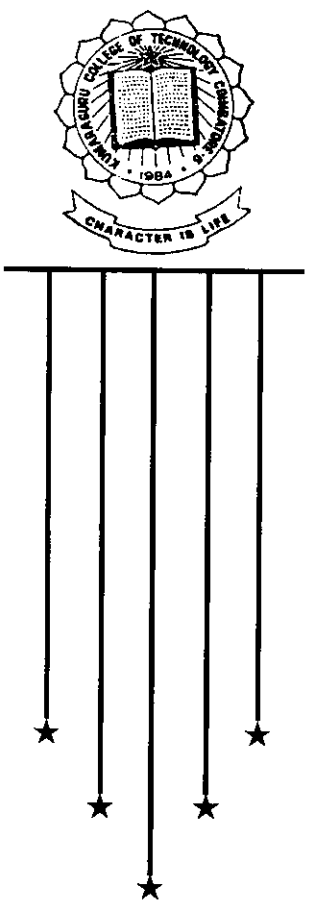
REPLACEMENT OF ELECTRONIC CONTROL BY PLC FOR A GEAR HOBBING MACHINE



1999 -2000

PROJECT REPORT

SUBMITTED BY

VIVEK VENKATESH. R

VIKRAM. J

SAMUEL SANTHOSH KUMAR. D

RAJESH PRABHU. G

GUIDED BY

Mr.V. DURAISWAMY, M.E.

IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE AWARD OF THE DEGREE OF

BACHELOR OF ENGINEERING IN

ELECTRICAL AND ELECTRONICS ENGINEERING

OF THE BHARATHIAR UNIVERSITY

Department of Electrical and Electronics Engineering

Kumaraguru College of Technology

Coimbatore - 641 006.

Department of Electrical and Electronics Engineering

Kumaraguru College of Technology

Coimbatore - 641 006.

CERTIFICATE

This is to certify that the contents of the project report entitled

REPLACEMENT OF ELECTRONIC CONTROL

BY

PLC FOR A GEAR HOBBING MACHINE

has been submitted by Mr VINEK VENKATESH VIKRAM, RAJESH KANNA S, SAMUEL SANTHOSH KUMAR

In Partial Fulfilment of the Requirements for the award of the

Degree of Bachelor of Engineering

IN ELECTRICAL AND ELECTRONICS ENGINEERING

Branch of the Bharathiar University, Coimbatore.

During the academic year 1999 - 2000

Guide

Professor and Head
Department of Electrical and Electronics Engineering
Kumaraguru College of Technology
Coimbatore - 641 006

Certified that the canditate with University Register Number .....

was examined by us in project Viva - Voce Examination held on .....

Internal Examiner

External Examiner

PREMIER INSTRUMENTS & CONTROLS LIMITED

pricol

P.B. NO. 4209, PERIANAICKENPALAYAM
COIMBATORE - 641 020. INDIA
PHONE : 0422 - 892901 TO 10
FAX : 0422 - 892928
TELEX : 0655 - 634 PIB IN
CABLE : DASHBOARD

HRD/TRG/2000
09-03-2000

PROJECT CERTIFICATE

P-404

This is to certify that the following B.E. Electrical and Electronics Engineering students of Kumaraguru College of Technology, Coimbatore have done their project on "Replacement of Electronic Control By PLC for a Gear Hobbing Machine (MIKRON)" in our organisation :-

1. **Mr.Vivek Venkatesh.R**
2. **Mr.Vikram.J**
3. **Mr.Samuel Santhosh Kumar.C**
4. **Mr.Rajesh Prabhu.C**

Period of project : September 1999 to March 2000

Process / Department : Plant Maintenance Department

During this period their attendance and conduct were found to be Good.

We wish them the very best for a bright future.

ANTHONY THIAGARAJAN
DEPUTY MANAGER-HRD

REGD. OFFICE : P.B. No. 4251, 1087 A, AVANASHI ROAD, COIMBATORE - 641 037. INDIA
PH : 0422 - 210520 TO 4, FAX : 0422 - 210029 TELEX : 0655 - 634 PIB IN CABLE : DASHBOARD

ISO 9001

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We are indebted in thanking our Professor and Head of the Department **Dr .K.A.Palaniswamy B.E. ,M.Sc (Engg.) ,Ph.D , M.I.S.T.E. , C.Eng (I), F.I.E.,** for his constant encouragement and for providing valuable ideas which helped in the completion of this project.

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We whole heartedly express our thanks to **Mr. Samuel B.E.** ,Engineer, Plant Maintenance Departement ,PRICOL for sparing his precious time and for guiding us throughout this project.

We extend our sincere gratitude to **Mr.Vijayan,**Technician,Plant Maintenance Department, PRICOL and **Mr.Shanmugasundram,**Technician, Manufacturing Engineering Department, PRICOL who helped us in the successful completion of the project.

We also sincerely thank our beloved parents,friends and others who stoodby ourside in pain and pleasure during the course of this project work.

SYNOPSIS

The latest trend in the field of Industrial Automation is the control through Programmable Logic Controller.The drawbacks and deficitness of other types of controls has paved way to the advancement of technology which is the control through PLC.

"Necessity is the mother of invention". The rate and the number of breakdowns in the conventional control methods like Electronic control, Pneumatic control, etc demanded a better means of control for the industrial machinery. The result is the emergence of PLC.

MIKRON,a Swiss based Gear Hobbing Machine which was operating on the conventional control panel was prone to a large number of breakdowns which affected it's efficient service.In this project,we have replaced the Electronic control by PLC.The entire operation of the machine was completely analysed and for the entire range of operation,a program which has a high degree of accuracy and precision has been formulated.

This programming has been done for three modes of operation of the GHM: 1.Manual , 2.Semi-Automatic , 3.Automatic.

This programming is incorporated in the PLC which can now be used for the control purposes.

CONTENTS

CHAPTER - 1

INTRODUCTION

Generally in the industrial automation processes, Electronic Controls, Manual Controls, Pneumatic Controls, Electromagnetic Controls and Hardwired Electronic IC Logic are used. They suffer a lot of disadvantages. Their main drawback is that they are inflexible and hence modification is difficult. Moreover they are bulky and expensive. The above mentioned drawbacks have paved way for the emergence of a better means of control known as the Programmable Logic Controller.

1.1. INTRODUCTION TO PLC:

The PLC can be defined as "a digitally operating electronic apparatus which uses a programmable memory for the internal storage of instructions for implementing specific functions such as logic, sequence, timing, counting and arithmetic to control through digital or analog input / output modules, various types of machines or processes."

The Programmable Logic Controller provides a new way of automation with a facility to alter the control sequence by simple programming without major changes in the hardware.The number of faults are reduced considerably. An additional advantage is that it can be simulated even before it is incorporated in to the process.

The major areas where PLC can be used are in the power engineering,machine tools,chemical industries and many.In our project,PLC is used for the automation of a Gear Hobbing Machine.This Gear Hobbing Machine produces straight and helical gears.

CHAPTER - 2

GEAR HOBBING MACHINE

2.1 INTRODUCTION TO GHM :

The Gear Hobbing Machine (Mikron) is used to produce straight and helical gears of type A102.5. Gears can be produced on small cylindrical brass piece. The gears are produced due to rotary and linear movements. The workpiece rotates along the spindle which is rotated by the main motor. While workpiece is rotating, the Cutter head (Hob) which is also rotating comes in contact with workpiece and gears are produced on the workpiece. Though Hob and spindle are run by the same motor, speed of Hob might vary according to the width of the gear to be produced. This speed variation is achieved by a gear and clutch arragement.

2.2 MAIN DRIVES OF GHM:

- Main motor.
- Hydraulic pump.
- Coolant pump.
- Rapid return motor.

2.2.1. Main Motor :

It is a squirrel cage induction motor of capacity 1.10kW and which has a speed of 1500rpm. This motor rotates the spindle and the Hob. The spindle is rotated at constant speed irrespective of the number of teeth and gear dimensions, whereas the Hob is rotated at adjustable constant speed by using a gear arrangement.

2.2.2. Hydraulic Motor:

It is also a squirrel cage induction motor of capacity 0.37 kW and having a speed of 1500 rpm. This develops a hydraulic pressure which is used to provide linear movements to various parts likes loader, disloader, collet, tailstock etc. A booster is also provided to maintain a constant pressure.

2.2.3. Coolant Pump Motor:

The coolant pump motor has a capacity of the motor is 0.11kW and the speed of the motor is 3000 rpm. During Hobbing operation heat is developed in the workpiece which may damage the machine. In order to avoid overheating and damage, coolant is poured on the workpiece. A float is provided in order to have control over the coolant level. If the coolant is below the required set level, then the operation is discontinued.

2.2.4. Rapid Return Motor:

It is a squirrel cage induction motor of capacity 0.04kW and has a speed of 3000rpm. This motor is used in bringing the cutter head to its original position when horizontal movement of the cutter head is encountered.

2.3. MAIN PARTS OF GHM:

- Auto loader Arrangement.
- Auto disloader Arrangement.
- Collet and Tailstock.
- Cutter Head or Hob.

2.3.1. Auto Loader Arrangement:

This hydraulic operated device is used to load automatically the workpiece into the work area. It also ensures that the workpiece is properly held in position by the tailstock and collet before it returns to its original position.

2.3.2. Auto Disloader Arrangement:

This device is used to unload the workpiece from the work area after the gears are produced. The collet and the tailstock open only after the disloader holds the completed workpiece.

2.3.3. Collet and Tailstock:

These are used to hold the workpiece in position when gears are cut. During the hobbing operation, the workpiece is rotated by a spindle. The tailstock makes to and fro linear motion to hold and release workpiece.

2.3.4. Cutter Head (Hob):

The Cutter head or Hob does the hobbing operation. The possible movements of cutter head are:

a. Up and down (Vertical).

b. Right to left and viceversa (Horizontal).

2.4. WORKING SEQUENCE OF A GEAR HOBBING MACHINE:

1. The mains are switched on.

2. The hydraulic motor is switched on.

3. The main motor is switched on.

4. The disloader comes and checks if there is workpiece in the work area. It clears the work area if there is a work piece.

5. After a time delay, the loader brings the workpiece and holes it in appropriate position.

6. After the workpiece is brought to the appropriate position, the tail stock and the collet closes there by holding the workpiece.

7. After ensuring that the workpiece is held rightly by the collet and tailstock, the loader goes back to its original position.

8. After a certain time delay, the Cutter head comes vertically up and after reaching its upper limit, it comes in contact with the workpiece. Both the workpiece and the Cutter head are rotating and hence gears are cut in the workpiece for a specified time interval. Simultaneously coolant flows to remove the excessive heat produced during hobbing.

9. If there is horizontal movement, the Cutter head is traversed horizontally using a feed clutch till the desired position is reached.

10. After the desired position is reached or by default the extreme position is reached, the Cutter head is lowered vertically downwards and then it is brought to its original position by a rapid clutch. If there is no horizontal movement the Cutter head is lowered vertically downwards.

11. After a certain time delay, the disloader comes to pickup the finished piece. After it holds the piece firmly, the tailstock and the collect open thereby going to their original position. The disloader then resumes its original position after dropping the finished piece in a tray.

2.5. GHM SPECIFICATIONS:

- Maximum workpiece diameter - 90mm(3.54").
- Maximum workpiece length - 200mm(7.88").
- Maximum length that can be hobbed - 150mm(5.91").
- Helix angle (left or right) - 150".
- No of teeth in cutter head - 6 to 325.
- Hob(cutterhead) speed - 140 - 1870 rpm.
- Dimension of machine - Height - 1700mm
- Length - 1000mm
- Width - 1600mm
- Weight of machine - 950 KG.

CHAPTER - 3

PLC HARDWARE DESCRIPTION

3.1 INTRODUCTION TO PLC :

In the automation process, generally Electronic Controls, Manual Controls, Pneumatic Controls, Electromagnetic Controls Hardwired Electronic IC logic are used. Their main drawback is that the life of such devices are limited. Moreover they are bulky and expensive.

They also have the drawback of being inflexible which effectively means, the modification is difficult. In this regard PLC provides a new way of automation with a facility to alter the control sequence by simple programming without major changes in the hardware.

3.2 PLC – DEFINITION :

The PLC can be defined as " a digitally operating electronic apparatus which uses a programmable memory for the internal storage of instructions for implementing specific functions such as logic, sequence, timing, counting and arithmetic to control through digital or analog input / output modules, various types of machines or processes."

3.3 PLC AS A COMPUTER :

A PLC is a computer but a different type from the Personal computer. Most of the people are familiar with data-processing computers, especially micro computers such as those from APPLE and IBM. Such Computers process reams of data. Their input peripherals are the Keyboard and Mouse. Their output peripherals are video display terminal, printer and the plotter.This is shown in Fig.3.1.

There is another type of computer known as a process control computer. Although it processes data, its main function is to control manufacturing and industrial processes (Machinery, Robots, Assembly lines etc). Such computers are said to be event driven. Although they may have a keyboard and other input peripherals, their control inputs are switches and sensors. The output peripherals such as VDT's and printers may be attached with the Process Control Computers. The process control computer primarily controls the devices such as motors, solenoids, lights and heaters.This is shown in fig 3.2.

PLC is a type of process control computer which is small, relatively inexpensive, environmentally hardened and easy to program, operate, maintain and repair. They are often installed close to the machinery or process they control and are thus seen as an extension of industrial equipment. PLC is the heart of today's manufacturing and process operations.

3.4 PLC HARDWARE DESCRIPTION

Fig.3.3. shows the hardware description of the PLC

3.5 THE CENTRAL PROCESSING UNIT :

In small PLC's, the processor, the solid state memory, I /O modules and power supply are housed in a single compact unit .

In large PLC's, the processor and memory are in one unit, the power supply in the second unit and the I /O interfaces in additional unit . Regardless of the PLC size the processor and memory are always in the same unit. This unit is called the Central Processing Unit.

The most commonly used configuration of PLC contains the processor, memory and power supply as the CPU with input interfaces placed in external modules. The schematic diagram is shown in Fig.3.4

The fixed memory contains the program set by the manufacturer. This system program is set into a special IC chips called Read Only Memory(ROM). The fixed program in the ROM cannot be altered or erased during the CPU's operation. The program in this nonvolatile memory is retained even when the power is switched off.

The alterable memory contains many sections where information is stored on IC chips that can be programmed , altered, and erased by the

programmer/user. The alterable memory is stored mainly on Random Access Memory (RAM) chips. RAM is often called as Read / Write memory. The typical RAM chip will loose all the information when the power is lost. If the input power fails, battery backup preserves any program that has been inserted into the Central Processing Unit RAM.

The CPUs have operational switches, some of them require a key to prevent unauthorised personnel from running a turned off process. It also prevents unauthorised alterations to the operating program of the system.

3.5.1. TYPICAL KEYS :

1. OFF - system cannot be run or programmed.
2. RUN - allows the system to run but no program alterations can be made.
3. DISABLE - turns output OFF or sets them to the operate state.
4. MONITOR - turns ON screen that displays operating information.
5. RUN/PROGRAM - system can run and program modifications can be made while it is running.

The processor is the controller that keeps information going from one place to another . It responds to programmed instructions stored in the memory, causing output devices to be energised and de-energized in response to the on-off status of input devices.

3.6 SOLID STATE MEMORY :

The major types of memory chips used in PLC CPU's are PROM, EPROM, EEPROM and NOVRAM.

The PROM (Programmable Read Only Memory) chip is similar to the ROM except that it may be programmed once and only by the user programmer. No erasures are possible. The PROM is seldom used because it requires programming circuits.

The Erasable Programmable Read Only Memory (EPROM) is a PROM which can be erased by subjecting a window on it's top to ultra - violet rays for a few minutes. There are two main disadvantages of EPROM . One is the down time required for it's reprogramming. Another is that when the EPROM is exposed to UV rays all it's memory locations are erased. The EPROM must be completely reprogrammed, even if one or two memory slots require updation.

The Electrically Erasable Programmable Read Only Memory (EEPROM) is similar to EPROM except that instead of UV rays we make use of electrical signal for erasure.

The Nonvolatile Random Access Memory (NOVRAM) is a combination of an EEPROM and RAM. When the power is about to be switched off, the

contents are read into the EEPROM memory. When the power is again restored the contents are again back into the RAM memory.

3.7 MEMORY ORGANISATION IN A PLC:

The memory organisation in a PLC is shown in the fig4. It can be divided into two categories : User Memory and Storage Memory. The former contains the ladder logic diagram. The latter contains information needed to carry out the user program (i.e.) the status of the discrete input and output devices, the preset and accumulated values of counters and timers, numerical values, sequencer patterns, internal I/O relay equivalents etc. The user memory occupies 75% of the total memory.

From fig.4, we see that all the addresses are given in octal numbering system. The first section consisting of eight words, is the ***input image status*** addresses ($110_{(8)}$ - $117_{(8)}$) and the discrete, real time inputs are stored in the above addresses.

The second section also consisting of eight words, is the ***output image status*** addresses($120_{(8)}$ - $127_{(8)}$). This is where the binary data (0's and 1's) that will activate real time outputs are stored.

Timing status, accumulated values and preset values are stored in the third section of storage memory, using a total of 24 words from address $130_{(8)}$.

to address $157_{(8)}$ .Counter status, accumulated values and preset values are stored in the fourth section also using a total of 24 words. These words are located at addresses $(160_{(8)} - 217_{(8)})$.

In the fifth section, numerical data is used for numbers system conversion. In this section, eight 16-bit words have been reserved at addresses($220_{(8)} - 227_{(8)}$).

Other functions can be continued at the bottom of the map as needed. The additional memory size required depends on the total number of different functions in the CPU.

3.8 THE PROCESSOR:

All computer processors are designed to carry out arithmetic and logic operations. They are programmed as per a set of instructions compiled to form a program.

Two factors determine the power of a microprocessor, bit size and clock speed. There are 4,8,16,32 bit microprocessors which manipulate 4,8,16,32 bits at a time respectively. The larger the bit size, the more powerful the computer.

Clock-speed determines how quickly the processor executes the instructions. The faster the clock-speed, the more powerful is the computer.

Large PLC's use the 80386 or the 80486 processor for satisfactory operation, which have a clock speed of 33MHZ and 50MHZ respectively.

The Fig.3.6. shows the operation and structure of a processor used in a PLC. To begin with from the Fig.5 a ROM with the fixed operating system program interfaces to the control section. This unalterable program manages the operation of the PLC.

The control section, the heart of the processor, consists of a control unit with a clock, an arithmetic / logic unit and a few internal temporary registers. The control section determines the sequence and duration of operation of the various sections .

The input scan block, when called upon to operate, scans the inputs and places the individual statuses in the RAM memory. After analysis the logic scan (uses ladder logic program) updates the output scan block to the appropriate state. Then the outputs are scanned and updated. The output channels are changed or left alone, depending on the logic analysis. The output status depends on the output status signals of the CPU.

3.9 I / O MODULES (INTERFACES) :

The I/O Module interface is shown in the fig(8).The Input modules perform four tasks electronically. First it senses the presence or absence of an input signal at each of its input terminals. The input signal selects the switch, sensor, or other signal is ON or OFF in the process which is being controlled. Second, it converts the input signal for ON OFF, to a DC level usable by the modules electronic circuit. For an OFF input signal, no signal is converted, indicating that it is OFF. Third, the input module carries out electronic isolation by electronically isolating the input module output from its input. Finally its electronic circuit produces an output to be used by the PLC Central Processing Unit.

3.10 POWER SUPPLIES :

The power supply available in the plant is 120V AC and the PLC's operate on +5 and –5 volts DC. The PLC CPU must therefore contain converter to convert the 120V AC input to the required 5V DC . The conversion is accomplished by a built-in voltage converting power supply.

3.11 PLC USED IN THE PROJECT:

The PLC that is used in this project is the KV-40 PLC of Keyence make. The KV PLC is provided with internal functions such as relay contacts Normally Open(N.O), Normally Closed(N.C), timers, and counters. Sequential control is made possible by programming these internal functions and executing logic Instructions. This software based control process eliminates the need for physical wiring. The Fig 3.7. given below gives the configuration of the KV PLC that is used in this project.

3.12. PARTS AND FUNCTIONS

Functions of various parts of the KV PLC are given below:

- **Input Terminals:**

  Rated input signals for these terminals are 24v DC.

- **Output Terminals:**

  Direct clock pulses as well as ordinary pulses are output through replays 0500 and 0501.

- **Power Supply Terminals:**

  Supply power at 24v DC.

- **Power Indicator:**

  Lights when the power is ON.

- **Run / Error Indicator:**

  - Lights when the unit is in operation.
  - Flashes when error occurs during operation.

