE INPUT
R_{TC}	–	EXTERNAL RESISTOR CONNECTION [R_t]
C_{TC}	–	EXTERNAL CAPACITOR CONNECTION [C_t]
R_S	–	EXTERNAL RESISTOR CONNECTION [R_S] OR EXTERNAL CLOCK INPUT

CHAPTER 4

DESIGN OF CONTROL PANEL

4.1 REQUIREMENTS OF DESIGN

While designing any circuit or any system a lot of things must be taken into account. These may be called as the requirements for which the design is done. The requirements that we considered while designing the panel are as follows :

1. In any big industry there will be a plant maintenance department. This department employs an electrician to maintain the control panels. So these panels must be designed as simple as possible to ensure that it can be maintained by that person. So the first requirement is simplicity in design.

2. The panel designed for a machine must satisfy the needs of the machine. It should be operation oriented.

3. The control panel must provide the necessary protection for the various devices in that machine.

4. It is necessary to design a control panel which costs less and which provides more advantages. It should be economical.

4.2 TIMING CIRCUIT

One of the objectives of this control panel is to reduce the gear hobbing time. At the same time the quality of the product must be high and the cost must be less.

By using the timing circuit, the time taken for hobbing is controlled. For this purpose we use time relays or timers. The type of timer used is "ON delay" timer. This is an electronic timer. A time setting of 0.5 seconds to 50 seconds can be had with this timer.

4.3 CONTACTORS AND RELAYS

Electromagnetic contactors and relays are used in these circuits for controlling purposes. The main advantages of using these electromagnetic devices instead of other devices are their low cost and simple circuitry. More over maintenance and trouble shooting are easier and no expertise is needed for them. Further there is no need for

complex circuit boards. A rail mounting is sufficient to fix these contactors and relays.

4.4 DESIGN FEATURES OF THE CIRCUITS

4.4.1 Motor ON-OFF Control Circuit With Overload Protection

The motors present in the machine are connected to the supply through a contactor and a relay. The relay used here is thermal overload relay which provides protection against overloads. The contactors and the relays are connected in series and the supply is given to the motors through this series connection.

4.4.2 Starting Circuit for Main Motor

The main motor is started using a circuit that resembles a star-delta starter. Here the star-delta starter is realised using contactors and a timer. The circuit for the above is shown in Fig. 4.1.

When the machine is switched on, the contactor C_3 is closed and C_4 is opened. Now the motor runs on star mode. The delay timer is set. After a delay of 20 seconds, the timer coil is energised and the contacts

of the timer are pulled. Now the contactor C_4 is closed and simultaneously C_3 is opened. Now the motor starts running in the delta mode.

While starting, since the windings are connected in star, the voltage applied to each phase is reduced by a factor of $1/\sqrt{3}$. Hence the torque developed is reduced to one third of that which would have been developed if normal voltage is applied. During the running period, the windings are delta connected. The main advantage in this method is that no power is lost while starting the motor.

4.5 POWER CIRCUIT OPERATION

The three phase supply is given to the control panel through the isolator a_1. When this isolator closes, supply is fed to the motors.

When the contactor C_1 closes, the hydraulic pump motor gets started. The output of this motor is connected to the hydraulic pump which pumps the hydraulic fluid with certain pressure into the tubes whenever input is given. This motor controls the movement of loader, disloader, head stock, tail stock, collet and the vertical movement of the hob.

When the contactors C_6, C_2 is closed, supply is given to the coolant motor as well as the main motor. The coolant motor will be running continuously along with the main motor. The output of this motor is applied to the coolant pump. This pumps the coolant into the tubes provided for that purpose. The coolant will be flowing continuously as long as the main motor is in operation.

The main motor gets started when the contactor C_2 is closed. At the time of starting, contactor C_3 will be closed and C_4 will be open. Now the windings of the motor are connected in star. After a time delay of 20 seconds, C_4 is closed and C_3 is opened. Now the windings are connected in delta mode. This motor is used for the rotation of the hob and the collect. The speed of rotation of the hob is same as that of the main motor. The speed of rotation of the collect is varied using gear arrangements.

When the contactor C_5 is closed, supply is given to the horizontal feed motor. This motor is mainly used when the length of the blank pieces to be threaded is varied. This motor is used to vary the distance between the collet and the tail stock to accomodate different lengths of work pieces.

The motors are provided with overload protection through thermal overload relays. These are connected in series with the contactors to protect the motors against overload. The pick up value of these relays can be varied in accordance to the rating of the motor. This provision is incorporated in the relay itself.

Another part of the control circuit consists of the transformer and the rectifiers.

A 380 v single phase A.C. supply is given to the primary of the transformer. The outputs taken from the secondary of the transformer are 24 volts, 32 volts and 110 volts.

Of the outputs taken from the secondary of the transformer, 24 volts and 32 volts are rectified using bridge rectifiers and are given to relays and clutches respectively. The 110 volts output is given as input to the timers and external lamps.

4.6 MANUAL MODE OF OPERATION

Manual operation is one in which each function and timing of each function is controlled manually by an operator. Obviously the

circuit for such an arrangement is provided with independent push button switches for each operation. The circuit for manual operation is shown in Fig. 4.4.

4.7 AUTOMATIC MODE OF OPERATION

Automatic mode of operation shown in Fig. 4.5 is one in which the machine performs a complete cycle of functions sequentially and repeatedly. The cycle stops only if there is a malfunction or if it is manually interrupted.

