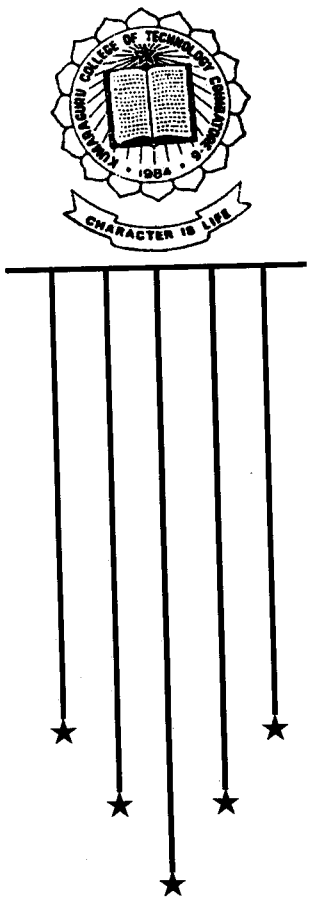
ENERGY SAVING IN AC ARC WELDING

P-410

PROJECT REPORT



1999 -2000

SUBMITTED BY

PADMA. G

NITHIN RAJ. C.R

PRABHU. S

SHAMEEM. V.P

GUIDED BY

Mrs. K. MALARVIZHI, B.E., MISTE.

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 project entitled

ENERGY SAVING IN AC ARC WELDING

has been submitted by

Miss.Padma.G.	96EEE25.
Mr. Nithin Raj.C.R.	96EEE23.
Mr. Prabhu.S.	96EEE27.
Mr.Shameem.V.P.	96EEE66.

In partial fulfilment of the requirements for the award degree of Bachelor of Engineering in Electrical and Electronics Engineering branch of Bharathiar University, Coimbatore - 641 046 during the academic year 1999-2000.

14/3

13/3/25

Guide

Professor and Head

Dr. K. A. PALANISWAMY, B.E.,M.Sc.(Engg).,Ph.D.,
MISTE,C.Engg(I).,FIE
Professor and Head
Department of Electrical and Electronics Engineering.
Kumaraguru College of Technology.
Coimbatore 641 006

Date:

Certified that the candidate with University No_____

was examined in project work viva-voce on_____

Internal Examiner

External Examiner

ELGI

ELGI EQUIPMENTS LIMITED

MAR 07, 2000

CERTIFICATE

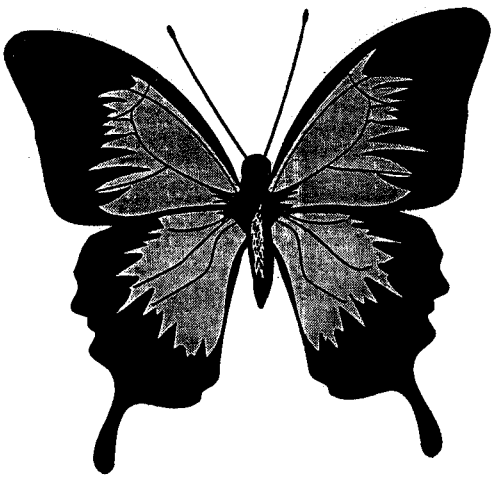
This is to certify that the following Final Year BE- EEE. Students of Kumaraguru College of Technology, Coimbatore has done a project titled "ENERGY SAVING IN ARC WELDING" at our Sheet metal Fabrication Department from 24.07.99 to 28.02.2000.

1. Mr. C.R.Nithin Raj
2. Miss G.Padma
3. Mr. S.Prabhu
4. Mr. V.P.Shameem

The keen interest shown by them during the period and their performance in totality is COMMENDABLE.

S.PRABAKARAN
(OFFICER – TRAINING)

Dedicated To Our
Beloved Parents



ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

It is with deep sense of gratitude that we thank our project guide **Mrs. K. Malarvizhi, B.E., MISTE.**, Lecturer, Department of Electrical and Electronics Engineering, for her guidance, keen and constant interest evinced through out the course of this project.

We are highly grateful to **Dr. K.A. Palaniswamy, B.E., M.Sc.(Engg), Ph.D., MISTE., C.Eng (I), F.I.E.**, Professor and Head of Department of Electrical and Electronics Engineering for his enthusiasm and encouragement which has been instrumental in the success of this project.

We thank our Principal **Dr. K.K. Padmanabhan, B.Sc.(Engg)., M.Tech., Ph.D.**, for his patronage.

We are thankful to **Mr. Subramaniam Manager** - Maintanence and **Mr. Viswanathan Engineer** - Fabrication ELGI Equipments, Coimbatore who rendered to complete this project. They provided us the necessary data and relevant materials for this project.

We also thank all the teaching and non teaching staff members of the Electrical and Electronics Engineering Department for their help and encouragement.