- **Input Indicator:**

  Lights when the input signal is ON.

- **Output Indicator:**

  Lights when the output signal is ON.

- **Connector Cable Port:**

  Connects any KV PLC to the handheld programmer or to the external computer.

- **Analog Timer (TRIMMER):**

  The timer / counter setting and the data on the register can be changed without using the hand held programmer just by opening the PLC cover and adjusting the trimmer.

3.13 TIMERS AND COUNTERS

3.13.1. PLC Timer :

In many control tasks, there is a need to control time. Toincorporate such control, PLC's are provided with built in timers. Timers count fraction of second or seconds using internal CPU Clock. The mainly used timer configuration are ON delay time and OFF delay time. PLC timer function can replace any of the industrial timer like RC time constant or dashpot. Advantage of PLC timer is that its time may be a programmable ,variable time as well as a fixed time. It also has a good accuracy and repeatability, since it is based on solid state technology.

3.13.2. PLC COUNTER :

A Counter counts the number of occurrences of a signal. A counter is set to some preset number value and when this value of signals has been recorded the contacts are operated. This PLC's include both type of counters. up counters and down counters. The counter in PLC may be considered to consist of two relay coils. One to count input pulses and the other to reset the counter.

Up counter can be used to count the number of products produced and down counter can be used to count the number of raw materials used. From this wanted raw materials can be calculated.

3.14. RELAYS USED IN KV - 40

Input relay : 24 relays :

0000 - 0015

0100 - 0107

Expansion input relay : 48 relays:

0200 - 0215

0300 - 0315

0400 - 0415

Output relay : 16 relays :

0500 - 0507

0600 - 0607

Expansion output relay : 48 relays :

0700 - 0715

0800 - 0815

0900 - 0915

Internal output relay : 800 relays :

1000 - 1015

1900 - 1915

3000 - 3015

3900 - 3915

4000 - 4015

4900 - 4915

5000 - 5015

5900 - 5915

6000 - 6915

6900 - 6915

Special utility relay : 160 relays

2000 - 2015

to

2900 - 2915

3.14.1. Input Relays:

Input relays receive ON/OFF signals from external equipment. Time constant of the input relays is normally between 8 and 12ms. This constant

changes to 25μs for OFF-> ON transition and to 75μs for ON ->OFF transition when HSP instruction is used.

Input response frequency of relay nos.0004 and 0005(sources of clock pulses for high speed counters CTHO and CTHI) automatically changes to 10KHZ.

Input response time of relay no's between 0000 and 0003 changes to 25μs for OFF-> ON transition and to 35μs for ON->OFF transition when INT instruction is used.

3.14.2. Output Relays:

These relays send results of operations to external equipment .output signals can be sent through either of 3 types of devices:

Relays, BJT, and MOSFET.

3.14.3. Internal Utility Relays:

When the same relay contact is used twice or more in relay circuit , actual relay must have as many poles as the number of times it is used . On the other hand , the internal utility relays of the PLC function only on programs , therefore assuring trouble-free circuit designing.

- On programs, these relays serve as a contact as well as a coil to drive the succeeding stages.
- These relays can be used both as N.O and N.C contacts. They can be used on any order. Also as many of them as desired can be used.

3.14.4. Special Utility Relays:

Each of these relays has a distinct function. Efficient use of these relays assures simple programming process and high control performance.

- The same relay can be used as many times as desired on a program
- These utility relays are used only as a contact but as a contact but not as a coil to drive the succeeding stages.

3.15 PROGRAM MEMORY :

The memory can be grouped unto two categories.

1. Data Memory

2.Temporary Memory

3.15.1. Data Memory :

Data memory stores various type of data. It retains data for arithmetic operators and also retains their results. Each data memory is 16 bit long and

stores binary data just as the internal register data memory area DM 0000 to DM 1999.

3.15.2. Temporary Memory

Temporary Memory stores temporary data. It temporarily retains data for arithmetic and also retains their result