A program switch connects or disconnects the auto mode enhancing circuit. The normally closed contact of last operation of the loader implies that the initial conditions have been restored. Then the hobbing cycle begins. The closing of control of the hob cycle signifies the end of the cycle. The closing of d16 provides excitation which in turn initiates a recycling timer which provides the necessary time delay between two cycles. End of this delay time initiates the next cycle.

The over all control circuit is as shown at the end of this chapter along with block diagram. The various control panel components that are in connection for different functions of the machine are given in Appendix - C.

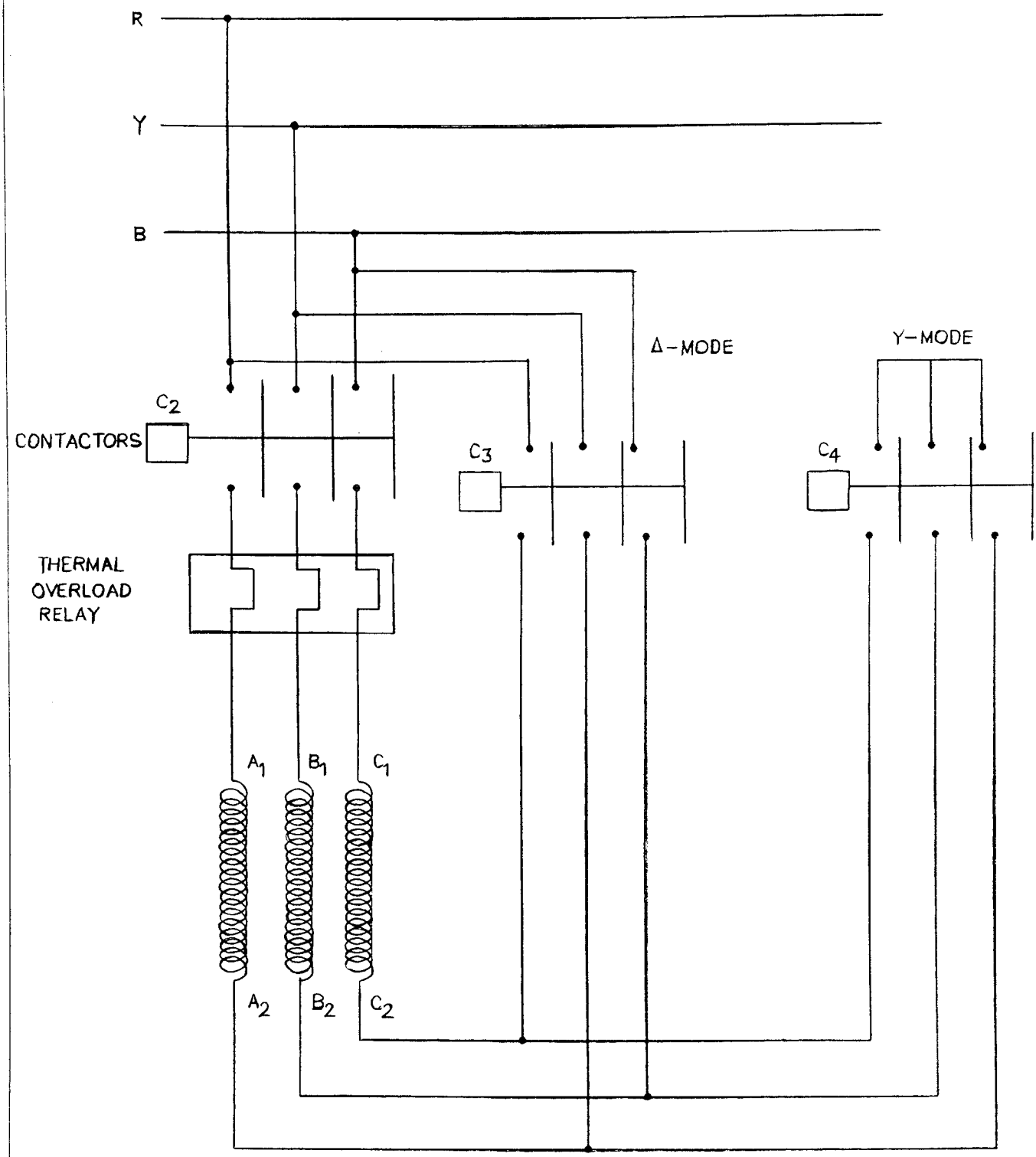


FIG 4.1 STARTING OF MAIN MOTOR

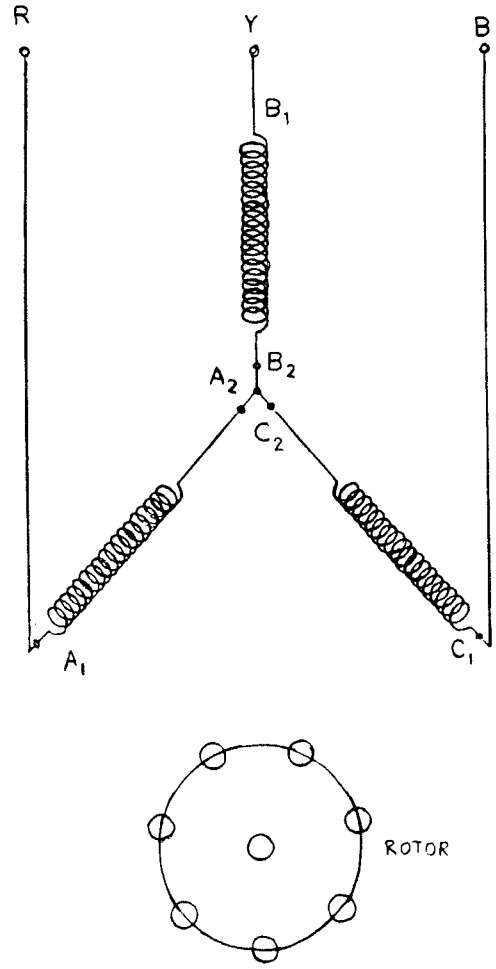


FIG 4.2 STATOR Y-MODE

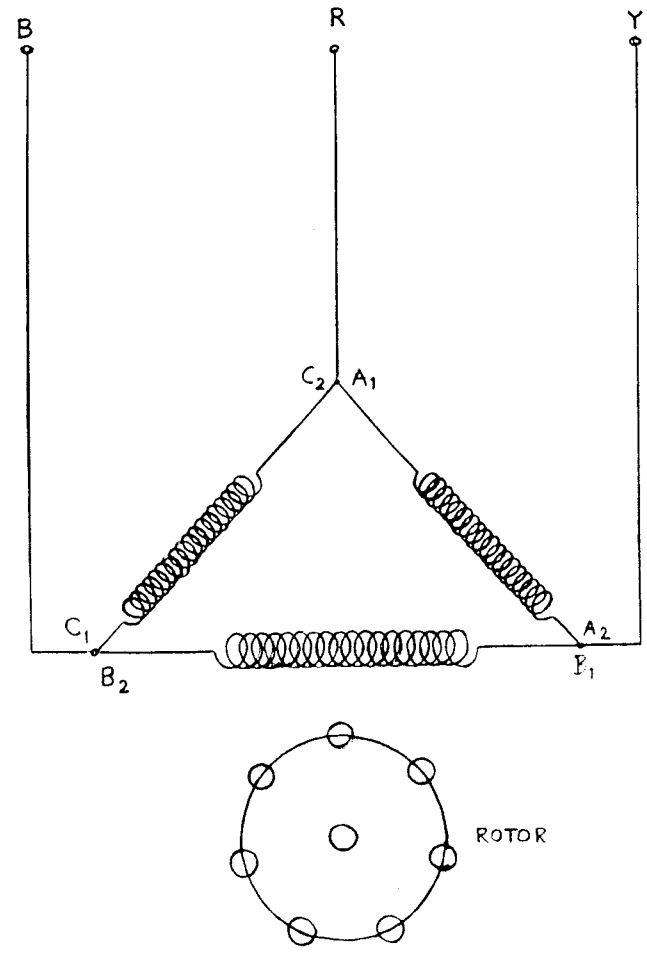


FIG 4.3 STATOR Δ-MODE