SYNOPSIS

SYNOPSIS

This project titled, Energy saving in ac arc welding is to switch on and off the welding equipment under load and noload conditions respectively, there by saving the energy consumption during noload condition.

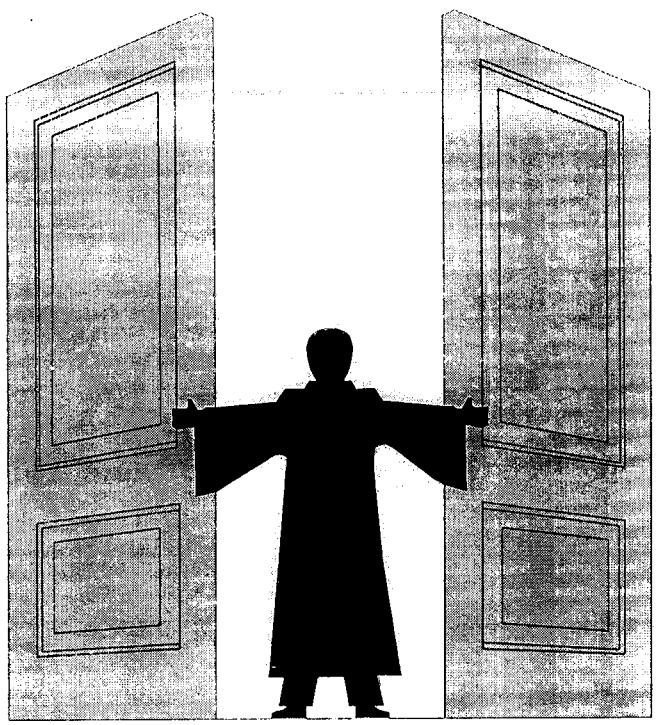
The arrangement of the power unit in the ac arc welding process is such that it is not easily accessible from the work place. This makes the job difficult to the worker to switch off the supply under no load. This difficulty is overcome by this project. The energy consumption under no load condition is also avoided in this case.

For accomplishing this a sensing unit and a control unit is used. The condition of the load is sensed by the sensing unit and accordingly the control unit controls the power-supply.

Thus a control circuit is designed and tested successfully.

CONTENTS

CONTENTS



INTRODUCTION

In this project the welding equipment's power source is switched off during idle [no load] condition by using a timer circuit. The welding equipment is switched on when the electrode is struck to the base metal. This is achieved by using a sensing element.

The circuit designed in this project is a simple electronic system and is very easy to assemble quite compact and works reliably.

GENERAL BLOCK DIAGRAM

CHAPTER - II

THE GENERAL BLOCK DIAGRAM

The general block diagram of this project is shown in the figure 2.1. It consists of the following:

- Supply unit
- Welding unit
- Control unit
- Sensor unit
- Dc power supply

The 3-ph supply from the mains, supply power to the welding transformer of the welding unit. The load conditions of the welding unit is sensed by the sensing unit. The sensing unit mainly consists of a current transformer.

According to the output of the sensing unit the control unit works. The control unit comprise of timer circuit, relay circuit and contactor . The contactor of the three phase,supply to the welding equipment.

The DC power supply for the components used in this circuit is got from the three phase supply by using a bridge rectifier circuit.