Memory area - TM 00 to TM 31

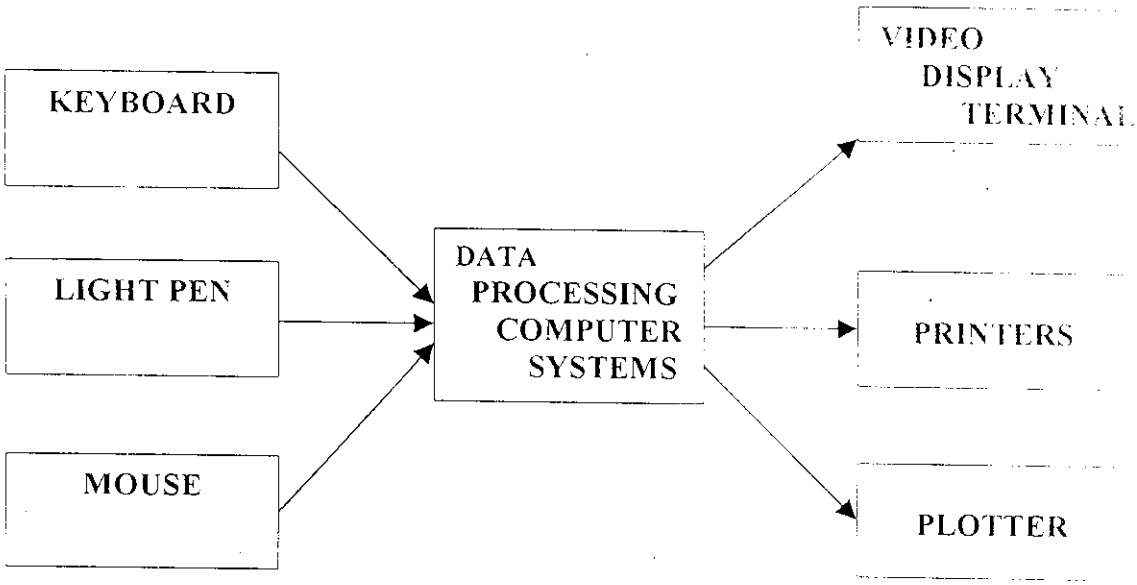


Fig.3.1. DATA PROCESSING COMPUTER

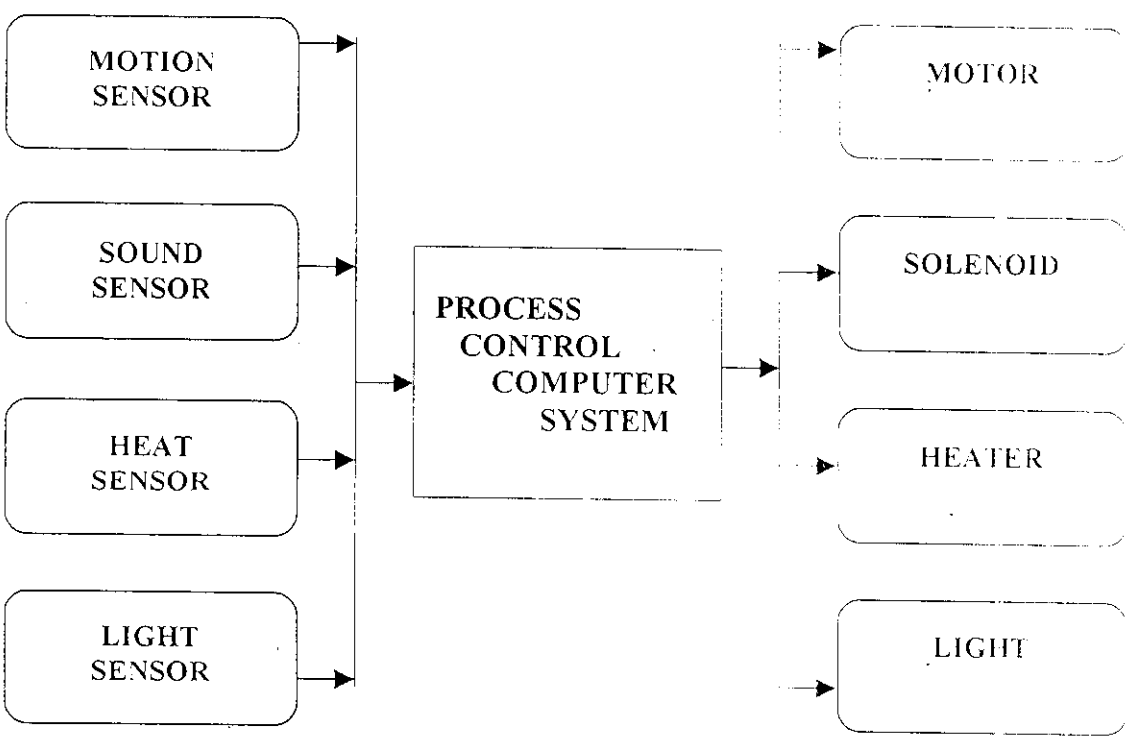


Fig.3.2 PROCESS CONTROL COMPUTER

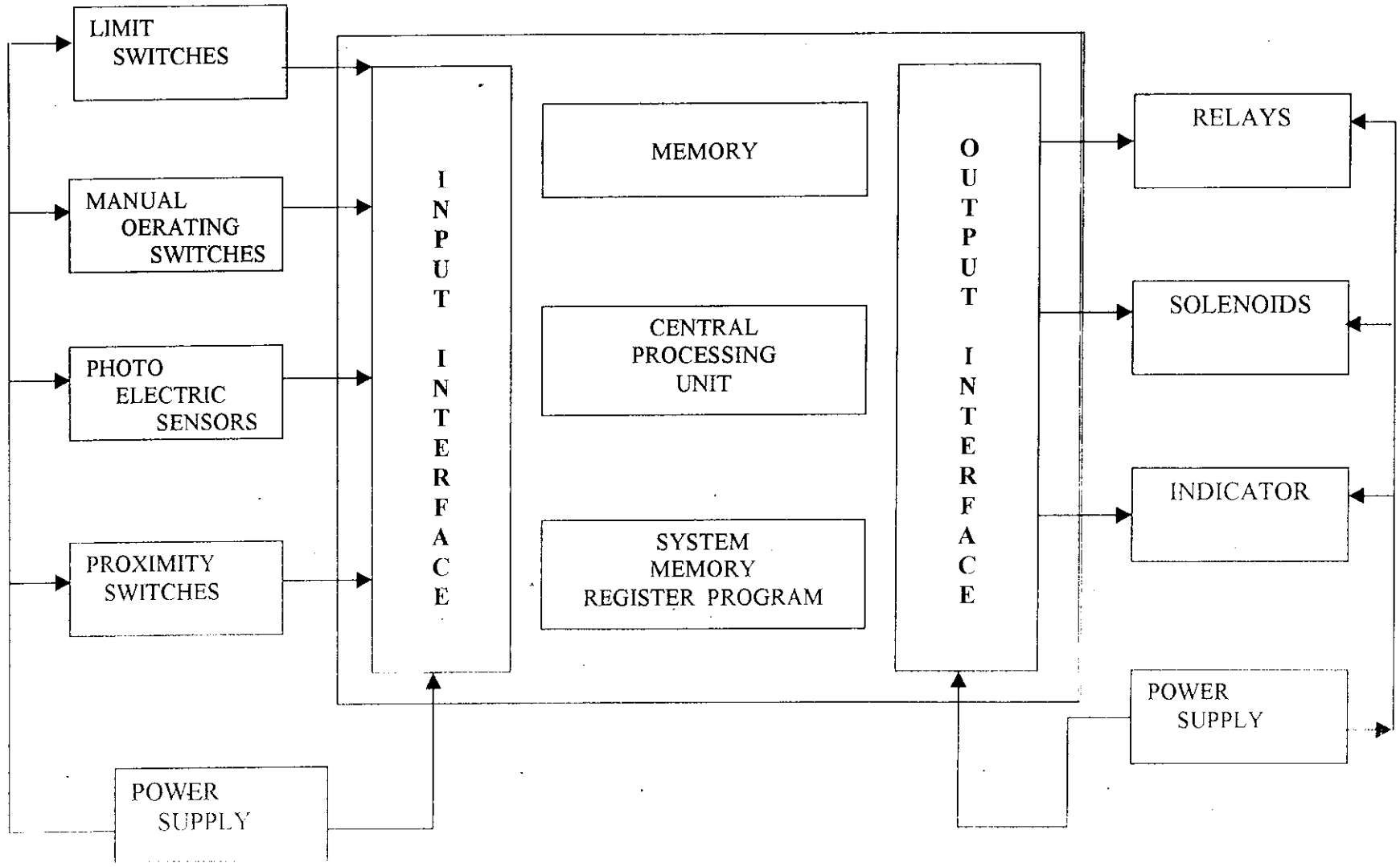


Fig 3.3 PROGRAMMABLE LOGIC CONTROLLER HARDWARE DETAILS

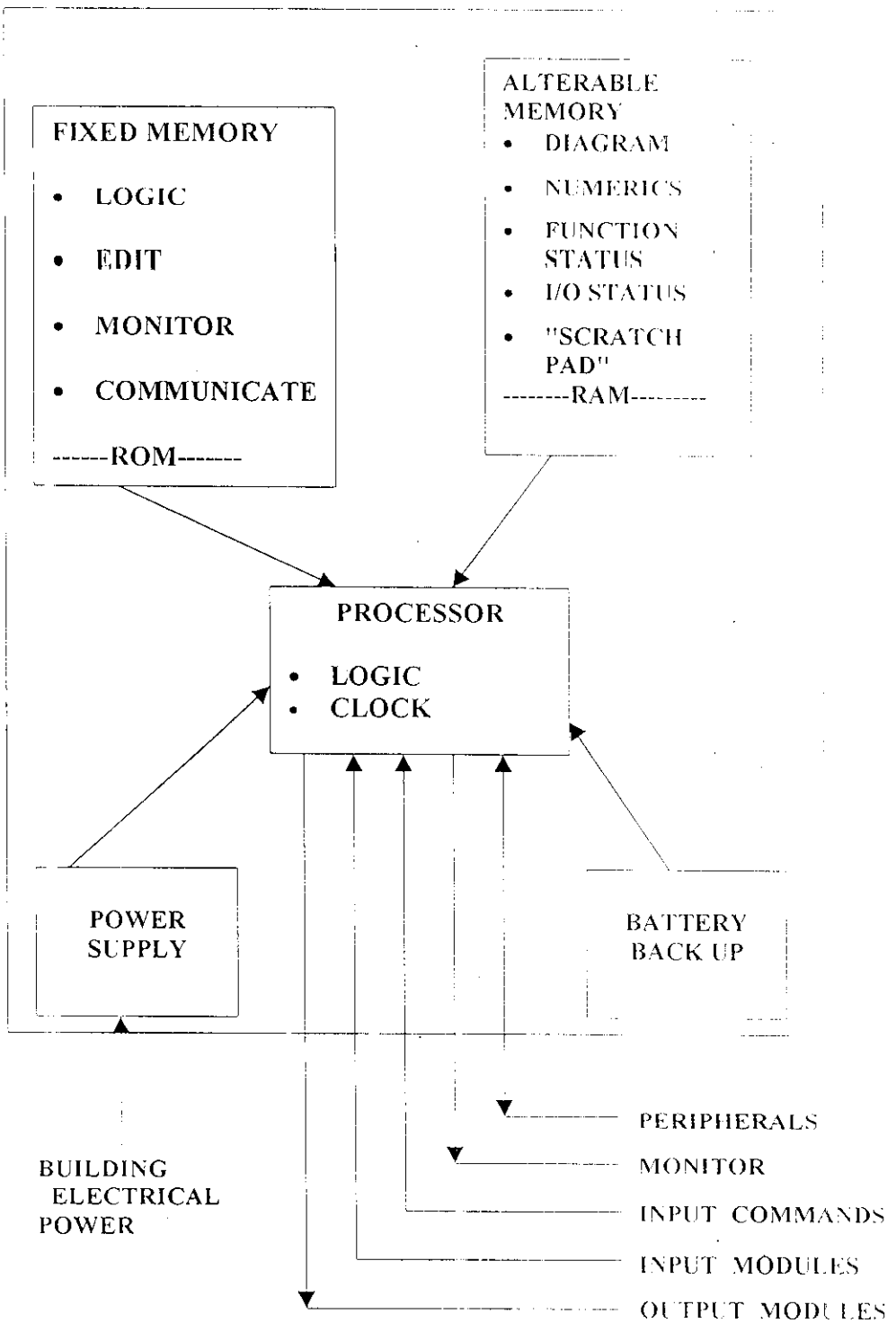


Fig .3.4 CENTRAL PROCESSING UNIT

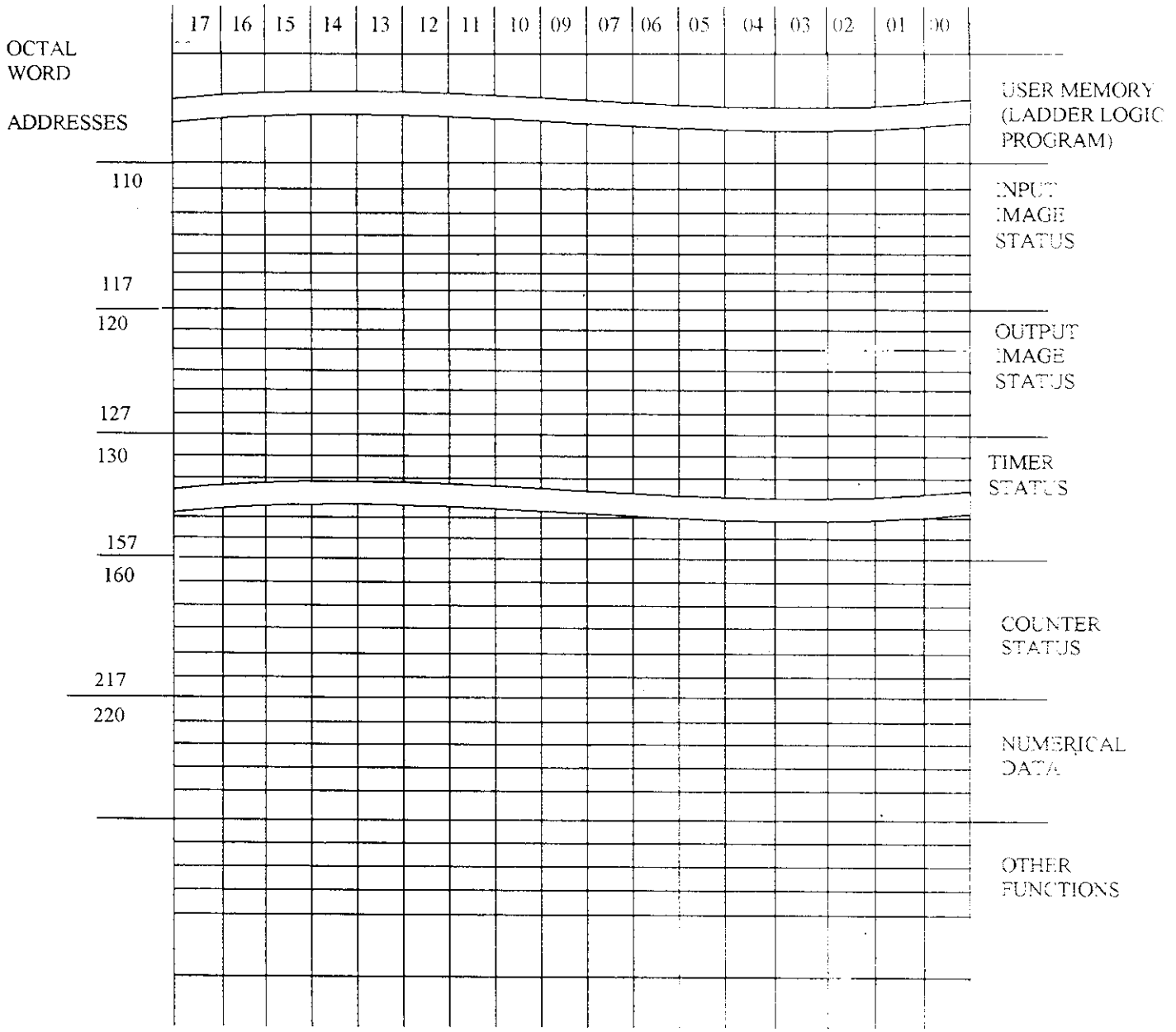


Fig . 3.5 BIT ADDRESS

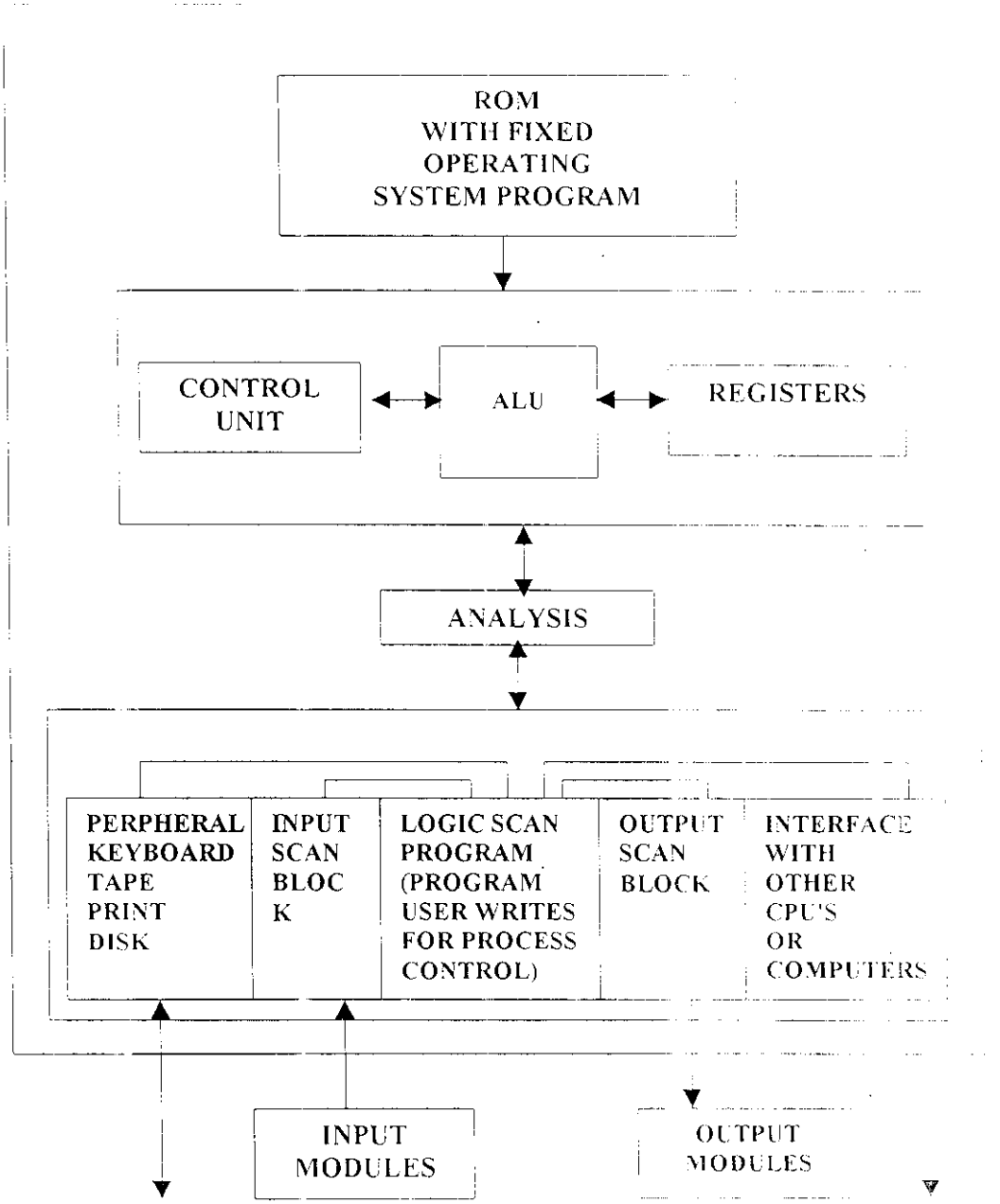


FIG 3.6 INTERNAL ARCHITECTURE OF THE PROCESSOR

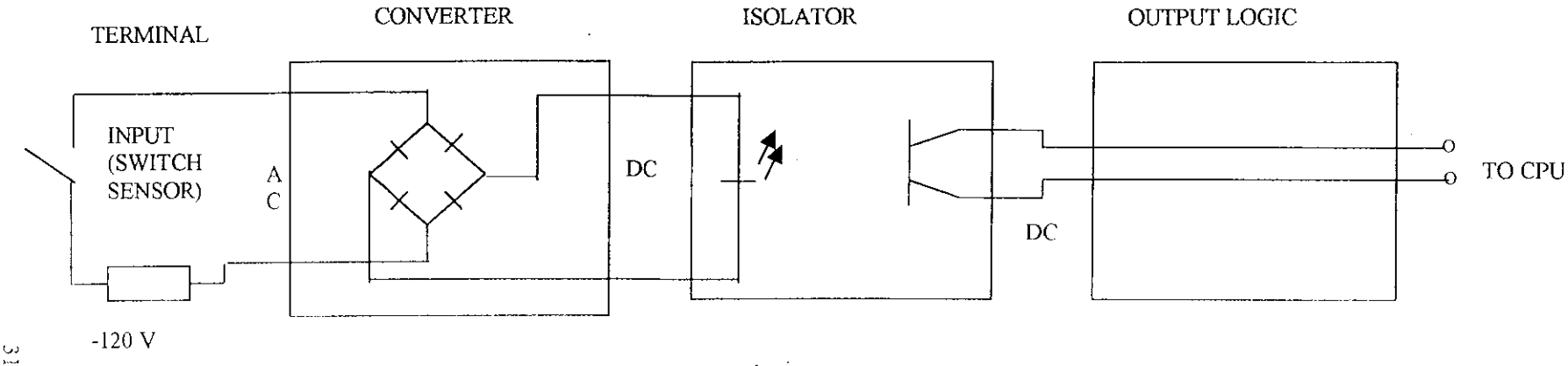


Fig 3.7 I/O MODULES(INTERFACE)

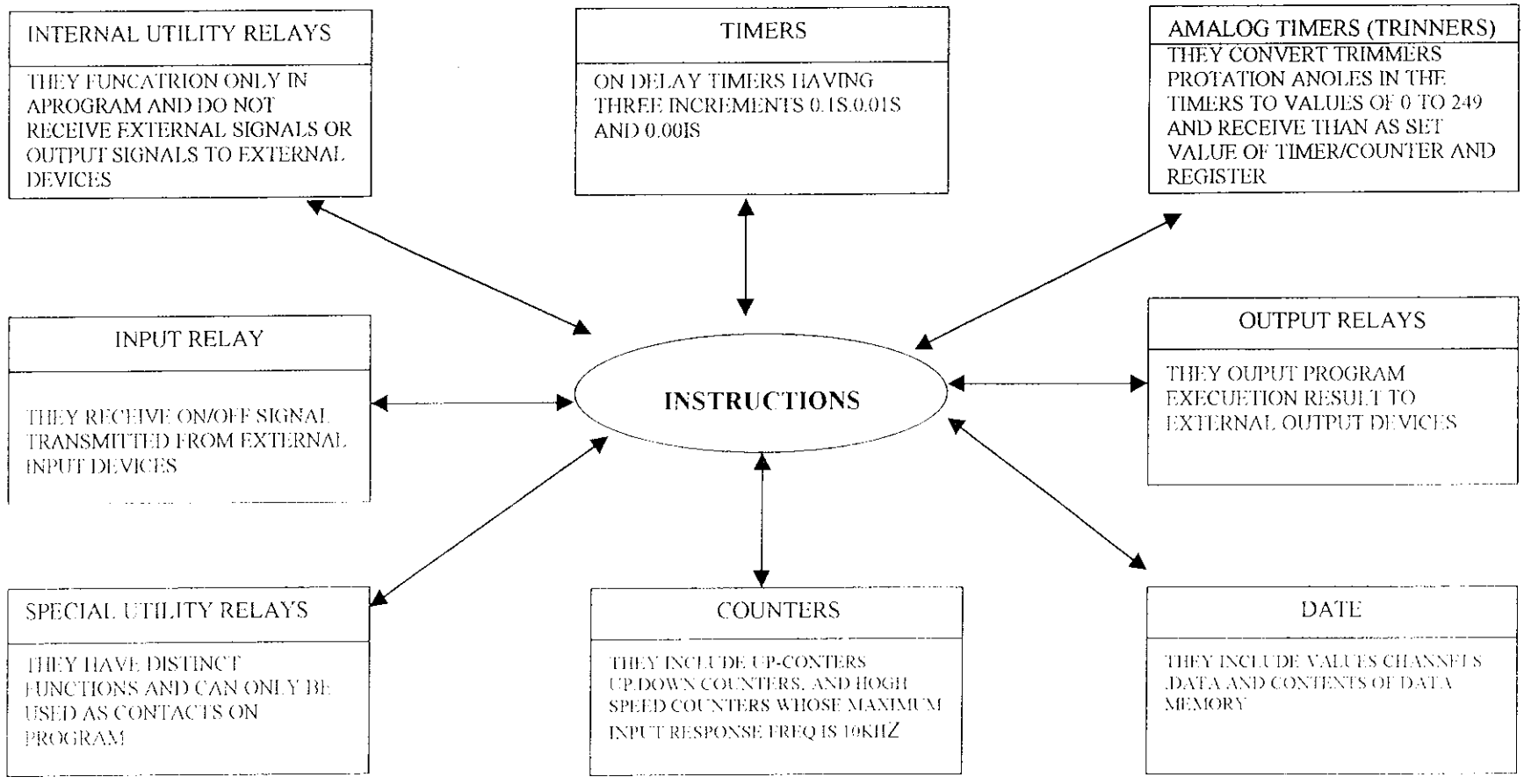


Fig 3.8 KV PLC CONFIGURATION

CHAPTER - 4

PLC PROGRAMMING TECHNIQUES

4.1 BASIC TERMINOLOGIES :

4.1.1. Ladder Diagram :

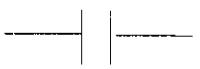
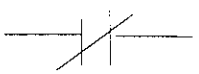
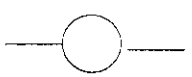
Electrical circuit diagrams show relative physical location of the circuit components and how they are actually wired but in ladder diagrams, importance is given to clearly show the control that is exercised.

Thus a ladder diagram can be briefly defined as a special, symbolic, schematic representation of hardware control and operating sequence description. In a ladder diagram , each ring of the ladder is composed of a number of conditions or input states and a single common output. The nature of the inputs determines whether the output is to be energised or not.

4.1.2. Relays :

Relays are mechanical switches whose coil when energised will make a few contacts. The contacts which gets closed when the relay is energised are called Normally Open contacts. The contacts which gets opened when the relay is energised are called Normally Closed contacts.

4.1.3. Elements And Symbols Used In Ladder Program :

SYMBOL	ELEMENTS
	Normally open contactor
	Normally closed contactor
	Relay Coil

4.2. PROCEDURE FOR PROGRAMMING:

The programming procedure includes the following steps :

1. Studying Electrical circuit .
2. Creating timing diagram (if required) .
3. Designing Sequential circuit .
4. Assigning I/O devices .
5. Creating ladder diagram .
6. Review and correction .
7. Coding .
8. Entering the Program .

The programming technique can be understood by considering the following simple example .

4.2.1. Studying The Electrical Circuit :

The above figure shows an example of a latch circuit . The lamp glows only when both PBI and LS are ON . This lamp remains ON even after both PBI and LS are turned off . This lamp can be switched off only when PB2 is opened .

This phase is very important in programming . A careful study of the electrical circuit reduces complication and changes of data thereby saving time and energy .

4.2.2. Creating Timing Diagram :

This stage clarifies the ON/OFF status and related conditions of peripheral devices and helps to create an appropriate ladder diagram . For the above circuit , the timing diagram is shown below .

4.2.3. Designing Sequential Circuit :

The Sequential circuit represents the sequence of operation that taken place . In this circuit diagram all the elements are replaced by their symbols .This is shown in Fig.4.3.

4.2.4. Creating Ladder Diagram :

This is same as the sequential circuit diagram except for the fact that the switch symbols are replaced by the appropriate Normally Open(N.O) or Normally Closed (N.C) contacts and appropriate numbers (as permitted by the PLC) are allotted for each switch .This is shown in Fig.4.1.

4.2.5. Assigning I/O Devices :

I/O device	PLC element	Number
PB1	Input relay	0000
LS	Input relay	0001
PB2	Input relay	0002
Relay	Internal utility relay	1000
Lamp	Output Relay	0500

4.2.6. Review And Correction :

Now a careful review has to be done on the ladder program in order to delete error if present . If there is any ever then correction should be made and again the whole program has to be revised again .

4.2.7. Coding :

The next step is to create a coding list (instruction list) according to the ladder diagram . The purpose of this process is to translate our ladder diagram into a language that the KV can understand .

Coding List :

Line no	Instruction	Operand (element no)
0000	LD	0000
0001	AND	0001
0002	OR	1000
0003	AND	0002
0004	OUT	1000
0005	LD	1000
0006	OUT	0...
0007	END	

4.2.8. Program Entry :

After the process of coding ,the data should be entered into the PLC using programming devices and then the PLC has to be incorporated in the control panel of the corresponding machine .

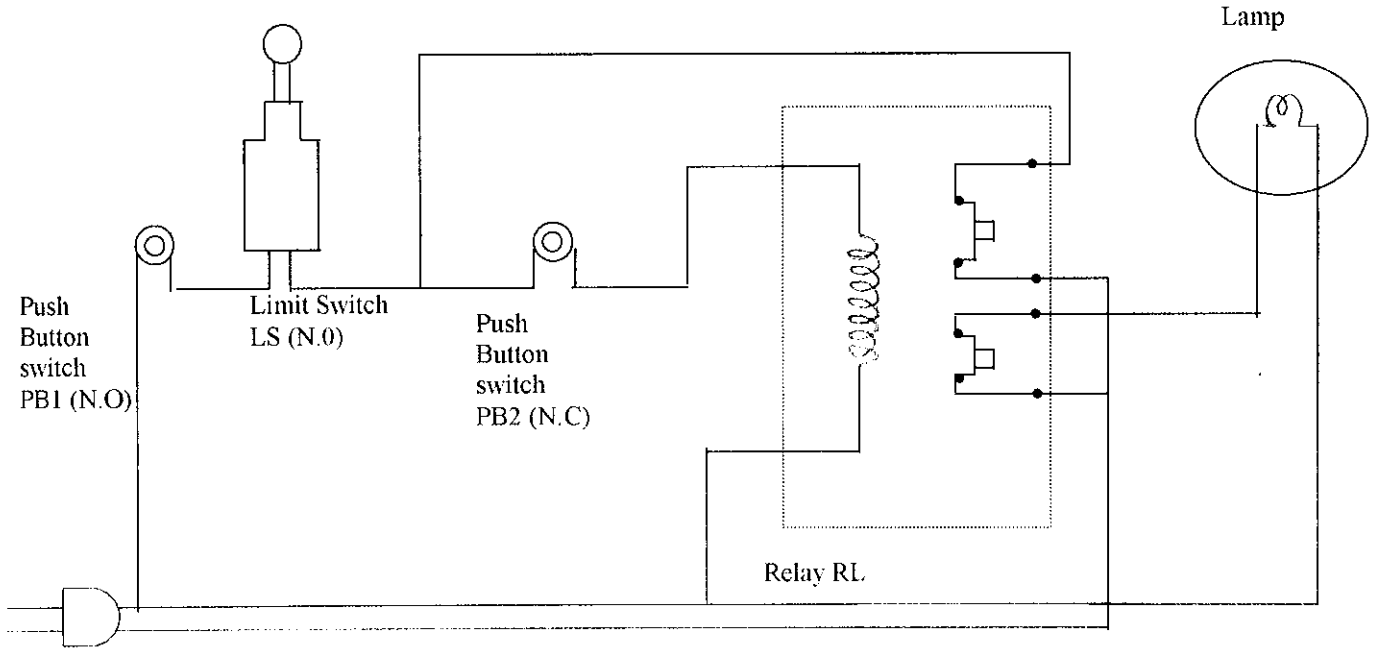


Fig . 4.1 LATCH CIRCUIT

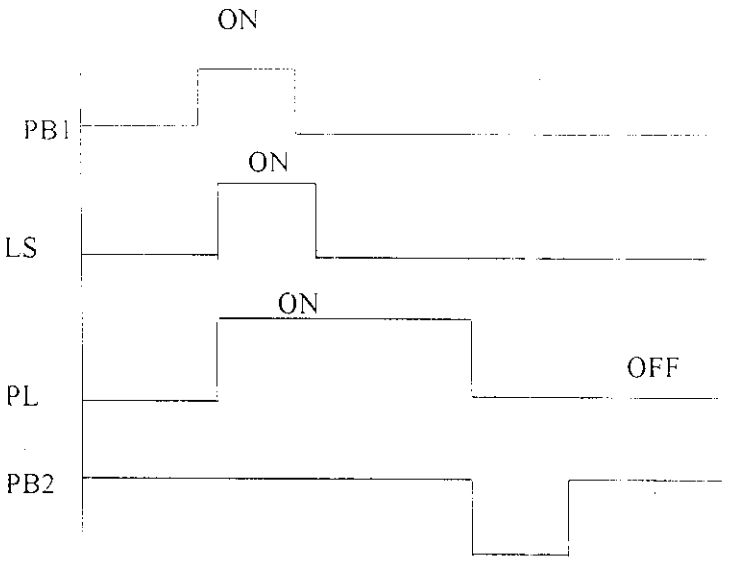


Fig.4.2. TIMING DIAGRAM

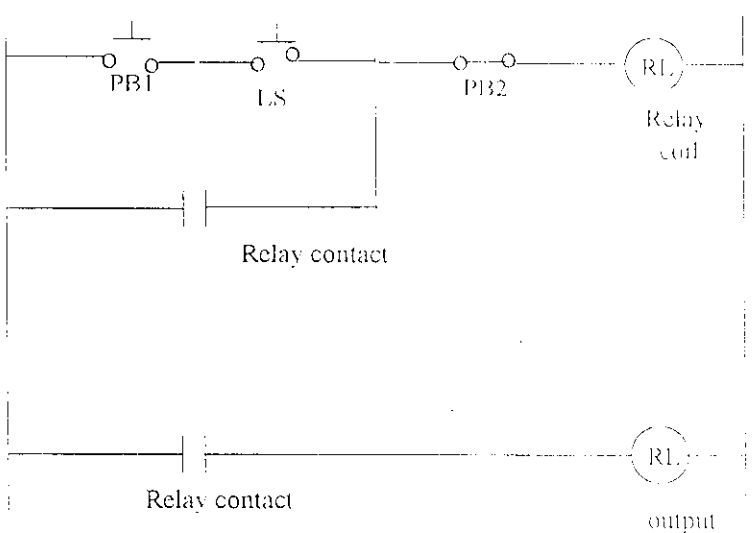


Fig.4.3. SEQUENTIAL CIRCUIT

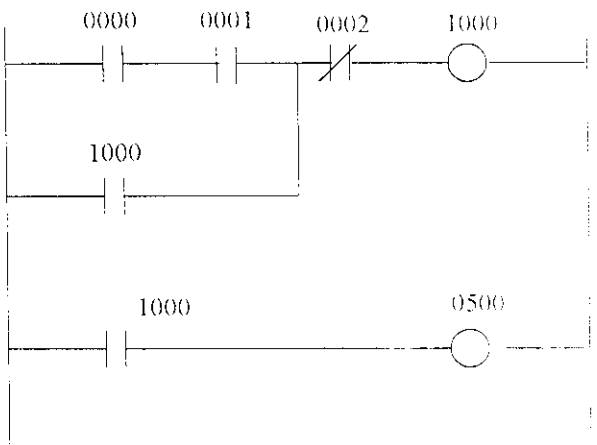


Fig.4.4. LADDER DIAGRAM

CHAPTER-5

FEATURES OF PLC

5.1. ADVANTAGES OF PLC:

5.1.1. Pilot Running:

A PLC program circuit can be pre run and evaluated without installing it actually on the machine but in a conventional relay system. The testing can be done only after installing the control system on the machine.

5.1.2. Visual Observation :

A PLC Circuit operation can be seen directly on a CRT screen. Trouble shooting can be done more quickly during Visual Observation.

5.1.3. Speed Of Operation :

Relays take a unacceptable time to actuate. The operational speed of PLC is very fast. The PLC speed is determined by the scan time.

5.1.4. Easier Programming :

Programming is made simpler due to ladder diagram. The availability of Computer has still reduced the Programming difficulties.

5.1.5. Reliability and Maintainability :

Solid state devices are more reliable in general than mechanical items or relays. The control system maintenance cost are low and down time minimized.

5.1.6. Documentation :

An immediate printout of the PLC circuit can be printed out easily. There is no need to look for the blueprint of the circuit in remote files. No wire tracing is needed for verification.