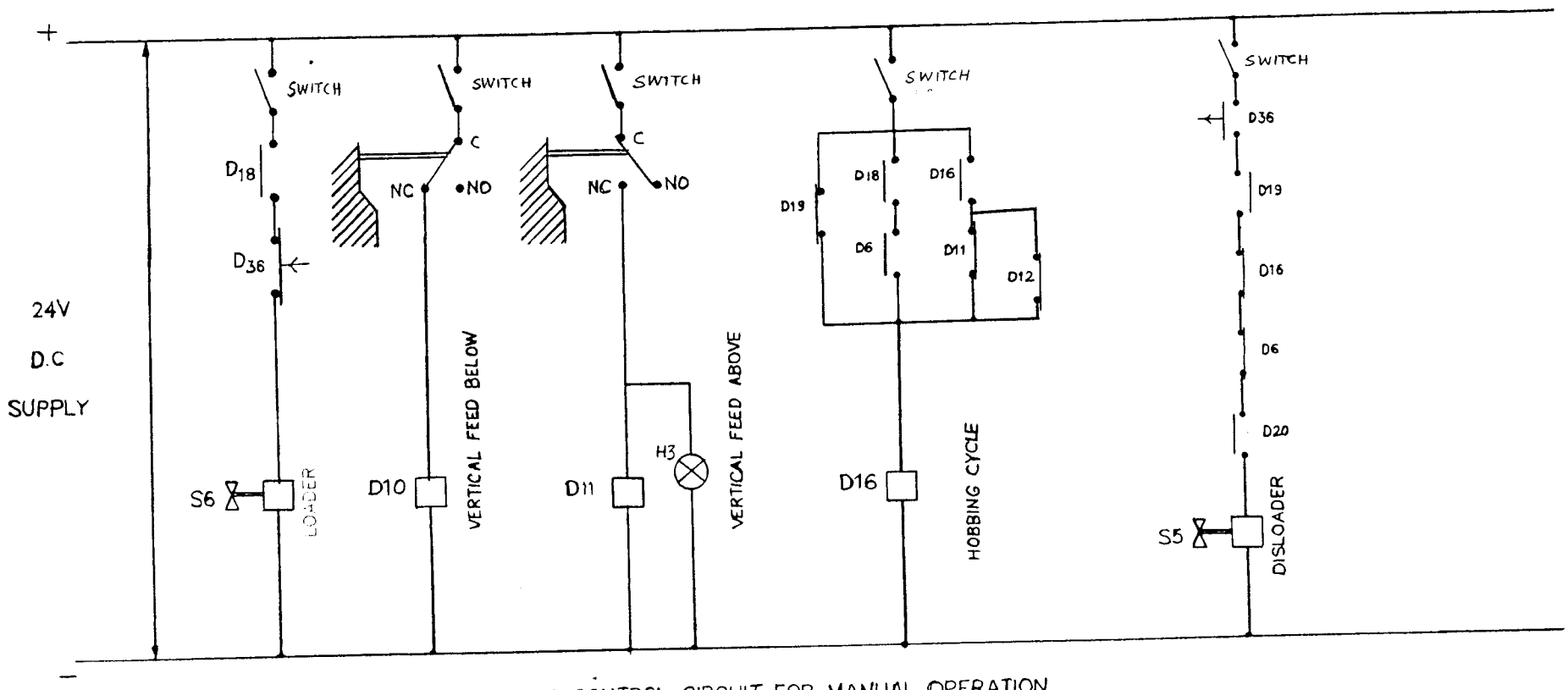


FIG 4.4 CONTROL CIRCUIT FOR MANUAL OPERATION

B – LIMIT SWITCHES

D36 – TIMER

S5,S6 – SOLENOIDS

D6,D10,D11,D12,
D19,D18,D16,D20 – RELAYS

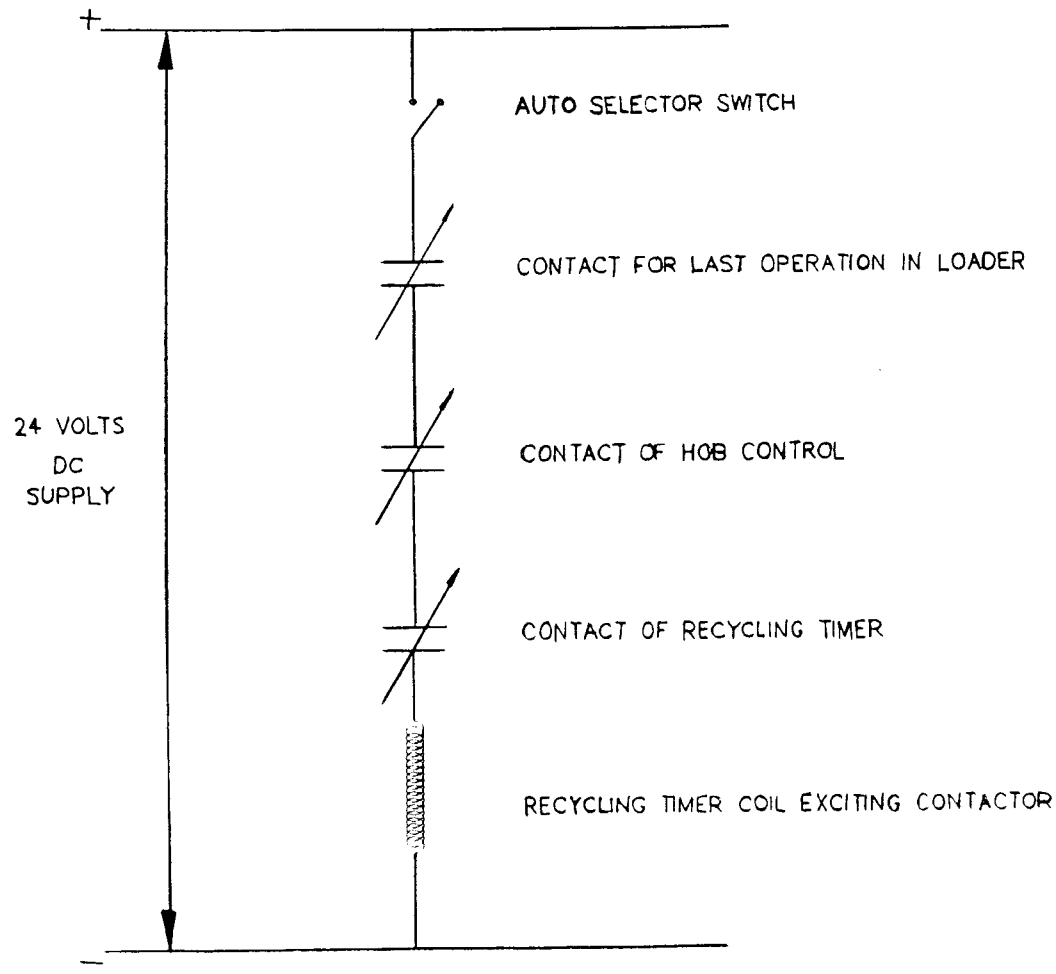


FIG. 4.5 AUTOMATIC MODE CONTROL CIRCUIT

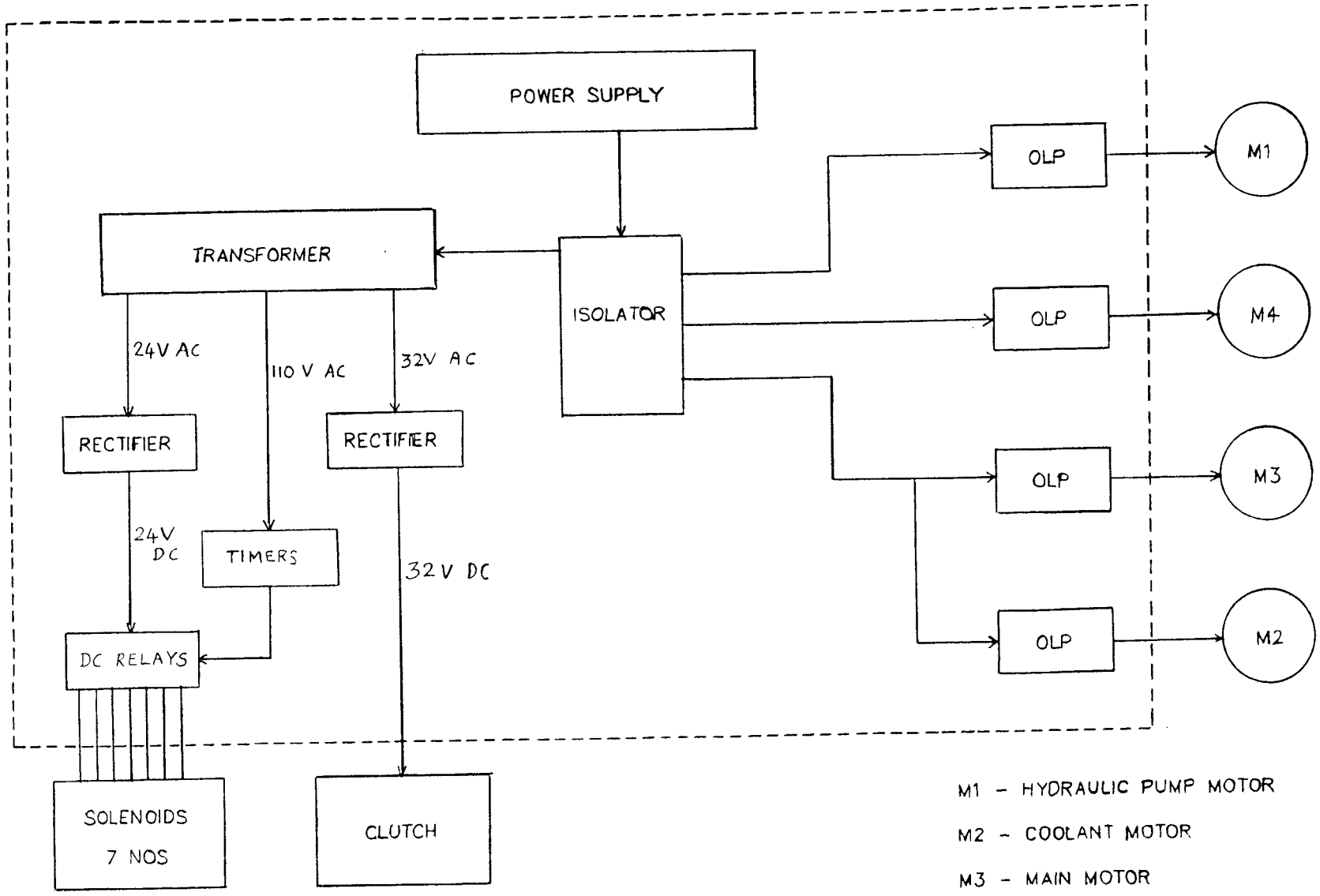


FIG 4.6BLOCK DIAGRAM OF CONTROL PANEL

COMPLETE
POWER
CIRCUIT

COMPLETE
CONTROL
CIRCUIT

CHAPTER 5

REALISATION OF CONTROL PANEL

5.1 FABRICATION

The control panel is manufactured from sheet steel of 2.6 mm thickness. It is pickled to remove dust and dirt particles. It is powder coated for resisting atmospheric effects and rusting. Local reinforcement is provided at the rear end of the panel for the supporting components. Also it is provided with sufficient thickness to allow engagements for two full threads of the screws.

All electrical components are mounted on the panel by means of fixing screws into the holes. Nuts and bolts are avoided totally.