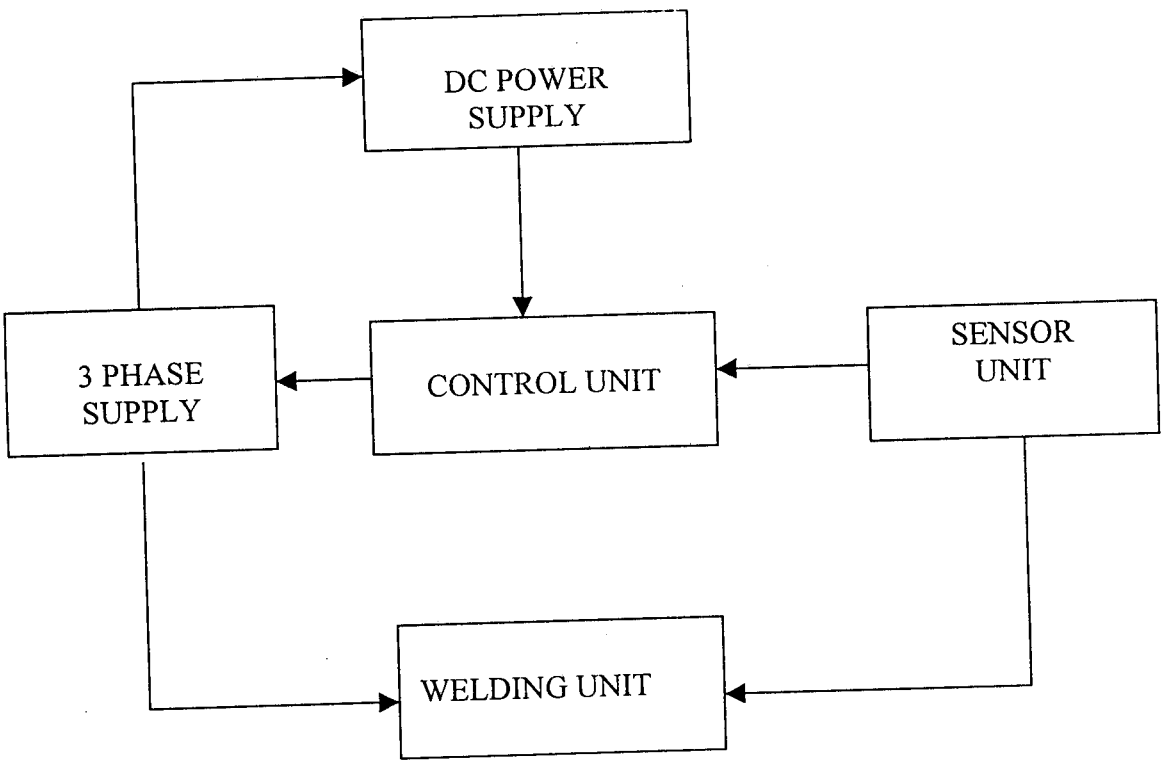


Fig. 1.1

GENERAL BLOCK DIAGRAM

WELDING

CHAPTER - III

WELDING

3.1 INTRODUCTION:

Welding is a process in which two metal parts are joined by heating. The process in which two metal parts are brought to a molten state and then allowed to solidify is known as fusion wedding. Arc welding comes under the group of fusion wedding.

3.2 PRINCIPLE OF ARC WELDING

Current is obtained from an AC source, one terminal is connected to the electrode and the other to the work piece and the circuit is completed through the air gap.

The gap is provided between the tip of the electrode and the surface of workpiece by keeping the electrode at a distance of about 3mm to 6mm from the surface of the work piece. Due to interruption by the air gap, heat is produced and the temperature attained varies from 3700°C to 4000°C. Electrical energy is convertd at the arc into heat energy.

3.3 REQUIREMENTS:

The main requirements for a sucessful welding are relatively high striking voltage to enable the arc to be struck and maintain stability, a relatively low voltage to enable the arc to be maintained without being violent and a current of correct value to melt the electrode and parent metal without burning. The

sparking voltage is usually in the region of 80 to 100 volts in case of AC. The arc voltage depends upon the metal and flux of the electrode and it varies between 25 to 35V.

The high open circuit (or) striking voltage and low arc voltage is obtained by means of equipment designed to give a drooping characteristics. The drooping characteristics is obtained in case of AC welding equipment by means of reactance coil in series with the arc. The voltage at the secondary side of transformer remains constant almost and is available for striking the arc but as soon as the current flows, the voltage drop across the reactance coil reduce the voltage at the arc to the required value. The reactance coil controls the flow of current.

When a reactance is used it must be designed to operate well below the point at its magnetic circuit to prevent the introduction of harmonics.

3.4 DESCRIPTION OF WELDING SET

The welding set has been designed as portable oil cooled set, suitable for general purpose manual metal arc welding and Tig welding in workshop.

This welding set consists of a stepdown transformer and reactor, the primary winding of the former being provided with tappings, enabling its connection to various supply voltages. The secondary winding is connected in series with the choke unit which has a fixed core. Welding current variations is obtained by providing the reactor with tappings which are connected through two rotary snap-action selector switches to the electrode holder terminal.

This set operate at 80 to 100 volts as desired, selected by means of a two position snap-action rotary switch. The current is adjusted to suit the type and size of electrode to be used.

The electrode holder and the welding return cable connections are made by terminals provided with large hand nuts. The welding leads in the set can be extended when necessary by the use of coupling sockets and plugs.

In this welding set, the primary cable connection terminal block together with primary tapping links, primary cable cleat, oil filler and dipstick are situated in the top below a removable plate. Cable entry is effected through a rubber grommet in the side of the top cover.

3.5 TECHNICAL SPECIFICATION OF WELDING SET:

Primary voltage range and phase	-	380-400 volts, Two lines
Frequency	-	50 Hz
Output secondary voltage	-	80 and 100 volts
Output Welding Current Range:		
At 80 ocv	-	25 - 300 amps
At 100 ocv	-	30 - 240 amps
Input Rating:		
a. Continuous	-	12 KVA
b. Maximum	-	24 KVA
Electrode sizes	-	1.6mm to 6mm

Recommended primary	-	163/0.457
Cable size	-	Three core TRS

3.6 WELDING APPLICATIONS:

Today all most all the commonly employed metals and their alloys can be welded by welding process. Metal arc welding is used for fabrication, maintenance and repair jobs.