5.1.7. Security :

The software security is made user friendly.

5.2. DISADVANTAGES OF PLC:

5.2.1. Newer Technology:

It is difficult to change some personnel's thinking from interlockers and contractors to the PLC Computer Concepts.

5.2.2. Fixed Program Applications :

Some applications are single junction application. It does not pay to use a PLC that includes multiple programming capabilities if theories are needed. One example is in the use of drum Controllers / Sequences. Some equipment manufacturers still use a mechanical drum with pegs at an overall

cost advantage. Their operational sequence seldom or never changes and the reprogramming available with the PLC would not be necessary.

5.2.3. Environmental Consideration :

Certain process environments, such as high heat and vibrations interrupt with electronic devices in PLC's which limits their use.

5.2.4. Fail-Safe Operations :

In relay systems, the stop button electrically disconnects the circuit, if the power fails and the system stops. Further more, the relay system does not automatically restart when the power is restored. This of course, can be programmed in the PLC. However in some PLC Programs you may have to apply an input voltage to cause a device to stop.

These systems are not safe. This disadvantage can be overcome by adding safety relays to a PLC System.

In Industries the process to be controlled by PLC will involve more complexities .So the ladder diagram will be lengthy and hence the code list will extend to pages. Human code conversion and feed will invelve more error and time consuming. So all PLC's provide a software for code conversion

5.3. APPLICATIONS OF PLC :

The PLC's original intent was the replacement of electromagnetic relays with a solid state switching systems that could be programmed. Although PLC's have replaced much of the relay control logic, electromagnetic relays are still used as auxiliary device to switch input and output devices. Further the PLC has eliminated many of the wires used in relay ladder devices (OFF button, ON button, limit switch, sensors etc) and output device (Coil, Indicating lamps) are direct and looks very simple. It makes trouble shooting easier and also reduces plant down times.

The major areas where the PLC can be used to replace the relay controls are :

1. Machine Tools.
2. Power Engineering .
3. Material handling.
4. Process and Petro - chemical.
5. Cement factory.
6. Steel plants.
7. Sewage plants.
8. Fertilizers plant.
9. Paper industry.

10. Chemical industries and many others.

A PLC program change cannot be made unless the PLC is properly unlocked and programmed.

Relay panels tend to undergo undocumented changes. People on late shifts do not always record panel alterations made when the office area is locked - up in the night.

5.4. COST COMPARISON :

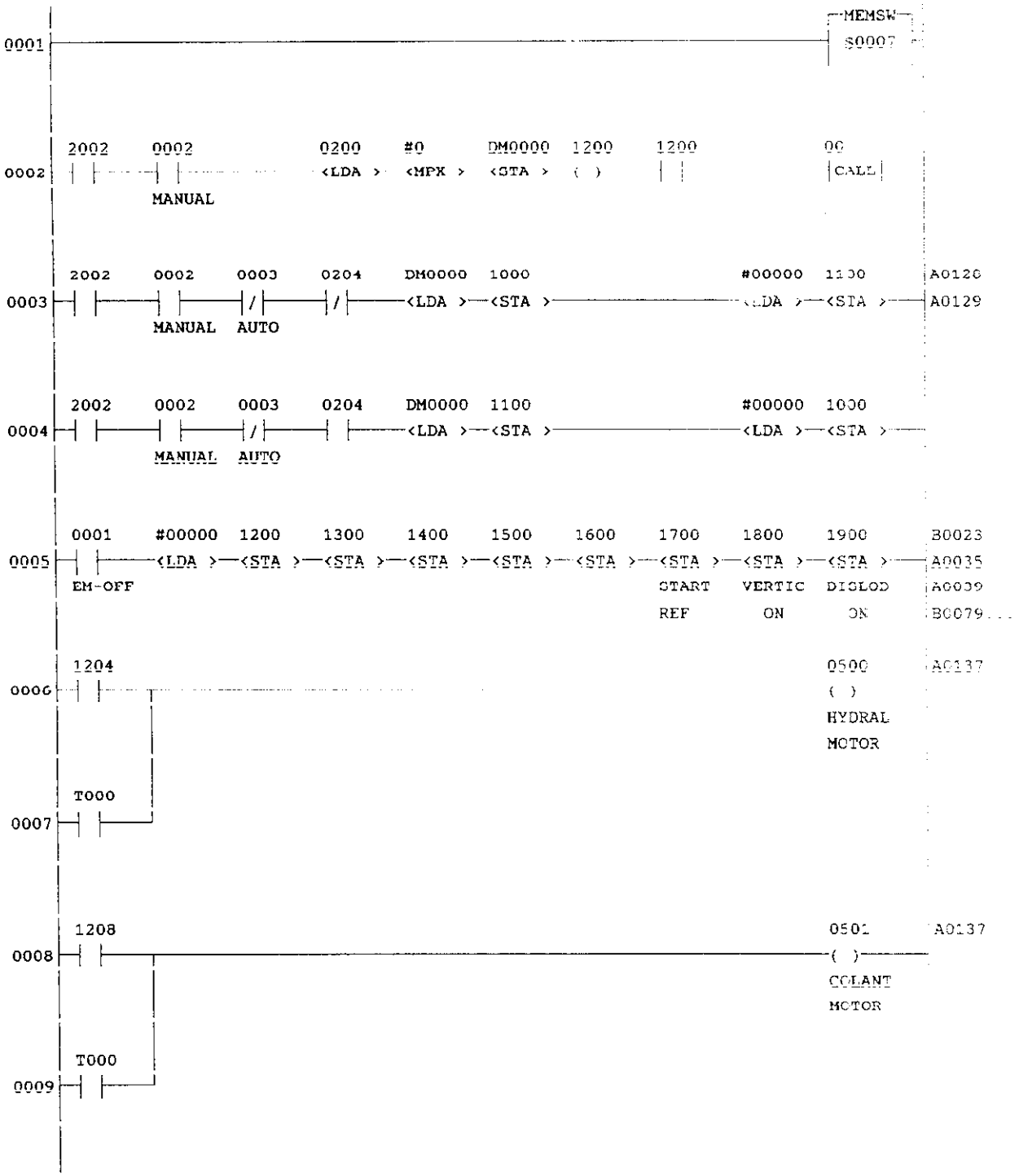
Although PLC's in India seemed to be costly as compared to the conventional relay / timer / counter panel, the cost aspect should not be considered in solution. Cost of any control system consists of

(1) Central Logic cost.

(2) Installation cost .

(3) Commissioning cost.