Terminals for power supply are provided separately by means of different termination blocks. From these blocks, wires can be taken out while installation.

The components are mounted on the board with sufficient spacing between them to account for easy accessing while trouble shooting.

The panel is provided with lamps on the outer cover for easy monitoring of the operations carried out.

5.2 COST ESTIMATION

The following table gives the cost for various materials employed in manufacturing the control panel.

	Material used	Quantity required	Rate (Rs.)	Total Cost (Rs.)
1.	110 V A.C. contactor	6	900	5,400.00
2.	Thermal overload relay	6	450	2,700.00
3.	110 V A.C. Timer	4	790	3,160.00
4.	24 V D.C. Relay	40	900	36,000.00
5.	Transformer	1	500	500.00
6.	Rectifier	2	50	100.00
7.	Isolator	2	250	500.00
8.	Program switch	3	140	420.00
9.	Limit switch	13	40	520.00
10.	Fuse with carrier	18	40	720.00
11.	Lamp	6	15	90.00
12.	Wires	-	-	500.00
13.	Cable duct	6 m	40 m	240.00
14.	Termination blocks	-	-	200.00
15.	Control panel box	1	2,200	2,200.00
16.	Miscellaneous	-	-	200.00
			Total	**Rs 53,450.00**

5.3 ADVANTAGES OF CONTROL PANEL

The control panel fabricated has lot of advantages. The advantages of which are listed below.

1. Using this control panel three modes of operations are possible. They are

   (a) Manual mode

   (b) Semi automatic mode

   (c) Automatic mode

a. Manual Mode

In this mode each function is done by an operator. Control operations are also monitored by him.

b. Semi Automatic Mode

In this mode of operation, the machine performs a complete cycle of functions automatically and then stops. It then requires an operator to manually start the next cycle.

c. Automatic mode

In this mode the machine performs the complete cycle of hobbing repeatedly. No manual interference is needed.