Depending on the supplies of PLC's, its cost is found to be 30% more than that of conventional relay logic which include relays, timer, counter enclosures and wiring. On the other hand, installation cost of PLC can be 10 - 15% less. This is because PLC's are compact and require minimal wiring between equipment and PLC.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MEMSW
$0007
0002
2002
0002
MANUAL
0200
<LDA >
#0
<MPX >
DM0000
<STA >
1200
( )
1200
00
CALL
0003
2002
0002
MANUAL
0003
AUTO
0204
DM0000
<LDA >
1000
<STA >
#00000
<LDA >
1100
<STA >
A0126
A0129
0004
2002
0002
MANUAL
0003
AUTO
0204
DM0000
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#00000
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1000
<STA >
0005
0001
EM-OFF
#00000
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1300
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1500
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1600
<STA >
1700
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START REF
1800
<STA >
VERTIC ON
1900
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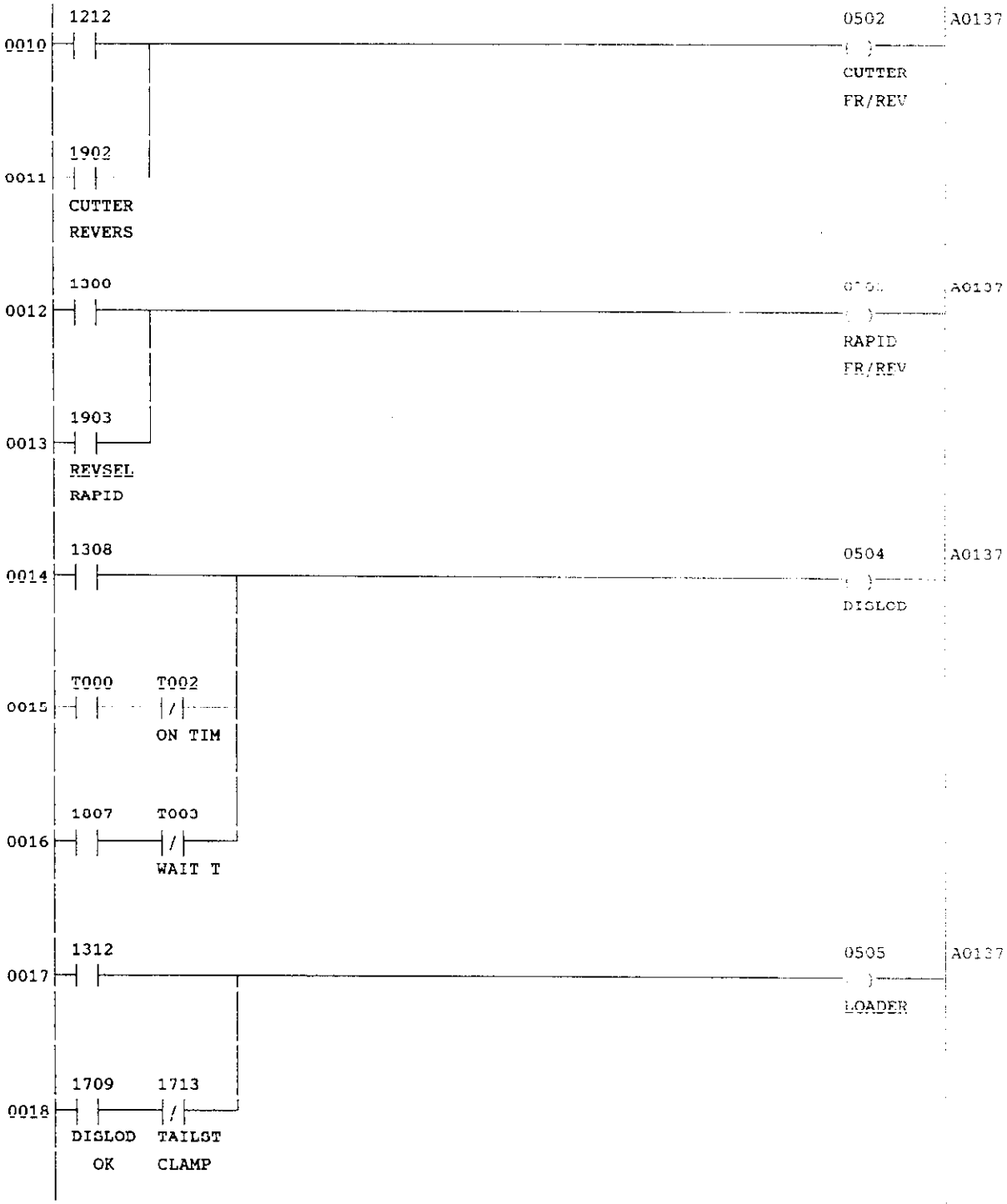
DISLOD ON
B0023
A0035
A0039
B0079...
0006
1204
0500
( )
HYDRAL MOTOR
A0137
0007
T000
0008
1208
0501
( )
COLANT MOTOR
A0137
0009
T000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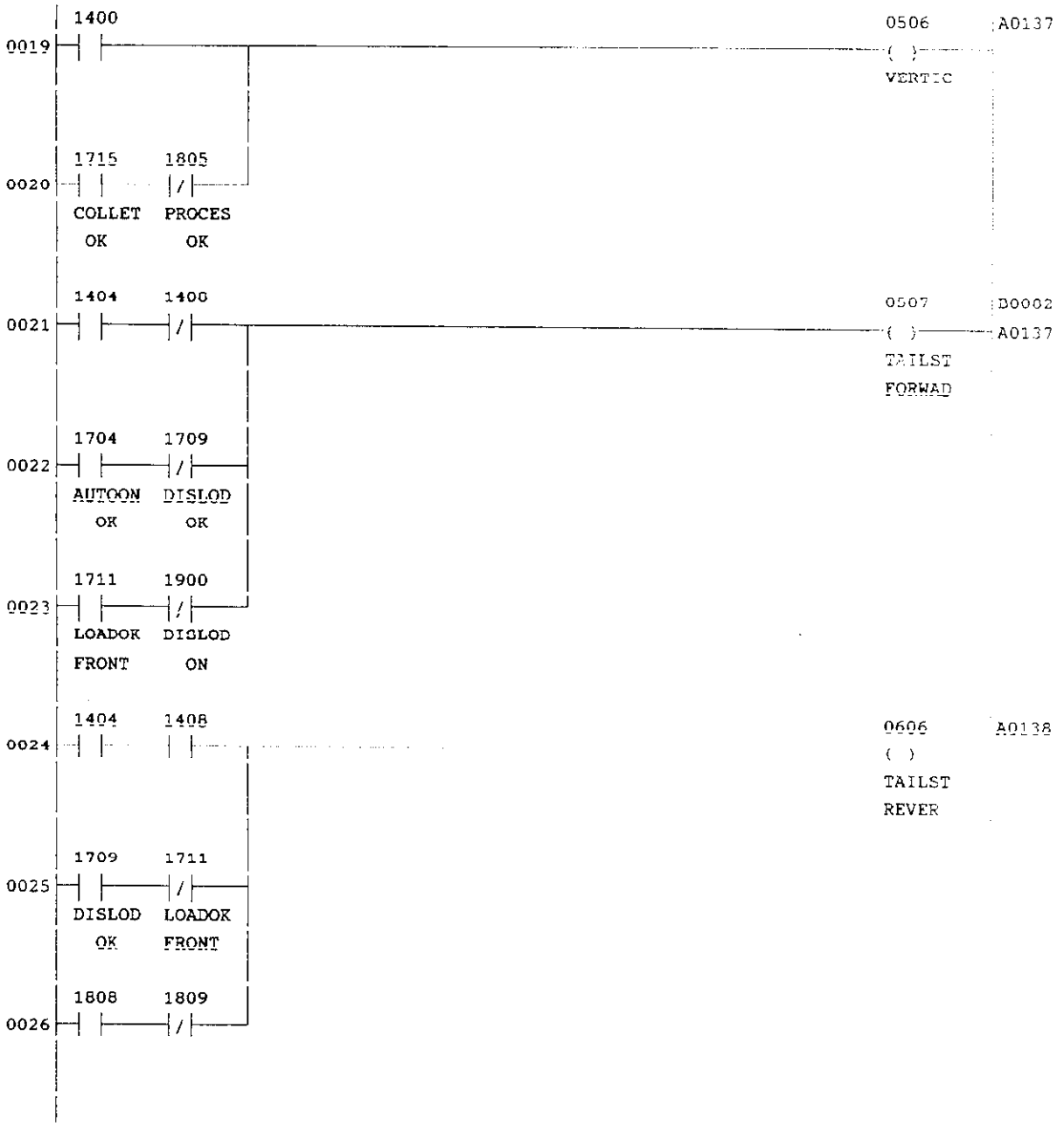
1212
0502
A0137
CUTTER
FR/REV
0011
1902
CUTTER
REVERS
0012
1300
RAPID
FR/REV
0013
1903
REVSEL
RAPID
0014
1308
0504
DISLOD
0015
T000
T002
ON TIM
0016
1007
T003
WAIT T
0017
1312
0505
LOADER
0018
1709
1713
DISLOD
OK
TAILST
CLAMP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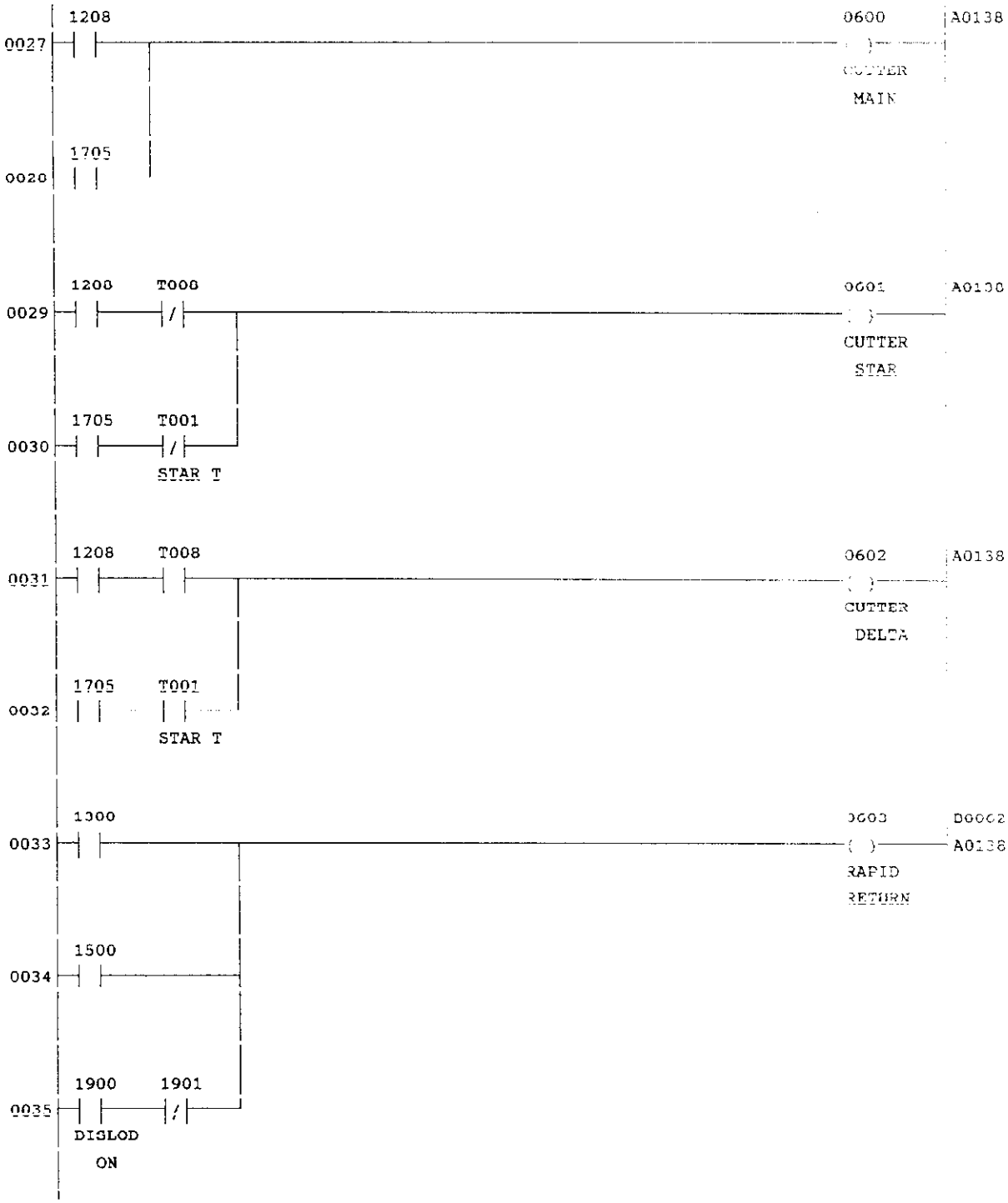
1400
0506
A0137
VERTIC
0020
1715
COLLET
OK
1805
PROCES
OK
0021
1404
1400
0507
D0002
A0137
TAILST
FORWAD
0022
1704
AUTOON
OK
1709
DISLOD
OK
0023
1711
LOADOK
FRONT
1900
DISLOD
ON
0024
1404
1408
0606
A0138
TAILST
REVER
0025
1709
DISLOD
OK
1711
LOADOK
FRONT
0026
1808
1809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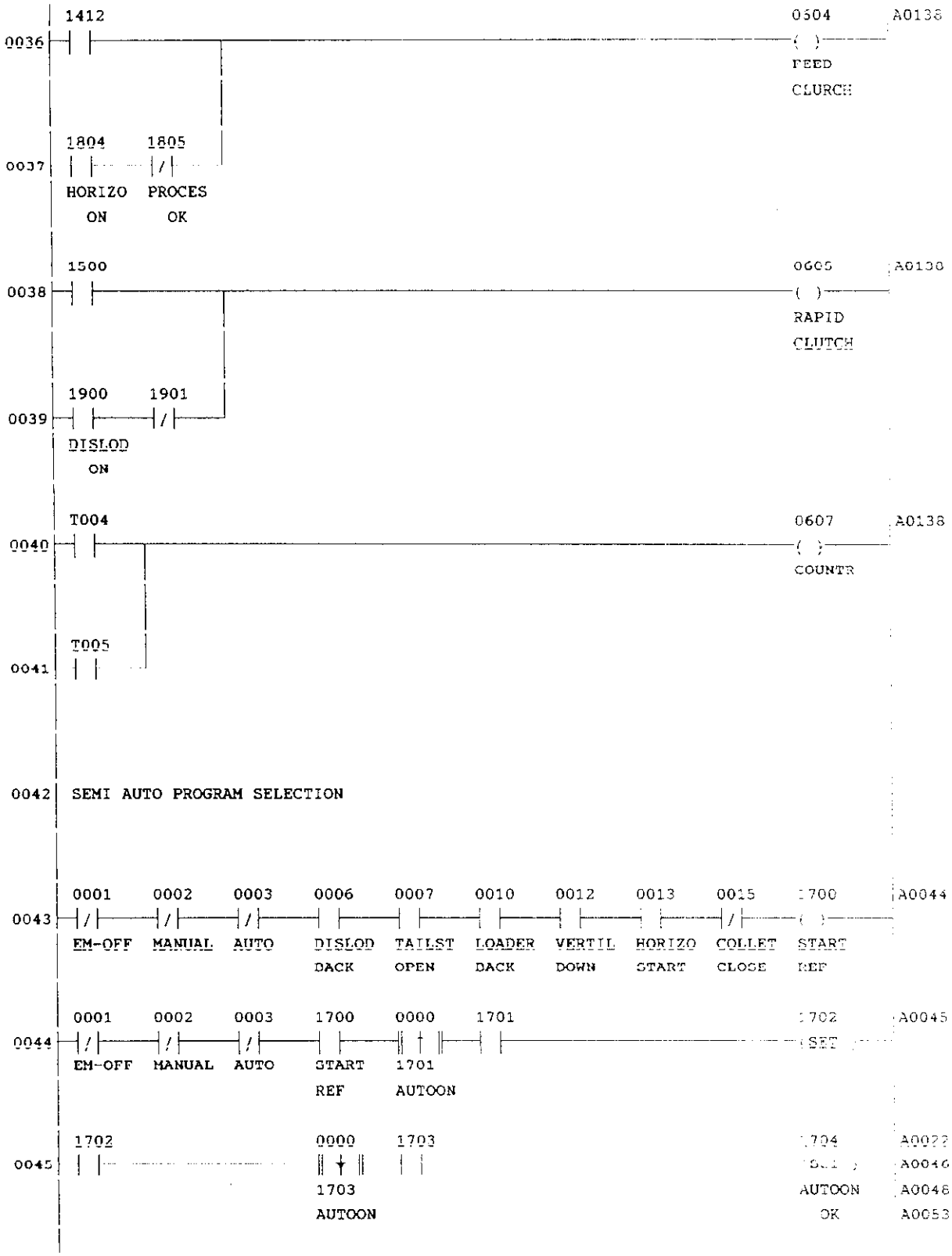
1208
0600
A0138
CUTTER
MAIN
0028
1705
0029
1208
T000
0601
A0139
CUTTER
STAR
0030
1705
T001
STAR T
0031
1208
T008
0602
A0138
CUTTER
DELTA
0032
1705
T001
STAR T
0033
1300
0603
D0002
A0138
RAPID
RETURN
0034
1500
0035
1900
1901
DISLOD
ON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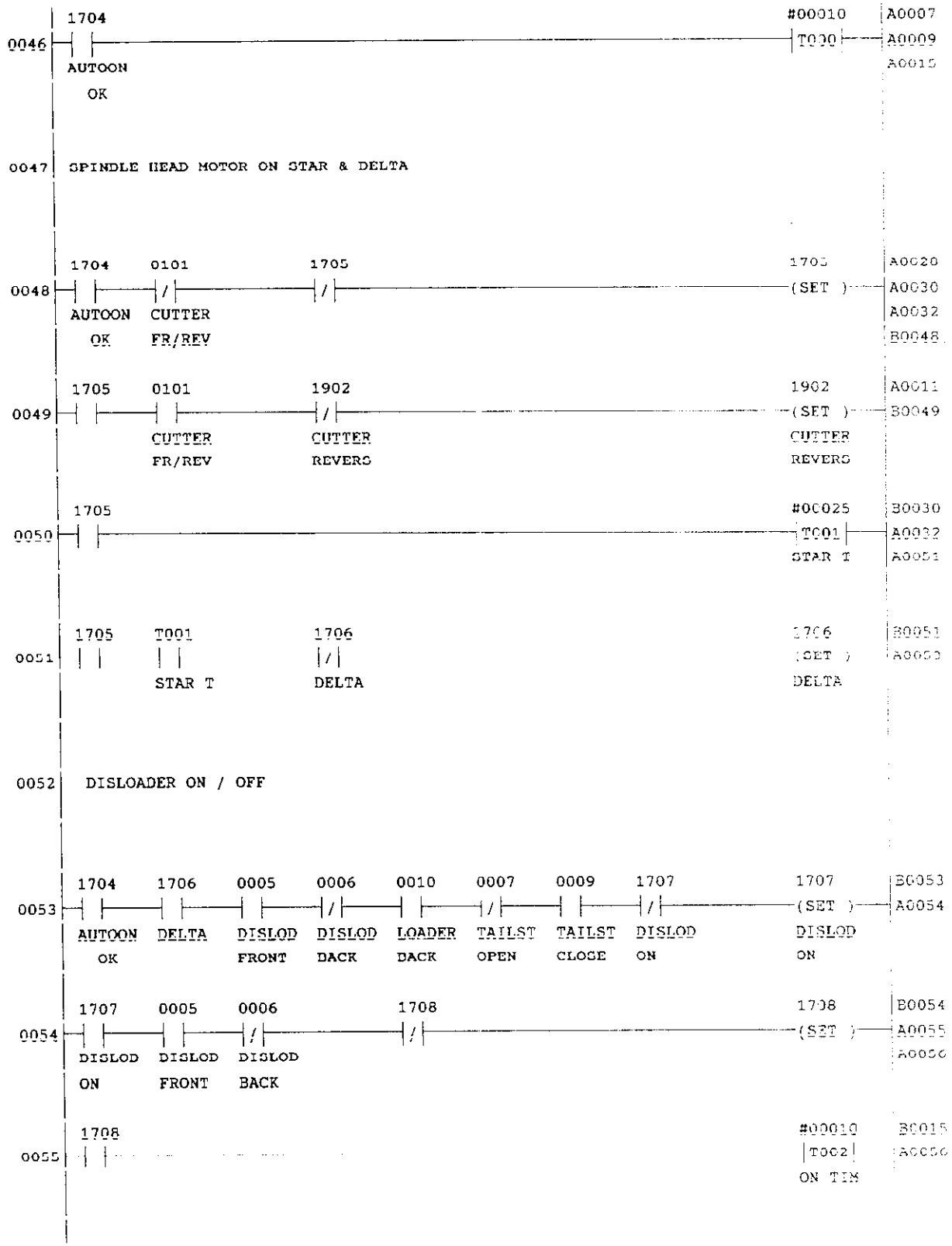
0037 1804 HORIZO ON 1805 PROCES OK
0038 1500 0605 A0130 RAPID CLUTCH
0039 1900 DISLOD ON 1901
0040 T004 0607 A0138 COUNTR
0041 T005
0042 SEMI AUTO PROGRAM SELECTION
0043 0001 EM-OFF 0002 MANUAL 0003 AUTO 0006 DISLOD DACK 0007 TAILST OPEN 0010 LOADER DACK 0012 VERTIL DOWN 0013 HORIZO START 0015 COLLET CLOSE 1700 START REF A0044
0044 0001 EM-OFF 0002 MANUAL 0003 AUTO 1700 START REF 0000 1701 AUTOON 1701 1702 SET A0045
0045 1702 0000 1703 1703 AUTOON 1704 AUTOON OK A0046 A0048 A0053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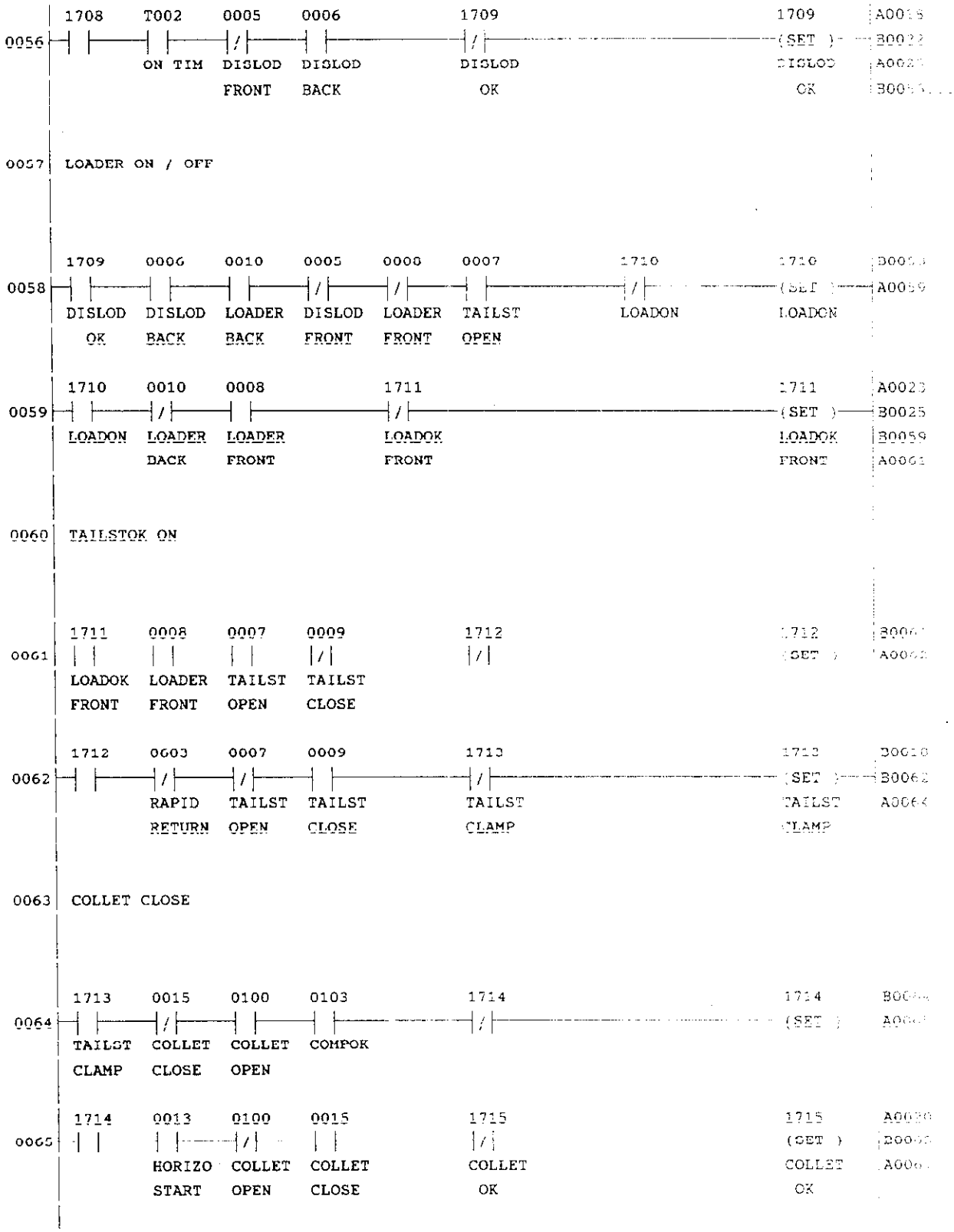
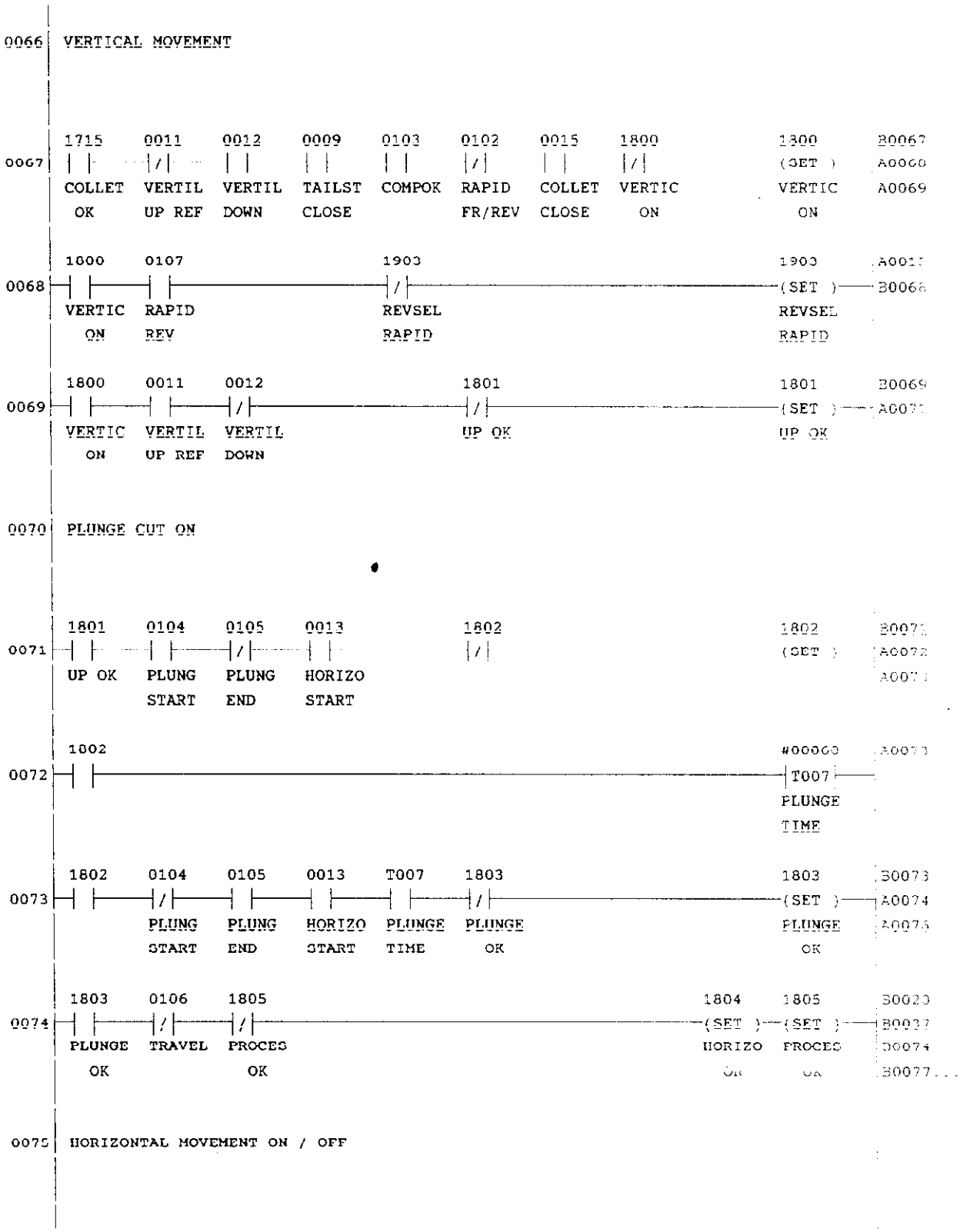
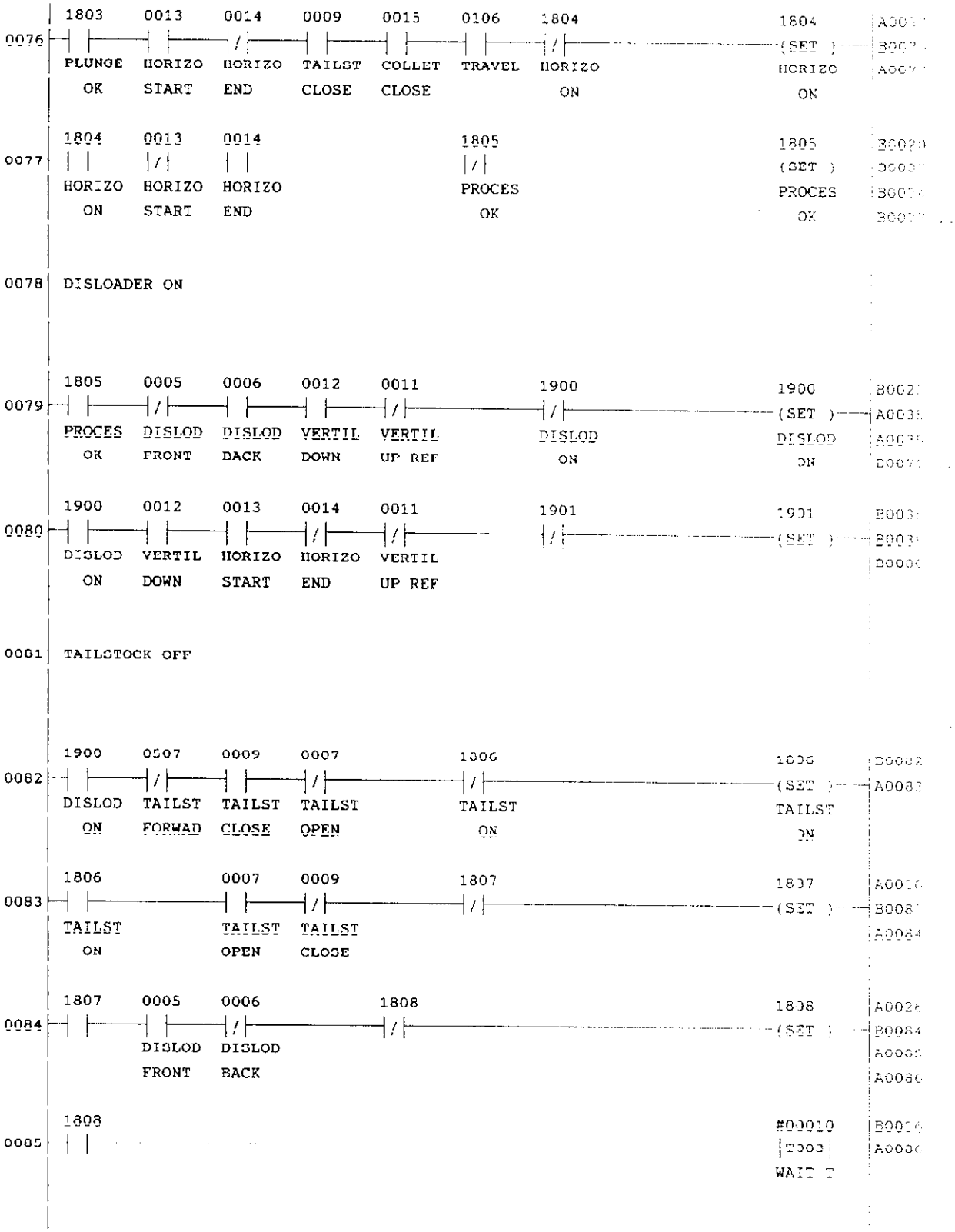
1704
AUTOON
OK
#00010
T000
A0007
A0009
A0015
0047
SPINDLE HEAD MOTOR ON STAR & DELTA
0048
1704
AUTOON
OK
0101
CUTTER
FR/REV
1705
1705
(SET)
A0020
A0030
A0032
B0048
0049
1705
0101
CUTTER
FR/REV
1902
CUTTER
REVERS
1902
(SET)
CUTTER
REVERS
A0011
B0049
0050
1705
#00025
T001
STAR T
B0030
A0032
A0051
0051
1705
T001
STAR T
1706
DELTA
1706
(SET)
DELTA
B0051
A0053
0052
DISLOADER ON / OFF
0053
1704
AUTOON
OK
1706
DELTA
0005
DISLOD
FRONT
0006
DISLOD
BACK
0010
LOADER
BACK
0007
TAILST
OPEN
0009
TAILST
CLOSE
1707
DISLOD
ON
1707
(SET)
DISLOD
ON
B0053
A0054
0054
1707
DISLOD
ON
0005
DISLOD
FRONT
0006
DISLOD
BACK
1708
1708
(SET)
B0054
A0055
A0056
0055
1708
#00010
T002
ON TIM
B0015
A0056


0056
1708 T002 0005 0006 1709 1709 A0016
ON TIM DISLOD DISLOD DISLOD DISLOD B0022
FRONT BACK OK OK A0023
B0033
0057
LOADER ON / OFF
0058
1709 0006 0010 0005 0000 0007 1710 1710 B0033
DISLOD DISLOD LOADER DISLOD LOADER TAILST LOADON LOADON A0039
OK BACK BACK FRONT FRONT OPEN
0059
1710 0010 0008 1711 1711 A0023
LOADON LOADER LOADER LOADOK LOADOK B0025
BACK FRONT FRONT FRONT B0059
A0061
0060
TAILSTOK ON
0061
1711 0008 0007 0009 1712 1712 B0061
LOADOK LOADER TAILST TAILST A0062
FRONT FRONT OPEN CLOSE
0062
1712 0003 0007 0009 1713 1713 B0010
RAPID TAILST TAILST TAILST B0062
RETURN OPEN CLOSE CLAMP TAILST A0064
CLAMP
0063
COLLET CLOSE
0064
1713 0015 0100 0103 1714 1714 B0064
TAILST COLLET COLLET COMPOK A0065
CLAMP CLOSE OPEN
0065
1714 0013 0100 0015 1715 1715 A0050
HORIZO COLLET COLLET COLLET (SET) B0065
START OPEN CLOSE OK COLLET A0066
OK


0066 VERTICAL MOVEMENT
0067 1715 COLLET OK | 0011 VERTIL UP REF | 0012 VERTIL DOWN | 0009 TAILST CLOSE | 0103 COMPOK | 0102 RAPID FR/REV | 0015 COLLET CLOSE | 1800 VERTIC ON | 1300 (SET) VERTIC ON | B0067 A0060 A0069
0068 1800 VERTIC ON | 0107 RAPID REV | 1903 REVSEL RAPID | 1903 (SET) REVSEL RAPID | B0066
0069 1800 VERTIC ON | 0011 VERTIL UP REF | 0012 VERTIL DOWN | 1801 UP OK | 1801 (SET) UP OK | B0069
0070 PLUNGE CUT ON
0071 1801 UP OK | 0104 PLUNG START | 0105 PLUNG END | 0013 HORIZO START | 1802 | 1802 (SET) | B0071 A0072 A0073
0072 1802 | #00060 T007 PLUNGE TIME | A0073
0073 1802 | 0104 PLUNG START | 0105 PLUNG END | 0013 HORIZO START | T007 PLUNGE TIME | 1803 PLUNGE OK | 1803 (SET) PLUNGE OK | B0073 A0074 A0075
0074 1803 PLUNGE OK | 0106 TRAVEL | 1805 PROCES OK | 1804 (SET) HORIZO | 1805 (SET) PROCES | B0023 B0027 B0074 B0077...
0075 HORIZONTAL MOVEMENT ON / OFF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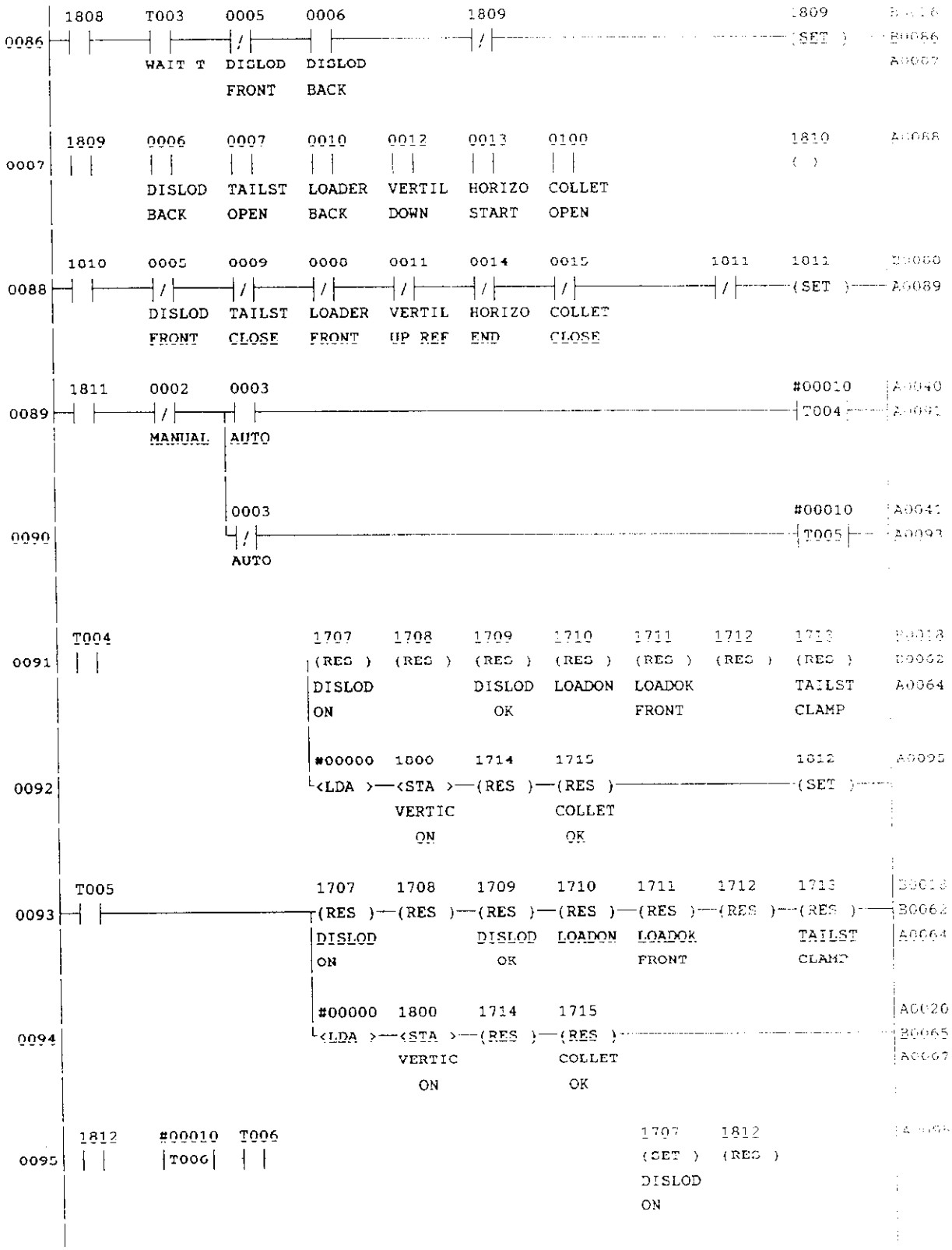
1803 PLUNGE OK
0013 HORIZO START
0014 HORIZO END
0009 TAILST CLOSE
0015 COLLET CLOSE
0106 TRAVEL
1804 HORIZO ON
1804 (SET) HORIZO ON
0077
1804 HORIZO ON
0013 HORIZO START
0014 HORIZO END
1805 PROCES OK
1805 (SET) PROCES OK
0078 DISLOADER ON
0079
1805 PROCES OK
0005 DISLOD FRONT
0006 DISLOD BACK
0012 VERTIL DOWN
0011 VERTIL UP REF
1900 DISLOD ON
1900 (SET) DISLOD ON
0080
1900 DISLOD ON
0012 VERTIL DOWN
0013 HORIZO START
0014 HORIZO END
0011 VERTIL UP REF
1901
1901 (SET)
0001 TAILSTOCK OFF
0082
1900 DISLOD ON
0507 TAILST FORWAD
0009 TAILST CLOSE
0007 TAILST OPEN
1006 TAILST ON
1006 (SET) TAILST ON
0083
1806 TAILST ON
0007 TAILST OPEN
0009 TAILST CLOSE
1807
1807 (SET)
0084
1807
0005 DISLOD FRONT
0006 DISLOD BACK
1808
1808 (SET)
0005
1808
#00010 T303 WAIT T


0086
1808
T003
WAIT T
0005
DISLOD
FRONT
0006
DISLOD
BACK
1809
1809
(SET)
B0086
A0007
0087
1809
0006
DISLOD
BACK
0007
TAILST
OPEN
0010
LOADER
BACK
0012
VERTIL
DOWN
0013
HORIZO
START
0100
COLLET
OPEN
1810
( )
A0088
0088
1010
0005
DISLOD
FRONT
0009
TAILST
CLOSE
0008
LOADER
FRONT
0011
VERTIL
UP REF
0014
HORIZO
END
0015
COLLET
CLOSE
1011
1011
(SET)
A0089
0089
1811
0002
MANUAL
0003
AUTO
#00010
T004
A0040
0090
0003
AUTO
#00010
T005
A0041
0091
T004
1707
(RES)
DISLOD
ON
1708
(RES)
1709
(RES)
DISLOD
OK
1710
(RES)
LOADON
1711
(RES)
LOADOK
FRONT
1712
(RES)
1713
(RES)
TAILST
CLAMP
B0062
A0064
0092
#00000
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1800
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ON
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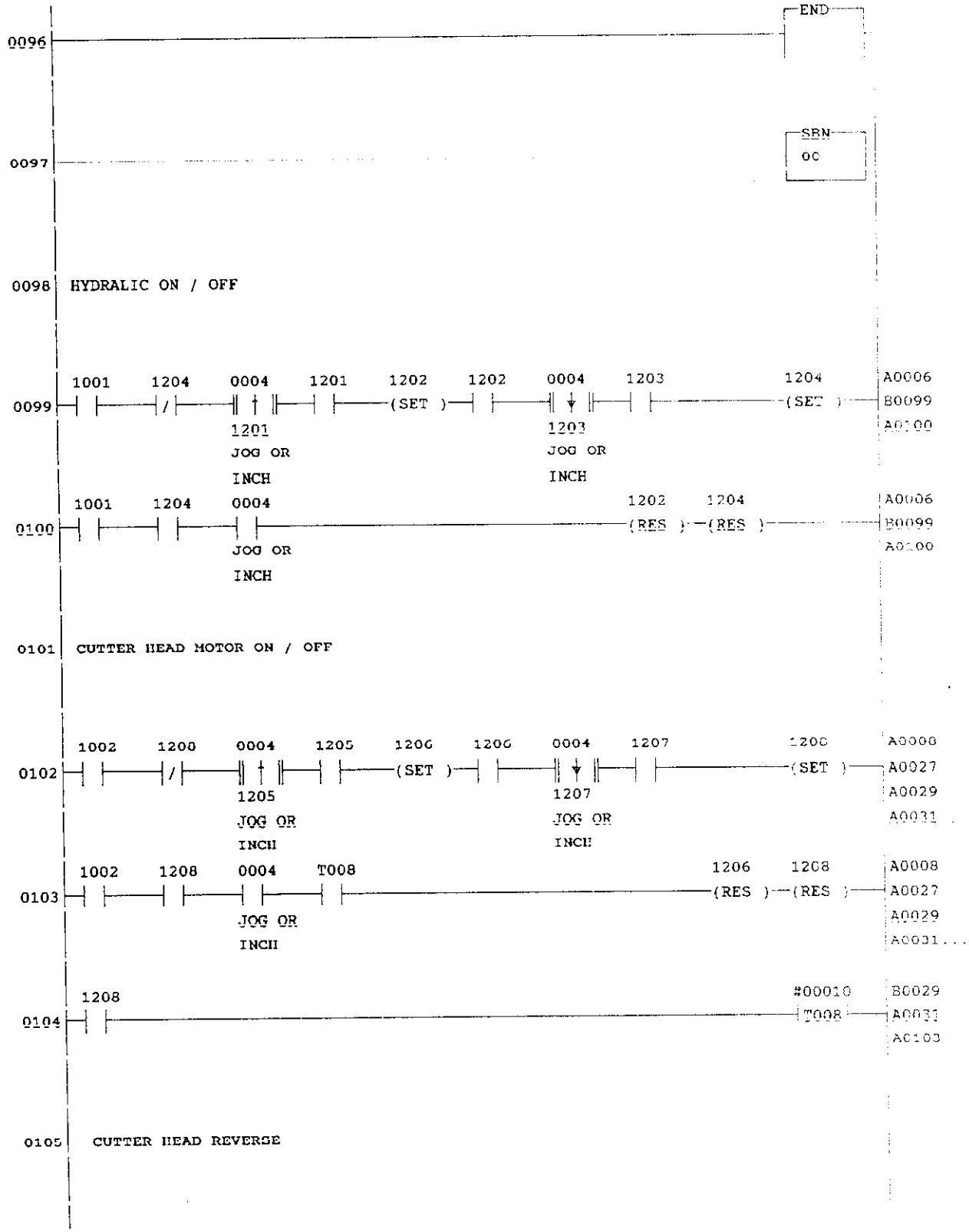
(RES)
1715
(RES)
COLLET
OK
1812
(SET)
A0095
0093
T005
1707
(RES)
DISLOD
ON
1708
(RES)
1709
(RES)
DISLOD
OK
1710
(RES)
LOADON
1711
(RES)
LOADOK
FRONT
1712
(RES)
1713
(RES)
TAILST
CLAMP
B0062
A0064
0094
#00000
<LDA >
1800
<STA >
VERTIC
ON
1714
(RES)
1715
(RES)
COLLET
OK
A0020
B0065
A0067
0095
1812
#00010
T006
T006
1707
(SET)
DISLOD
ON
1812
(RES)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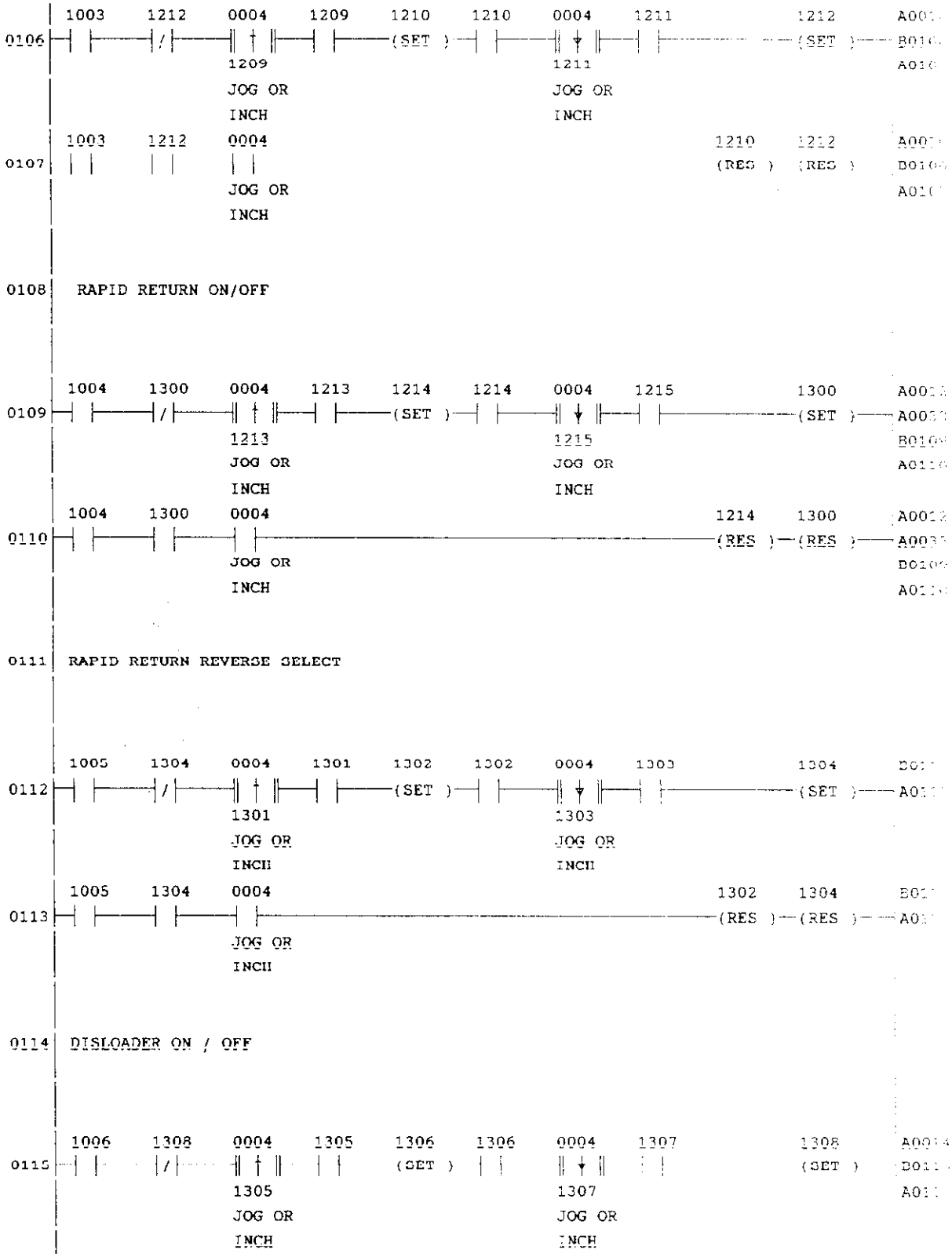
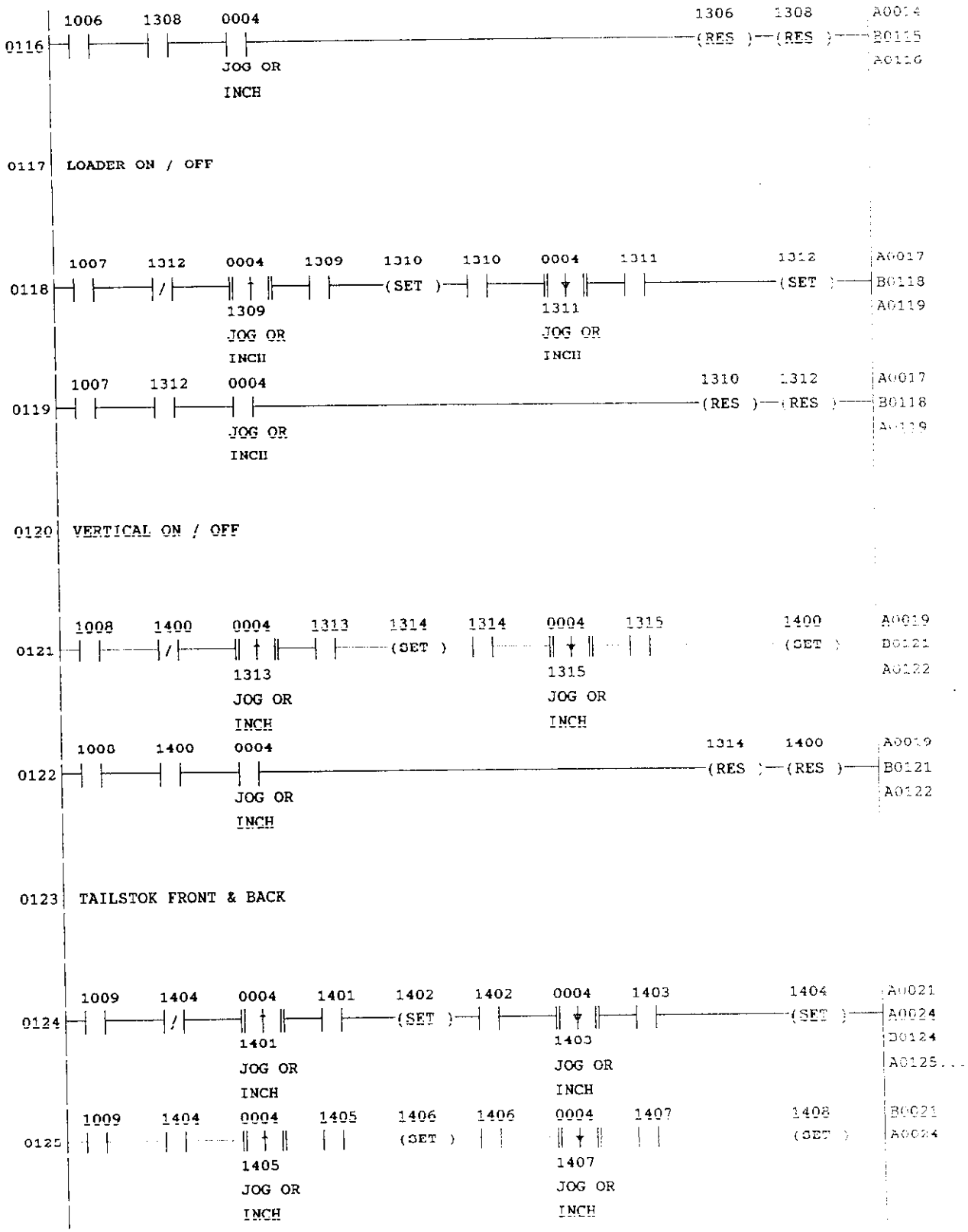
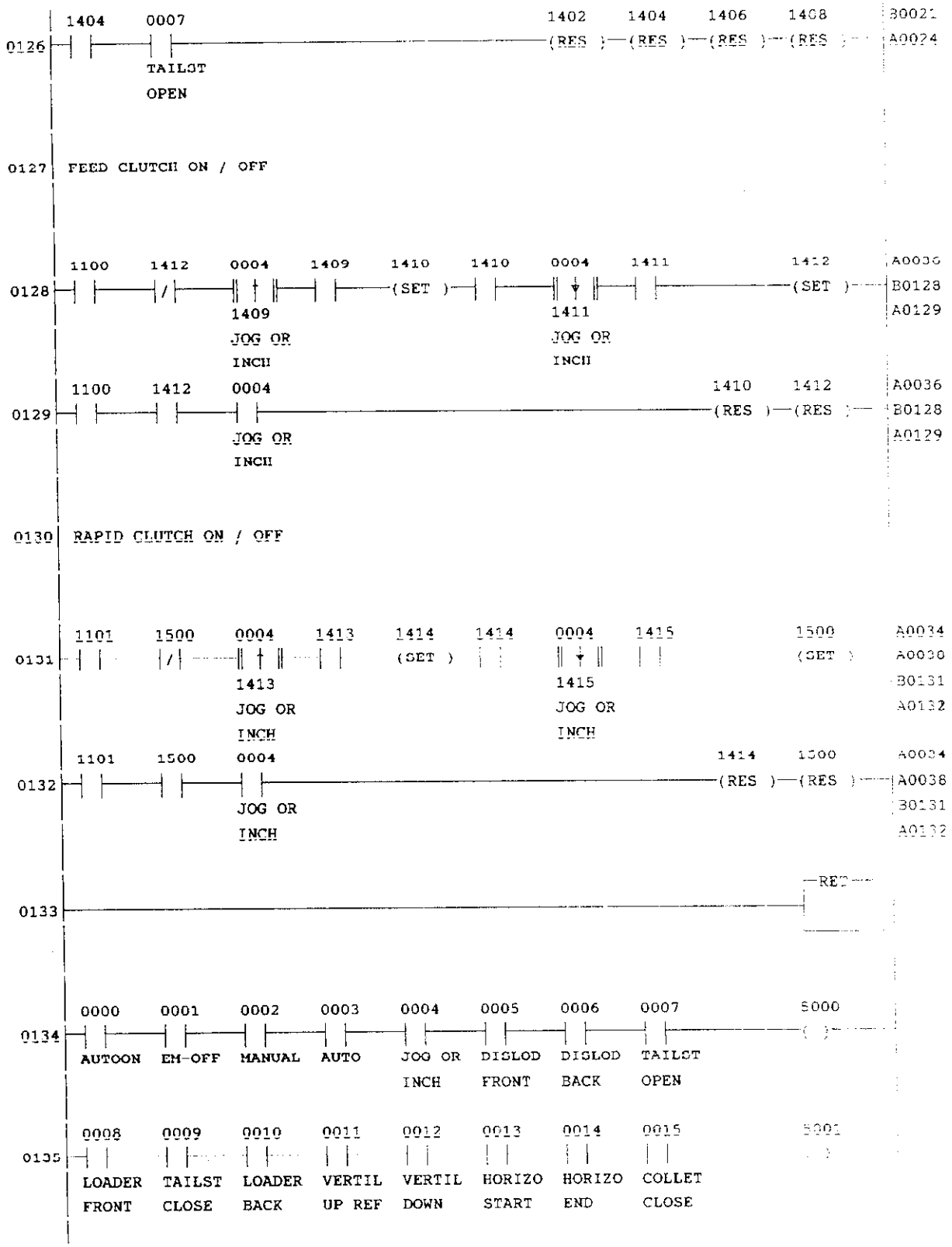
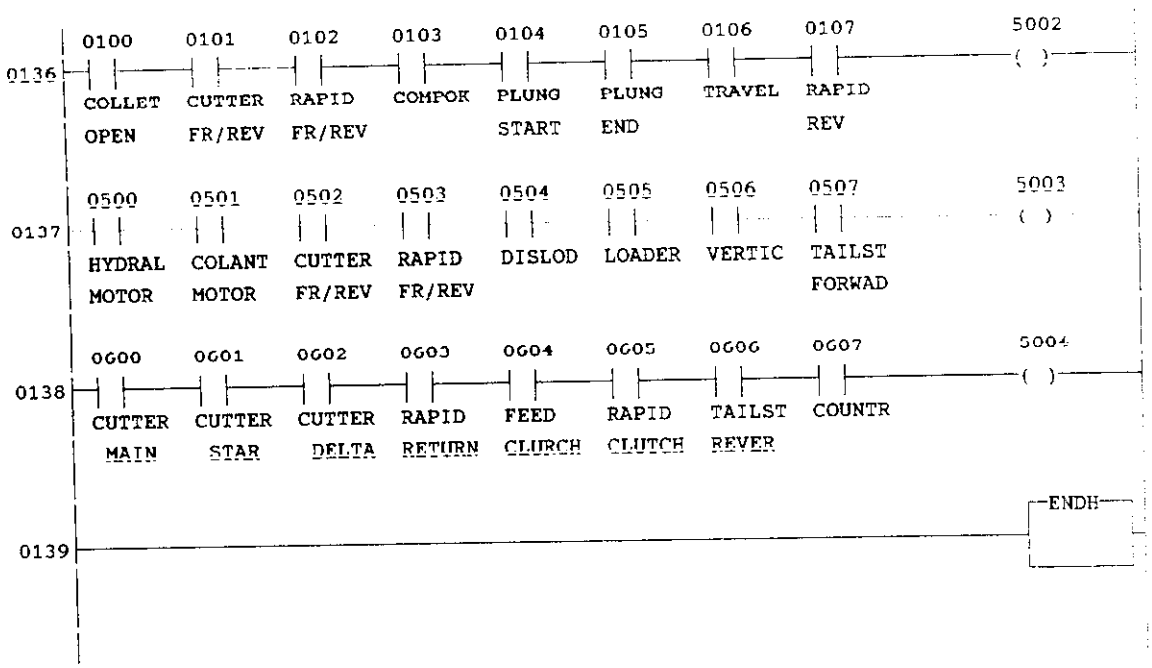
END
0097
SBN
0C
0098
HYDRALIC ON / OFF
0099
1001
1204
0004
1201
1202
1202
0004
1203
1204
(SET)
A0006
B0099
A0100
1201
JOG OR
INCH
1203
JOG OR
INCH
0100
1001
1204
0004
1202
1204
(RES)
(RES)
A0006
B0099
A0100
JOG OR
INCH
0101
CUTTER HEAD MOTOR ON / OFF
0102
1002
1200
0004
1205
1206
1206
0004
1207
1200
(SET)
A0008
A0027
A0029
A0031
1205
JOG OR
INCH
1207
JOG OR
INCH
0103
1002
1208
0004
T008
1206
1208
(RES)
(RES)
A0008
A0027
A0029
A0031...
JOG OR
INCH
0104
1208
#00010
T008
B0029
A0031
A0100
0105
CUTTER HEAD REVERSE