2. This control panel has an easy accessibility for maintenance.

3. Compact relays are used instead of ordinary electromagnetic contactors. So space occupied is less.

4. Independent time control is provided for the following:
   a. To control overall cycle.
   b. For loading and unloading.

5. Use of control panel increases the production efficiency of the machine. Mass production is made possible.

6. No skilled labour is necessary for operating the machine with this control panel.

7. Overload protection for the motors used in the machine are provided by using thermal overload relays.

8. The number of faulty products are reduced. Moreover there will be great uniformity in the finished products. Quality of products will be maintained at a high level.

9. This control panel is cheaper compared to other types.

10. The power consumption of this control panel is less.

11. This control panel offers more safety to the operator as the control circuit is achieved by use of low voltage components.

The inner view of the control panel is shown in the Fig. 5.1. The various components used are :

R	-	Thermal Overload Relay
C	-	Contactor
T	-	Timer
C.R.	-	Control Relays
F	-	Fuses
Rec	-	Rectifier
Tr.	-	Transformer
T.B.	-	Termination Blocks

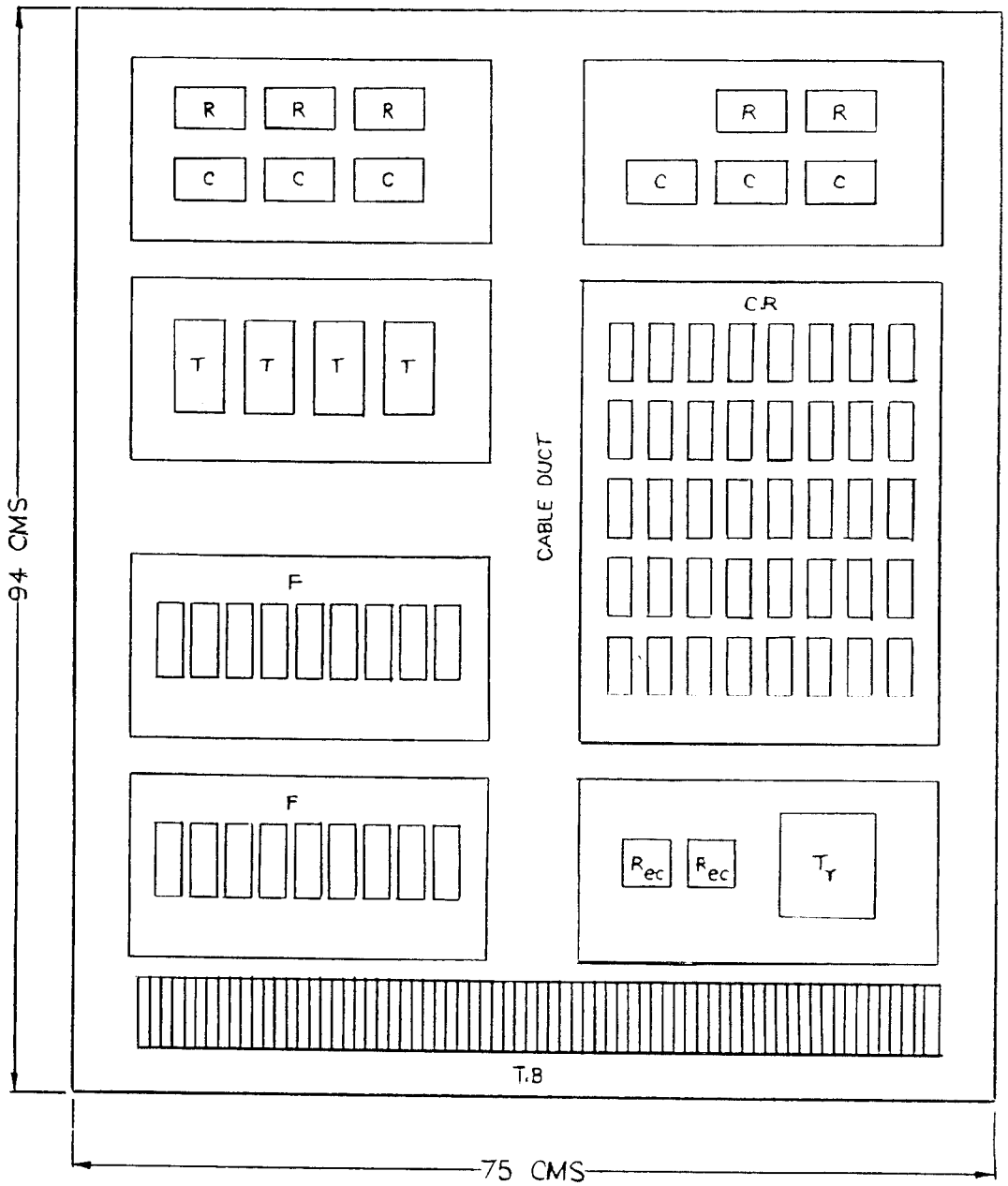
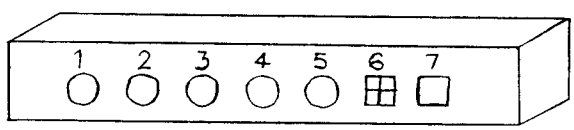


FIG 5.1 OPEN VIEW OF CONTROL PANEL



1. EMERGENCY STOP PUSH BUTTON
2. HYDRAULIC OIL MOTOR START/STOP PUSH BUTTON
3. INCHING PUSH BUTTON
4. MAIN MOTOR START/STOP PUSH BUTTON
5. RAPID RETURN MOTOR START/STOP PUSH BUTTON
6. PROGRAM SELECTOR SWITCH
7. AUTO/MANUAL ROTARY CAM SWITCH