0106
1003
1212
0004
1209
1210
(SET)
1210
0004
1211
1212
(SET)
1209
JOG OR
INCH
1211
JOG OR
INCH
0107
1003
1212
0004
1210
(RES)
1212
(RES)
JOG OR
INCH
0108
RAPID RETURN ON/OFF
0109
1004
1300
0004
1213
1214
(SET)
1214
0004
1215
1300
(SET)
1213
JOG OR
INCH
1215
JOG OR
INCH
0110
1004
1300
0004
1214
(RES)
1300
(RES)
JOG OR
INCH
0111
RAPID RETURN REVERSE SELECT
0112
1005
1304
0004
1301
1302
(SET)
1302
0004
1303
1304
(SET)
1301
JOG OR
INCH
1303
JOG OR
INCH
0113
1005
1304
0004
1302
(RES)
1304
(RES)
JOG OR
INCH
0114
DISLOADER ON / OFF
0115
1006
1308
0004
1305
1306
(SET)
1306
0004
1307
1308
(SET)
1305
JOG OR
INCH
1307
JOG OR
INCH


0116
1006
1308
0004
JOG OR
INCH
1306
(RES)
1308
(RES)
A0014
B0115
A0116
0117
LOADER ON / OFF
0118
1007
1312
0004
1309
JOG OR
INCH
1309
(SET)
1310
1310
0004
1311
JOG OR
INCH
1311
1312
(SET)
A0017
B0118
A0119
0119
1007
1312
0004
JOG OR
INCH
1310
(RES)
1312
(RES)
A0017
B0118
A0119
0120
VERTICAL ON / OFF
0121
1008
1400
0004
1313
JOG OR
INCH
1313
1314
(SET)
1314
0004
1315
JOG OR
INCH
1315
1400
(SET)
A0019
B0121
A0122
0122
1008
1400
0004
JOG OR
INCH
1314
(RES)
1400
(RES)
A0019
B0121
A0122
0123
TAILSTOK FRONT & BACK
0124
1009
1404
0004
1401
JOG OR
INCH
1401
1402
(SET)
1402
0004
1403
JOG OR
INCH
1403
1404
(SET)
A0021
A0024
B0124
A0125...
0125
1009
1404
0004
1405
JOG OR
INCH
1405
1406
(SET)
1406
0004
1407
JOG OR
INCH
1407
1408
(SET)
B0021
A0024


0126
1404
0007
TAILST
OPEN
1402
(RES)
1404
(RES)
1406
(RES)
1408
(RES)
B0021
A0024
0127
FEED CLUTCH ON / OFF
0128
1100
1412
0004
1409
JOG OR
INCH
1409
(SET)
1410
1410
0004
1411
JOG OR
INCH
1411
(SET)
1412
A0036
B0128
A0129
0129
1100
1412
0004
JOG OR
INCH
1410
(RES)
1412
(RES)
A0036
B0128
A0129
0130
RAPID CLUTCH ON / OFF
0131
1101
1500
0004
1413
JOG OR
INCH
1413
(SET)
1414
1414
0004
1415
JOG OR
INCH
1415
1500
(SET)
A0034
A0036
B0131
A0132
0132
1101
1500
0004
JOG OR
INCH
1414
(RES)
1500
(RES)
A0034
A0038
B0131
A0132
0133
RET
0134
0000
AUTOON
0001
EM-OFF
0002
MANUAL
0003
AUTO
0004
JOG OR
INCH
0005
DISLOD
FRONT
0006
DISLOD
BACK
0007
TAILST
OPEN
5000
0135
0008
LOADER
FRONT
0009
TAILST
CLOSE
0010
LOADER
BACK
0011
VERTIL
UP REF
0012
VERTIL
DOWN
0013
HORIZO
START
0014
HORIZO
END
0015
COLLET
CLOSE
5001