FIG 5.2 PANEL BOX ATTACHED WITH MACHINE

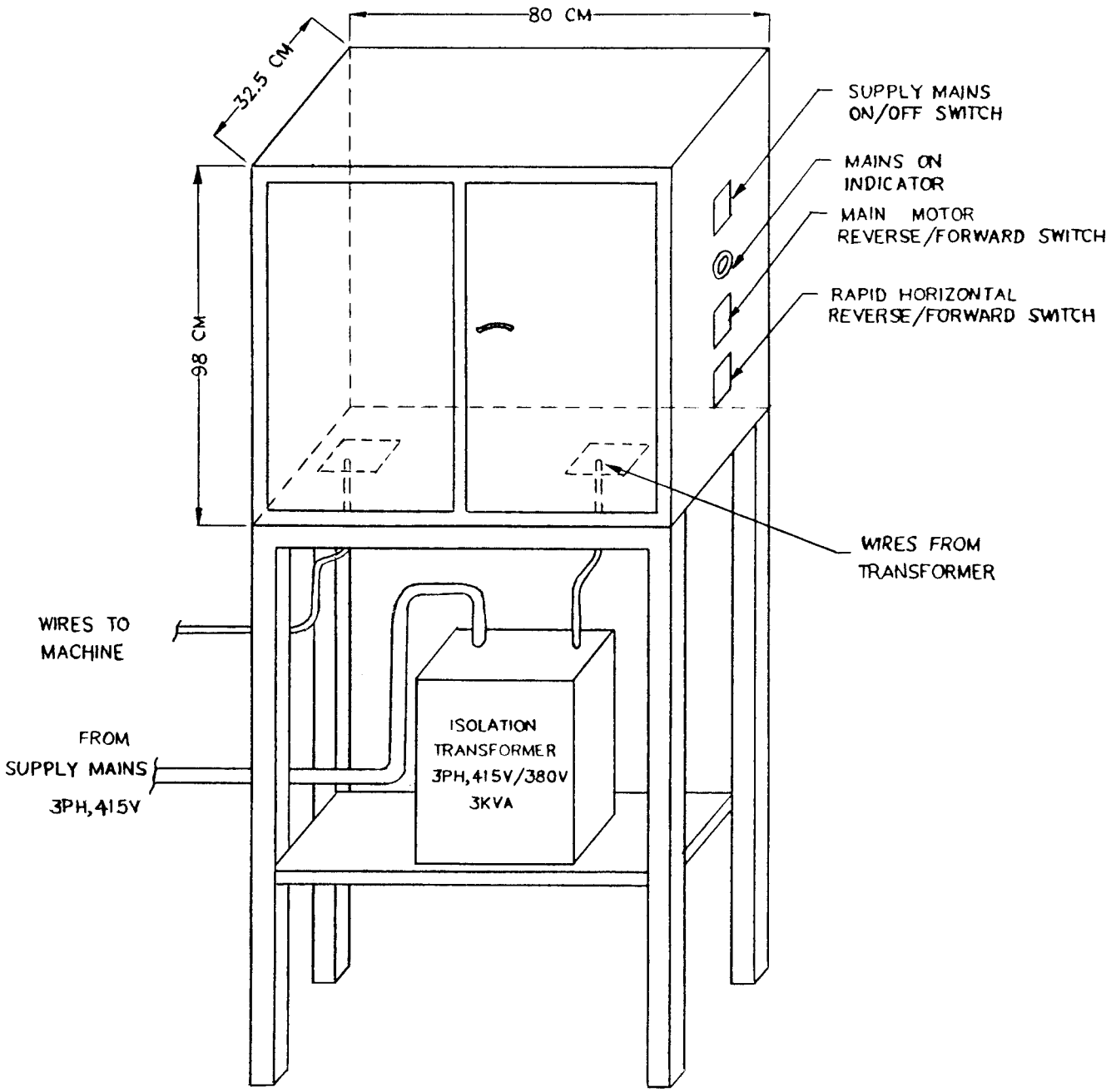


FIG 5.3 CONTROL PANEL BOX

CHAPTER 6

CONCLUSION

A modern control panel with electromagnetic contacts and electronic time control has been designed, fabricated at 'PREMIER INSTRUMENTS AND CONTROLS LIMITED', Perianaickenpalayam, Coimbatore and tested. This control panel offers most of the advantages of modern control. The use of this control panel increases the production efficiency of the gear hobbing machine. The operating cost is also reduced considerably because of less power consumption. Maintenance, trouble shooting and repairing are made easier by using compact components which in turn reduces the space.

This control panel provides better scope for updation while machine functions are to be expanded.