0136
0100 COLLET OPEN
0101 CUTTER FR/REV
0102 RAPID FR/REV
0103 COMPOR
0104 PLUNG START
0105 PLUNG END
0106 TRAVEL
0107 RAPID REV
5002
0137
0500 HYDRAL MOTOR
0501 COLANT MOTOR
0502 CUTTER FR/REV
0503 RAPID FR/REV
0504 DISLOD
0505 LOADER
0506 VERTIC
0507 TAILST FORWAD
5003
0138
0600 CUTTER MAIN
0601 CUTTER STAR
0602 CUTTER DELTA
0603 RAPID RETURN
0604 FEED CLURCH
0605 RAPID CLUTCH
0606 TAILST REVER
0607 COUNTR
5004
0139
ENDH

```
0000  MEMSW   $0007
0001  LD      2002
0002  AND     0002          ; MANUAL
0003  LDA     0200
0004  CON
0005  MPX     #0
0006  CON
0007  STA     DM0000
0008  CON
0009  OUT     1200
0010  CON
0011  AND     1200
0012  CALL    00
0013  LD      2002
0014  AND     0002          ; MANUAL
0015  ANB     0003          ; AUTO
0016  ANB     0204
0017  LDA     DM0000
0018  CON
0019  STA     1000
0020  CON
0021  LDA     #00000
0022  CON
0023  STA     1100
0024  LD      2002
0025  AND     0002          ; MANUAL
0026  ANB     0003          ; AUTO
0027  AND     0204
0028  LDA     DM0000
0029  CON
0030  STA     1100
0031  CON
0032  LDA     #00000
0033  CON
0034  STA     1000
0035  LD      0001          ; EM-OFF
0036  LDA     #00000
0037  CON
0038  STA     1200
0039  CON
0040  STA     1300
0041  CON
0042  STA     1400
0043  CON
0044  STA     1500
0045  CON
0046  STA     1600
0047  CON
0048  STA     1700          ; START REF
0049  CON
0050  STA     1800          ; VERTIC  ON
0051  CON
0052  STA     1900          ; DISLOD  ON
0053  LD      1204
```

```
0054  OR    T000
0055  OUT   0500          ; HYDRALMOTOR
0056  LD    1208
0057  OR    T000
0058  OUT   0501          ; COLANTMOTOR
0059  LD    1212
0060  OR    1902          ; CUTTERREVERS
0061  OUT   0502          ; CUTTERFR/REV
0062  LD    1300
0063  OR    1903          ; REVSELRAPID
0064  OUT   0503          ; RAPID FR/REV
0065  LD    1308
0066  LD    T000
0067  ANB   T002          ; ON TIM
0068  ORL
0069  LD    1807
0070  ANB   T003          ; WAIT T
0071  ORL
0072  OUT   0504          ; DISLOD
0073  LD    1312
0074  LD    1709          ; DISLOD  OK
0075  ANB   1713          ; TAILSTCLAMP
0076  ORL
0077  OUT   0505          ; LOADER
0078  LD    1400
0079  LD    1715          ; COLLET OK
0080  ANB   1805          ; PROCES  OK
0081  ORL
0082  OUT   0506          ; VERTIC
0083  LD    1404
0084  ANB   1408
0085  LD    1704          ; AUTOON  OK
0086  ANB   1709          ; DISLOD  OK
0087  ORL
0088  LD    1711          ; LOADOKFRONT
0089  ANB   1900          ; DISLOD  ON
0090  ORL
0091  OUT   0507          ; TAILSTFORWAD
0092  LD    1404
0093  AND   1408
0094  LD    1709          ; DISLOD  OK
0095  ANB   1711          ; LOADOKFRONT
0096  ORL
0097  LD    1808
0098  ANB   1809
0099  ORL
0100  OUT   0606          ; TAILSTREVER
0101  LD    1208
0102  OR    1705
0103  OUT   0600          ; CUTTER MAIN
0104  LD    1208
0105  ANB   T008
0106  LD    1705
0107  ANB   T001          ; STAR T
```

```
0108  ORL
0109  OUT     0601              ; CUTTER STAR
0110  LD      1208
0111  AND     T008
0112  LD      1705
0113  AND     T001              ; STAR T
0114  ORL
0115  OUT     0602              ; CUTTER DELTA
0116  LD      1300
0117  OR      1500
0118  LD      1900              ; DISLOD  ON
0119  ANB     1901
0120  ORL
0121  OUT     0603              ; RAPID RETURN
0122  LD      1412
0123  LD      1804              ; HORIZO  ON
0124  ANB     1805              ; PROCES  OK
0125  ORL
0126  OUT     0604              ; FEED  CLURCH
0127  LD      1500
0128  LD      1900              ; DISLOD  ON
0129  ANB     1901
0130  ORL
0131  OUT     0605              ; RAPID CLUTCH
0132  LD      T004
0133  OR      T005
0134  OUT     0607              ; COUNTR
;SEMI AUTO PROGRAM SELECTION
0135  LDB     0001              ; EM-OFF
0136  ANB     0002              ; MANUAL
0137  ANB     0003              ; AUTO
0138  AND     0006              ; DISLODBACK
0139  AND     0007              ; TAILSTOPEN
0140  AND     0010              ; LOADERBACK
0141  AND     0012              ; VERTILDOWN
0142  AND     0013              ; HORIZOSTART
0143  ANB     0015              ; COLLETCLOSE
0144  OUT     1700              ; START REF
0145  LDB     0001              ; EM-OFF
0146  ANB     0002              ; MANUAL
0147  ANB     0003              ; AUTO
0148  AND     1700              ; START REF
0149  W-UE    0000    1701      ; AUTOON
0150  CON
0151  AND     1701
0152  SET     1702
0153  LD      1702
0154  W-DE    0000    1703      ; AUTOON
0155  CON
0156  AND     1703
0157  SET     1704              ; AUTOON  OK
0158  LD      1704              ; AUTOON  OK
0159  TMR     000     #00010
;SPINDLE HEAD MOTOR ON STAR & DELTA
```

```
0160  LD      1704              ; AUTOON  OK
0161  ANB     0101              ; CUTTERFR/REV
0162  ANB     1705
0163  SET     1705
0164  LD      1705
0165  AND     0101              ; CUTTERFR/REV
0166  ANB     1902              ; CUTTERREVERS
0167  SET     1902              ; CUTTERREVERS
0168  LD      1705
0169  TMR     001     #00025    ; STAR T
0170  LD      1705
0171  AND     T001              ; STAR T
0172  ANB     1706              ; DELTA
0173  SET     1706              ; DELTA
; DISLOADER ON / OFF
0174  LD      1704              ; AUTOON  OK
0175  AND     1706              ; DELTA
0176  AND     0005              ; DISLODFRONT
0177  ANB     0006              ; DISLODBACK
0178  AND     0010              ; LOADERBACK
0179  ANB     0007              ; TAILSTOPEN
0180  AND     0009              ; TAILSTCLOSE
0181  ANB     1707              ; DISLODON
0182  SET     1707              ; DISLODON
0183  LD      1707              ; DISLODON
0184  AND     0005              ; DISLODFRONT
0185  ANB     0006              ; DISLODBACK
0186  ANB     1708
0187  SET     1708
0188  LD      1708
0189  TMR     002     #00010    ; ON TIM
0190  LD      1708
0191  AND     T002              ; ON TIM
0192  ANB     0005              ; DISLODFRONT
0193  AND     0006              ; DISLODBACK
0194  ANB     1709              ; DISLOD  OK
0195  SET     1709              ; DISLOD  OK
;LOADER ON / OFF
0196  LD      1709              ; DISLOD  OK
0197  AND     0006              ; DISLODBACK
0198  AND     0010              ; LOADERBACK
0199  ANB     0005              ; DISLODFRONT
0200  ANB     0008              ; LOADERFRONT
0201  AND     0007              ; TAILSTOPEN
0202  ANB     1710              ; LOADON
0203  SET     1710              ; LOADON
0204  LD      1710              ; LOADON
0205  ANB     0010              ; LOADERBACK
0206  AND     0008              ; LOADERFRONT
0207  ANB     1711              ; LOADOKFRONT
0208  SET     1711              ; LOADOKFRONT
;TAILSTOK ON
0209  LD      1711              ; LOADOKFRONT
0210  AND     0008              ; LOADERFRONT
```

```
0211  AND     0007              ; TAILSTOPEN
0212  ANB     0009              ; TAILSTCLOSE
0213  ANB     1712
0214  SET     1712
0215  LD      1712
0216  ANB     0603              ; RAPID RETURN
0217  ANB     0007              ; TAILSTOPEN
0218  AND     0009              ; TAILSTCLOSE
0219  ANB     1713              ; TAILSTCLAMP
0220  SET     1713              ; TAILSTCLAMP
;COLLET CLOSE
0221  LD      1713              ; TAILSTCLAMP
0222  ANB     0015              ; COLLETCLOSE
0223  AND     0100              ; COLLETOPEN
0224  AND     0103              ; COMPOK
0225  ANB     1714
0226  SET     1714
0227  LD      1714
0228  AND     0013              ; HORIZOSTART
0229  ANB     0100              ; COLLETOPEN
0230  AND     0015              ; COLLETCLOSE
0231  ANB     1715              ; COLLET OK
0232  SET     1715              ; COLLET OK
;VERTICAL MOVEMENT
0233  LD      1715              ; COLLET OK
0234  ANB     0011              ; VERTILUP REF
0235  AND     0012              ; VERTILDOWN
0236  AND     0009              ; TAILSTCLOSE
0237  AND     0103              ; COMPOK
0238  ANB     0102              ; RAPID FR/REV
0239  AND     0015              ; COLLETCLOSE
0240  ANB     1800              ; VERTIC  ON
0241  SET     1800              ; VERTIC  ON
0242  LD      1800              ; VERTIC  ON
0243  AND     0107              ; RAPID REV
0244  ANB     1903              ; REVSELRAPID
0245  SET     1903              ; REVSELRAPID
0246  LD      1800              ; VERTIC  ON
0247  AND     0011              ; VERTILUP REF
0248  ANB     0012              ; VERTILDOWN
0249  ANB     1801              ; UP OK
0250  SET     1801              ; UP OK
;PLUNGE CUT ON
0251  LD      1801              ; UP OK
0252  AND     0104              ; PLUNG START
0253  ANB     0105              ; PLUNG END
0254  AND     0013              ; HORIZOSTART
0255  ANB     1802
0256  SET     1802
0257  LD      1802
0258  TMR     007     #00060    ; PLUNGETIME
0259  LD      1802
0260  ANB     0104              ; PLUNG START
0261  AND     0105              ; PLUNG END
```

```
0262  AND     0013              ; HORIZOSTART
0263  AND     T007              ; PLUNGETIME
0264  ANB     1803              ; PLUNGE  OK
0265  SET     1803              ; PLUNGE  OK
0266  LD      1803              ; PLUNGE  OK
0267  ANB     0106              ; TRAVEL
0268  ANB     1805              ; PROCES  OK
0269  SET     1804              ; HORIZO  ON
0270  CON
0271  SET     1805              ; PROCES  OK
;HORIZONTAL MOVEMENT ON / OFF
0272  LD      1803              ; PLUNGE  OK
0273  AND     0013              ; HORIZOSTART
0274  ANB     0014              ; HORIZOEND
0275  AND     0009              ; TAILSTCLOSE
0276  AND     0015              ; COLLETCLOSE
0277  AND     0106              ; TRAVEL
0278  ANB     1804              ; HORIZO  ON
0279  SET     1804              ; HORIZO  ON
0280  LD      1804              ; HORIZO  ON
0281  ANB     0013              ; HORIZOSTART
0282  AND     0014              ; HORIZOEND
0283  ANB     1805              ; PROCES  OK
0284  SET     1805              ; PROCES  OK
;DISLOADER ON
0285  LD      1805              ; PROCES  OK
0286  ANB     0005              ; DISLODFRONT
0287  AND     0006              ; DISLODBACK
0288  AND     0012              ; VERTILDOWN
0289  ANB     0011              ; VERTILUP REF
0290  ANB     1900              ; DISLOD  ON
0291  SET     1900              ; DISLOD  ON
0292  LD      1900              ; DISLOD  ON
0293  AND     0012              ; VERTILDOWN
0294  AND     0013              ; HORIZOSTART
0295  ANB     0014              ; HORIZOEND
0296  ANB     0011              ; VERTILUP REF
0297  ANB     1901
0298  SET     1901
;TAILSTOCK OFF
0299  LD      1900              ; DISLOD  ON
0300  ANB     0507              ; TAILSTFORWAD
0301  AND     0009              ; TAILSTCLOSE
0302  ANB     0007              ; TAILSTOPEN
0303  ANB     1806              ; TAILST  ON
0304  SET     1806              ; TAILST  ON
0305  LD      1806              ; TAILST  ON
0306  AND     0007              ; TAILSTOPEN
0307  ANB     0009              ; TAILSTCLOSE
0308  ANB     1807
0309  SET     1807
0310  LD      1807
0311  AND     0005              ; DISLODFRONT
0312  ANB     0006              ; DISLODBACK
```

```
0313  ANB   1808
0314  SET   1808
0315  LD    1808
0316  TMR   003    #00010    ; WAIT T
0317  LD    1808
0318  AND   T003             ; WAIT T
0319  ANB   0005             ; DISLODFRONT
0320  AND   0006             ; DISLODBACK
0321  ANB   1809
0322  SET   1809
0323  LD    1809
0324  AND   0006             ; DISLODBACK
0325  AND   0007             ; TAILSTOPEN
0326  AND   0010             ; LOADERBACK
0327  AND   0012             ; VERTILDOWN
0328  AND   0013             ; HORIZOSTART
0329  AND   0100             ; COLLETOPEN
0330  OUT   1810
0331  LD    1810
0332  ANB   0005             ; DISLODFRONT
0333  ANB   0009             ; TAILSTCLOSE
0334  ANB   0008             ; LOADERFRONT
0335  ANB   0011             ; VERTILUP REF
0336  ANB   0014             ; HORIZOEND
0337  ANB   0015             ; COLLETCLOSE
0338  ANB   1811
0339  SET   1811
0340  LD    1811
0341  ANB   0002             ; MANUAL
0342  MPS
0343  AND   0003             ; AUTO
0344  TMR   004    #00010
0345  MPP
0346  ANB   0003             ; AUTO
0347  TMR   005    #00010
0348  LD    T004
0349  MPS
0350  RES   1707             ; DISLODON
0351  CON
0352  RES   1708
0353  CON
0354  RES   1709             ; DISLOD  OK
0355  CON
0356  RES   1710             ; LOADON
0357  CON
0358  RES   1711             ; LOADOKFRONT
0359  CON
0360  RES   1712
0361  CON
0362  RES   1713             ; TAILSTCLAMP
0363  MPP
0364  LDA   #00000
0365  CON
0366  STA   1800             ; VERTIC  ON
```

```
0367  CON
0368  RES     1714
0369  CON
0370  RES     1715              ; COLLET OK
0371  CON
0372  SET     1812
0373  LD      T005
0374  MPS
0375  RES     1707              ; DISLODON
0376  CON
0377  RES     1708
0378  CON
0379  RES     1709              ; DISLOD  OK
0380  CON
0381  RES     1710              ; LOADON
0382  CON
0383  RES     1711              ; LOADOKFRONT
0384  CON
0385  RES     1712
0386  CON
0387  RES     1713              ; TAILSTCLAMP
0388  MPP
0389  LDA     #00000
0390  CON
0391  STA     1800              ; VERTIC  ON
0392  CON
0393  RES     1714
0394  CON
0395  RES     1715              ; COLLET OK
0396  LD      1812
0397  TMR     006     #00010
0398  CON
0399  AND     T006
0400  SET     1707              ; DISLODON
0401  CON
0402  RES     1812
0403  END
0404  SBN     00
;HYDRALIC ON / OFF
0405  LD      1001
0406  ANB     1204
0407  W-UE    0004    1201      ; JOG ORINCH
0408  CON
0409  AND     1201
0410  SET     1202
0411  CON
0412  AND     1202
0413  W-DE    0004    1203      ; JOG ORINCH
0414  CON
0415  AND     1203
0416  SET     1204
0417  LD      1001
0418  AND     1204
0419  AND     0004              ; JOG ORINCH
```

```
0420  RES     1202
0421  CON
0422  RES     1204
;CUTTER HEAD MOTOR ON / OFF
0423  LD      1002
0424  ANB     1208
0425  W-UE    0004    1205      ; JOG ORINCH
0426  CON
0427  AND     1205
0428  SET     1206
0429  CON
0430  AND     1206
0431  W-DE    0004    1207      ; JOG ORINCH
0432  CON
0433  AND     1207
0434  SET     1208
0435  LD      1002
0436  AND     1208
0437  AND     0004              ; JOG ORINCH
0438  AND     T008
0439  RES     1206
0440  CON
0441  RES     1208
0442  LD      1208
0443  TMR     008     #00010
; CUTTER HEAD REVERSE
0444  LD      1003
0445  ANB     1212
0446  W-UE    0004    1209      ; JOG ORINCH
0447  CON
0448  AND     1209
0449  SET     1210
0450  CON
0451  AND     1210
0452  W-DE    0004    1211      ; JOG ORINCH
0453  CON
0454  AND     1211
0455  SET     1212
0456  LD      1003
0457  AND     1212
0458  AND     0004              ; JOG ORINCH
0459  RES     1210
0460  CON
0461  RES     1212
; RAPID RETURN ON/OFF
0462  LD      1004
0463  ANB     1300
0464  W-UE    0004    1213      ; JOG ORINCH
0465  CON
0466  AND     1213
0467  SET     1214
0468  CON
0469  AND     1214
0470  W-DE    0004    1215      ; JOG ORINCH
```

```
0471  CON
0472  AND     1215
0473  SET     1300
0474  LD      1004
0475  AND     1300
0476  AND     0004              ; JOG ORINCH
0477  RES     1214
0478  CON
0479  RES     1300
;RAPID RETURN REVERSE SELECT
0480  LD      1005
0481  ANB     1304
0482  W-UE    0004    1301      ; JOG ORINCH
0483  CON
0484  AND     1301
0485  SET     1302
0486  CON
0487  AND     1302
0488  W-DE    0004    1303      ; JOG ORINCH
0489  CON
0490  AND     1303
0491  SET     1304
0492  LD      1005
0493  AND     1304
0494  AND     0004              ; JOG ORINCH
0495  RES     1302
0496  CON
0497  RES     1304
;DISLOADER ON / OFF
0498  LD      1006
0499  ANB     1308
0500  W-UE    0004    1305      ; JOG ORINCH
0501  CON
0502  AND     1305
0503  SET     1306
0504  CON
0505  AND     1306
0506  W-DE    0004    1307      ; JOG ORINCH
0507  CON
0508  AND     1307
0509  SET     1308
0510  LD      1006
0511  AND     1308
0512  AND     0004              ; JOG ORINCH
0513  RES     1306
0514  CON
0515  RES     1308
;LOADER ON / OFF
0516  LD      1007
0517  ANB     1312
0518  W-UE    0004    1309      ; JOG ORINCH
0519  CON
0520  AND     1309
0521  SET     1310
```

```
0522  CON
0523  AND     1310
0524  W-DE    0004    1311      ; JOG ORINCH
0525  CON
0526  AND     1311
0527  SET     1312
0528  LD      1007
0529  AND     1312
0530  AND     0004              ; JOG ORINCH
0531  RES     1310
0532  CON
0533  RES     1312
;VERTICAL ON / OFF
0534  LD      1008
0535  ANB     1400
0536  W-UE    0004    1313      ; JOG ORINCH
0537  CON
0538  AND     1313
0539  SET     1314
0540  CON
0541  AND     1314
0542  W-DE    0004    1315      ; JOG ORINCH
0543  CON
0544  AND     1315
0545  SET     1400
0546  LD      1008
0547  AND     1400
0548  AND     0004              ; JOG ORINCH
0549  RES     1314
0550  CON
0551  RES     1400
;TAILSTOK FRONT & BACK
0552  LD      1009
0553  ANB     1404
0554  W-UE    0004    1401      ; JOG ORINCH
0555  CON
0556  AND     1401
0557  SET     1402
0558  CON
0559  AND     1402
0560  W-DE    0004    1403      ; JOG ORINCH
0561  CON
0562  AND     1403
0563  SET     1404
0564  LD      1009
0565  AND     1404
0566  W-UE    0004    1405      ; JOG ORINCH
0567  CON
0568  AND     1405
0569  SET     1406
0570  CON
0571  AND     1406
0572  W-DE    0004    1407      ; JOG ORINCH
0573  CON
```

```
0574  AND     1407
0575  SET     1408
0576  LD      1404
0577  AND     0007              ; TAILSTOPEN
0578  RES     1402
0579  CON
0580  RES     1404
0581  CON
0582  RES     1406
0583  CON
0584  RES     1408
;FEED CLUTCH ON / OFF
0585  LD      1100
0586  ANB     1412
0587  W-UE    0004    1409      ; JOG ORINCH
0588  CON
0589  AND     1409
0590  SET     1410
0591  CON
0592  AND     1410
0593  W-DE    0004    1411      ; JOG ORINCH
0594  CON
0595  AND     1411
0596  SET     1412
0597  LD      1100
0598  AND     1412
0599  AND     0004              ; JOG ORINCH
0600  RES     1410
0601  CON
0602  RES     1412
;RAPID CLUTCH ON / OFF
0603  LD      1101
0604  ANB     1500
0605  W-UE    0004    1413      ; JOG ORINCH
0606  CON
0607  AND     1413
0608  SET     1414
0609  CON
0610  AND     1414
0611  W-DE    0004    1415      ; JOG ORINCH
0612  CON
0613  AND     1415
0614  SET     1500
0615  LD      1101
0616  AND     1500
0617  AND     0004              ; JOG ORINCH
0618  RES     1414
0619  CON
0620  RES     1500
0621  RET
0622  ENDH
```

<< Input Relay >>

0000:AUTOON
L0044(W-UE) L0045(W-DE) L0134(A)

0001:EM-OFF
L0005(A) L0043(B) L0044(B) L0134(A)

0002:MANUAL
L0002(A) L0003(A) L0004(A) L0043(B)
L0044(B) L0089(B) L0134(A)

0003:AUTO
L0003(B) L0004(B) L0043(B) L0044(B)
L0089(A) L0090(B) L0134(A)

0004:JOG ORINCH
L0099(W-UE) L0099(W-DE) L0100(A) L0102(W-UE)
L0102(W-DE) L0103(A) L0106(W-UE) L0106(W-DE)
L0107(A) L0109(W-UE) L0109(W-DE) L0110(A)
L0112(W-UE) L0112(W-DE) L0113(A) L0115(W-UE)
L0115(W-DE) L0116(A) L0118(W-UE) L0118(W-DE)
L0119(A) L0121(W-UE) L0121(W-DE) L0122(A)
L0124(W-UE) L0124(W-DE) L0125(W-UE) L0125(W-DE)
L0128(W-UE) L0128(W-DE) L0129(A) L0131(W-UE)
L0131(W-DE) L0132(A) L0134(A)

0005:DISLODFRONT
L0053(A) L0054(A) L0056(B) L0058(B)
L0079(B) L0084(A) L0086(B) L0088(B)
L0134(A)

0006:DISLODBACK
L0043(A) L0053(B) L0054(B) L0056(A)
L0058(A) L0079(A) L0084(B) L0086(A)
L0087(A) L0134(A)

0007:TAILSTOPEN
L0043(A) L0053(B) L0058(A) L0061(A)
L0062(B) L0082(B) L0083(A) L0087(A)
L0126(A) L0134(A)

0008:LOADERFRONT
L0058(B) L0059(A) L0061(A) L0088(B)
L0135(A)

0009:TAILSTCLOSE
L0053(A) L0061(B) L0062(A) L0067(A)
L0076(A) L0082(A) L0083(B) L0088(B)
L0135(A)

0010:LOADERBACK
L0043(A) L0053(A) L0058(A) L0059(B)
L0087(A) L0135(A)

0011:VERTILUP REF
L0067(B) L0069(A) L0079(B) L0080(B)
L0088(B) L0135(A)

0012:VERTILDOWN
L0043(A) L0067(A) L0069(B) L0079(A)
L0080(A) L0087(A) L0135(A)

0013:HORIZOSTART
L0043(A) L0065(A) L0071(A) L0073(A)
L0076(A) L0077(B) L0080(A) L0087(A)
L0135(A)

0014:HORIZOEND

L0076(B) L0077(A) L0080(B) L0088(B)
L0135(A)
0015:COLLETCLOSE
L0043(B) L0064(B) L0065(A) L0067(A)
L0076(A) L0088(B) L0135(A)
0100:COLLETOPEN
L0064(A) L0065(B) L0087(A) [illegible](A)
0101:CUTTERFR/REV
L0048(B) L0049(A) L0136(A)
0102:RAPID FR/REV
L0067(B) L0136(A)
0103:COMPOK
L0064(A) L0067(A) L0136(A)
0104:PLUNG START
L0071(A) L0073(B) L0136(A)
0105:PLUNG END
L0071(B) L0073(A) L0136(A)
0106:TRAVEL
L0074(B) L0076(A) L0136(A)
0107:RAPID REV
L0068(A) L0136(A)

<< Output Relay >>
0500:HYDRALMOTOR
L0006(OUT) L0137(A)
0501:COLANTMOTOR
L0008(OUT) L0137(A)
0502:CUTTERFR/REV
L0010(OUT) L0137(A)
0503:RAPID FR/REV
L0012(OUT) L0137(A)
0504:DISLOD
L0014(OUT) L0137(A)
0505:LOADER
L0017(OUT) L0137(A)
0506:VERTIC
L0019(OUT) L0137(A)
0507:TAILSTFORWAD
L0021(OUT) L0082(B) L0137(A)
0600:CUTTER MAIN
L0027(OUT) L0138(A)
0601:CUTTER STAR
L0029(OUT) L0138(A)
0602:CUTTER DELTA
L0031(OUT) L0138(A)
0603:RAPID RETURN
L0033(OUT) L0062(B) L0138(A)
0604:FEED CLURCH
L0036(OUT) L0138(A)
0605:RAPID CLUTCH
L0038(OUT) L0138(A)
0606:TAILSTREVER
L0024(OUT) L0138(A)
0607:COUNTR

L0040(OUT) L0138(A)

<< Internal Sub Relay >>

1700:START REF
L0005(STA) L0043(OUT) L0044(A)

1704:AUTOON OK
L0022(A) L0045(SET) L0046(A) L0048(A)
L0053(A)

1706:DELTA
L0051(B) L0051(SET) L0053(A)

1707:DISLODON
L0053(B) L0053(SET) L0054(A) L0091(RES)
L0093(RES) L0095(SET)

1709:DISLOD OK
L0018(A) L0022(B) L0025(A) L0056(B)
L0056(SET) L0058(A) L0091(RES) L0093(RES)

1710:LOADON
L0058(B) L0058(SET) L0059(A) L0091(RES)
L0093(RES)

1711:LOADOKFRONT
L0023(A) L0025(B) L0059(B) L0059(SET)
L0061(A) L0091(RES) L0093(RES)

1713:TAILSTCLAMP
L0018(B) L0062(B) L0062(SET) L0064(A)
L0091(RES) L0093(RES)

1715:COLLET OK
L0020(A) L0065(B) L0065(SET) L0067(A)
L0092(RES) L0094(RES)

1800:VERTIC ON
L0005(STA) L0067(B) L0067(SET) L0068(A)
L0069(A) L0092(STA) L0094(STA)

1801:UP OK
L0069(B) L0069(SET) L0071(A)

1803:PLUNGE OK
L0073(B) L0073(SET) L0074(A) L0076(A)

1804:HORIZO ON
L0037(A) L0074(SET) L0076(B) L0076(SET)
L0077(A)

1805:PROCES OK
L0020(B) L0037(B) L0074(B) L0074(SET)
L0077(B) L0077(SET) L0079(A)

1806:TAILST ON
L0082(B) L0082(SET) L0083(A)

1900:DISLOD ON
L0005(STA) L0023(B) L0035(A) L0039(A)
L0079(B) L0079(SET) L0080(A) L0082(A)

1902:CUTTERREVERS
L0011(A) L0049(B) L0049(SET)

1903:REVSELRAPID
L0013(A) L0068(B) L0068(SET)

<< Timer >>

T001:STAR T
L0030(B) L0032(A) L0050(TMR) L0051(A)

T002:ON TIM
L0015(B) L0055(TMR) L0056(A)
T003:WAIT T
L0016(B) L0085(TMR) L0086(A)
T007:PLUNGETIME
L0072(TMR) L0073(A)

CHAPTER - 7

CONCLUSION

The programming has been done for the control of GHM in three modes.They are

(1) Manual

(2) Semi- Automatic

(3) Automatic.

The programs have been successfully formulated in accordance with the requirements.It has been incorporated in the PLC.This replacement of electronic control by PLC reduces the frequency of fault occurrence in the gear hobbing machine and hence the down time of the machine is reduced.

CHAPTER - 8

REFERENCES

1 MIKRON USERS MANUAL.

2 KEYENCE PLC USERS MANUAL.

3 WWW.MIKRON-LG.COM

4. WWW.PLCONTROLLER.COM.

A.1. MOTOR DETAILS

A.1.1. Main Motor:

Type :- 3 phase Induction motor.

Capacity :- 1.1KW.

Voltage :- 380V.

Current :- 2.5A.

Frequency :- 50Hz.

Speed :- 1500rpm.

A.1.2. Hydraulic Motor:

Type :- 3 phase Induction motor.

Capacity :- 0.37KW.

Voltage :- 380V.

Current :- 1.1A.

Frequency :- 50Hz.

Speed :- 1500rpm.

A.1.3. Coolant pump motor:

Type :- 3 phase Induction motor.

Capacity :- 0.11KW.

Voltage :- 380V.

Current :- 0.39A.

Frequency :- 50Hz.

Speed :- 3000rpm.

A.1.4. Rapid Return Motor:

Type :- 3 phase Induction motor.

Capacity :- 0.04KW.

Voltage :- 380V.

Current :- 0.56A.

Frequency :- 50Hz.

Speed :- 3000rpm.

A.2. PUMP DETAILS

A.2.1. Hydraulic Pump :

Type :- Centrifugal.

Inlet :- Hydraulic oil.

Outlet :- Hydraulic oil with vatiation in pressure of 5 to 15 kg/cm^2 for various operations.