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APPENDIX A

A.1 MOTOR DETAILS

1. Main Motor

Type	:	3 ph. Induction motor
Capacity	:	1.1 KW
Voltage	:	380 V
Current	:	2.5 A
Frequency	:	50 Hz
Speed	:	1500 rpm

2. Hydraulic Pump Motor

Type	:	3 ph. Induction motor
Capacity	:	0.37 KW
Voltage	:	380 V
Current	:	1.1 A
Frequency	:	50 Hz
Speed	:	1500 rpm

3. Coolant Pump Motor

Type	:	3 ph. Induction motor
Capacity	:	0.11 KW

Voltage	:	380 V
Current	:	0.39 A
Frequency	:	50 Hz
Speed	:	3000 rpm

4. Return Horizontal Feed Motor

Type	:	3 ph. Induction motor
Capacity	:	0.04 KW
Voltage	:	380 V
Current	:	0.56 A
Frequency	:	50 Hz
Speed	:	3000 rpm

A.2 PUMP DETAILS

1. Hydraulic Pump

Type	:	Centrifugal
Inlet	:	Hydraulic oil
Outlet	:	Hydraulic oil with variation in pressure of 5 to 15 kg/cm^2 for various operations

2. Coolant Pump

Type	:	Centrifugal

Inlet	:	Coolant oil
Outlet	:	Coolant oil with constant pressure

A.3 OIL DETAILS

1. Hydraulic Oil

   Servo system 68 (or) castrol perfecto 68 (or) sigma 68

2. Coolant Oil

   WS 500 NR (or) Castrol cutting oil - ILO cut 171
   (or) Indian Oil - Servo cut 335.

3. Gear Box oil

   ALPHA ZM 220 (or) Servo Mesh 40

4. Lubrication oil

   Servo system 32

APPENDIX B

CONTROL PANEL COMPONENTS

1. Contactors

Make	:	L & T
Type	:	ML 1.5
Rating	:	3 ph., 110 V, 50 Hz, 25 A
Auxiliary contact's Current rating	:	10 A
Auxiliary contacts	:	2 NO + 2 NC

2. Thermal overload relay

Make	:	L & T
Type	:	ML 1.5
Auxiliary contacts	:	1 NO + 1 NC
Current rating		
e_1	:	0.6 A (0.6 to 1 A)
e_2, e_3	:	0.4 A (0.4 to 0.65 A)
e_4, e_5	:	2.5 A (2.5 to 4A)

3. Timer

Make	:	ESS JAY
Type	:	DT 101
Voltage	:	110 V AC
Contacts	:	2 NO + 2 NC

4. Control Relays

Make	:	O/E/N INDIA LTD
Type	:	67 DP - 24 - 8C7 7A RES 28 VDC
Coil voltage	:	24 V DC
Contacts	:	8 NO + 8 NC

5. Transformer

Input	:	0-380 V A.C.
Output I	:	110 V, 300 VA
Output II	:	110 V, 150 VA
Output III	:	32 V, 100 VA
Output IV	:	24 V, 60 VA

6. Rectifier

Type	:	SRM 25
Voltage	:	24 V rectifier, 32 V rectifier

7. Termination Blocks

Types used	:	16 mm^2, 10CST, 6CST, 2.5CST

8. Isolator

Make	:	KAYCEE
Rating	:	25 A

9. Program switch

Make	:	KAYCEE
Rating	:	16 Amps
Types used	:	2 way 2 pole, 4 way 4 pole, 10 way 10 pole

10. Cable duct

Make	:	Salzer
Size	:	25 x 40 mm, 15 x 40 mm

APPENDIX C

The various control panel components that are in operation for different machine functions are given in the following Table.

S. No.	Machine functions	Relays	Contactors	Timers	Solenoids	Limit switches
1.	Unlocking of horizontal feed	d_1, d_4, d_{11}, d_{34}, d_{38}	c_5			
2.	Stop	d_2, d_8, d_{51}				
3.	Start	d_8				
4.	Main motor operations	d_3, d_5, d_6, d_7, d_8, d_9, d_{10}, d_{22}, d_{23}, d_{25}, d_{27}, d_{28}, d_{41}, d_{50}	c_1, c_2, c_3, c_4	d_5		
5.	Full off of main motor	d_6, d_8, d_9, d_{11}				
6.	Vertical feed below	d_{10}				b_{31}
7.	Vertical feed above	d_{11}				b_{32}
8.	Horizontal feed end	d_{12}, d_{13}				b_{33}
9.	Rapid return end	d_{14}				b_{34}
10.	Vertical feed	d_3, d_6, d_8, d_{11}, d_{12}, d_{15}, d_{16}, d_{18}, d_{19}, d_{20}, d_{41}			s_4, s_{11}	

19.	Centering pin front (hold)	d_{27}, d_{28}, d_{51}				

22.	Disloader	d_3, d_{14}, d_{20}			s_5	
23.	Loader	d_2, d_3, d_9, d_{18}, d_{21}, d_{24}, d_{26}, d_{28}, d_{37}		d_{36}	s_6	
24.	Tail stock spindle open (release)	d_3, d_7, d_{10}, d_{17}, d_{19}, d_{20}, d_{21}, d_{26}, d_{27} d_{50}, d_{51}			s_7	
25.	Tail stock spindle close (release)	d_3, d_{17}, d_{18}, d_{19}, d_{23}, d_{24}, d_{27}, d_{51}			s_8	
26.	Centering pin front (release)	d_2, d_4, d_7, d_{17}, d_{18}, d_{19}, d_{22}, d_{23}, d_{24}, d_{25}, d_{26}, d_{50}, d_{51}			s_9	
27.	Centering pin behind (release)	d_2, d_4, d_{17}, d_{18}, d_{20}, d_{21}, d_{22}, d_{24}, d_{25}, d_{26}, d_{28}, d_{50}, d_{51}			s_{10}	
28.	Clutch for horizontal feed (s_1)	d_1, d_{12}				
29.	Clutch for rapid horizontal feed (s_2)	d_1	c_5			
30.	Program switch-1	d_2, d_3, d_6, d_7, d_{41}	c_3			