3.6.1 FABRICATION:

The manufacturing and construction industries use welding as a primary means of fabricating metal assemblies. The fabrication process involves taking many specially formed parts of an assembly and joining them to form a complete unit.

3.6.2 REPAIR:

Metal is a strong, tough material but it can break, bend or worn down. Welding process allows us to repair metal parts with relative ease. Outer repairs can be made quickly on site.

3.6.2 SHAPING:

Welding equipment can be used to cut many metals, metal cutting is used to shape metal parts for fabrication and to proper joints for welding.

The welding process finds applications in

- Air receiver, tank, boiler and pressure vessel fabrication
- Ship building
- Pipes and pen stock joining
- Building and bridge construction
- Automotive and air craft industry etc.

ENERGY CONCEPTS IN AC ARC WELDING

CHAPER - IV

ENERGY CONCEPTS IN ARC WELDING

4.1 ENERGY LOSSES IN WELDING TRANSFORMER:

In a welding equipment, under idle condition i.e., under no load condition, the losses that met are core loss and no load copper loss. Core loss, otherwise called as iron loss, or magnetising losses is practically same at both on load and no load condition.

Core loss in the transformer includes both hysteresis and eddy current loss, Hysteresis loss, is due to the requirement of power for continuous reversal of molecular magnets when the magnetic material is subjected to reversal of flux. This power is dissipated in the form of heat and is proportional to the valve of applied voltage and frequencies.

Eddy current losses is due to the requirement of power to maintain the circulation of eddy current in the core, which is dissipated in the form of heat. Since the flux is alternating, it links with the magnetic material of the core resulting in production of emf which results in the circulation of eddy current. These losses are proportional to the applied voltage and sequence of frequency.

In practical cases, under no load condition there exist a small amount of current in the transformer primary. This leads to copper loss due to the existence of ohmic resistance in the primary and secondary.

In the welding equipment to obtain the drooping characteristic, a resistance is connected in series with the primary of the welding transformer. This leads to additional loss in the welding equipment.

When the welding equipment is kept idle, the above explained losses occurs in the equipment. In order to avoid these losses, the supply has to be switched off every time, when it is not in use. Since the power unit is at a distance from the work place, usually it is not switched off and hence some amount of energy is consumed by the welding equipment under no load.

4.2 ENERGY SAVING:

Considering a single welding unit, the no load losses may be neglected. In industries a large number of such welding sets are used. The power consumptions as a whole is appreciable.

In a day, about 2 to 3 hrs, the welding equipment is kept idle. About 3 to 4 units of energy is consumed by each welding sets under no load condition. The commercial charge of one unit of energy is Rs.2.60. If we consider, twenty such welding sets, the cost comes around Rs.100. This wastage of money is avoided by including this energy saving unit to the welding set.

DESIGN OF TIMING CIRCUIT

CHAPTER V

DESIGN OF TIMING CIRCUIT

5.1 TIMER DESCRIPTION:

Timing Circuit is a circuit which is used to give an output after a desired time delay. There are many types of timing circuits available most of them are available in IC form which is compactable and easy to use. The timer that is used in the circuit is 555 IC Timer.

The 555 Timer is a highly stable device, for generating accurate time delay. It can be used with a supply voltage range of +5 V to +18V and can drive a load of current upto 200 mA because of this wide range of supply voltage the 555 timer is versatile and easy to use in various applications. It is compactable with both TTL and CMOS Logic circuits.

5.2 WORKING OF TIMER:

The Timer circuit designed here to switch off the 440 V supply to the welding equipment under no load conditions after giving a specific time delay.

In this circuit the time delay can be varied to 10 seconds to 1.5 Minutes using the potentiometer.

Current transformer connected to the primary of the welding transformer senses whether the equipment is under load or not. Accordingly the level of the transistor Q becomes high or low under no load condition the current in the

secondary of current transformer is negligible and so the output of the transistor Q becomes low. This unclamps the capacitor and the capacitor starts charging through the resistor R. At the end of the time constant RC the output of timer circuit goes low and the relay deenergize.

When the relay is deenergized 440V supply to the welding equipment is disconnected through the contactor and 18V supply is given to the primary of the welding transformer.

Under load conditions i.e., whenever the work is started the output of the current transformer becomes apperciable and this make the output of the transistor to go high. This clamps capacitor from charging. Under this condition through the control circuit the negative triggering pulse is given to the time circuit. This make the output to go high and the relay is operated to disconnect the 18 V supply and 440V supply gets connected to the primary of the welding transformer.

Thus the energy consumption during no load condition is reduced to a large extent by the transfer of primary voltage from 440V to 18V through the electrical contactor.

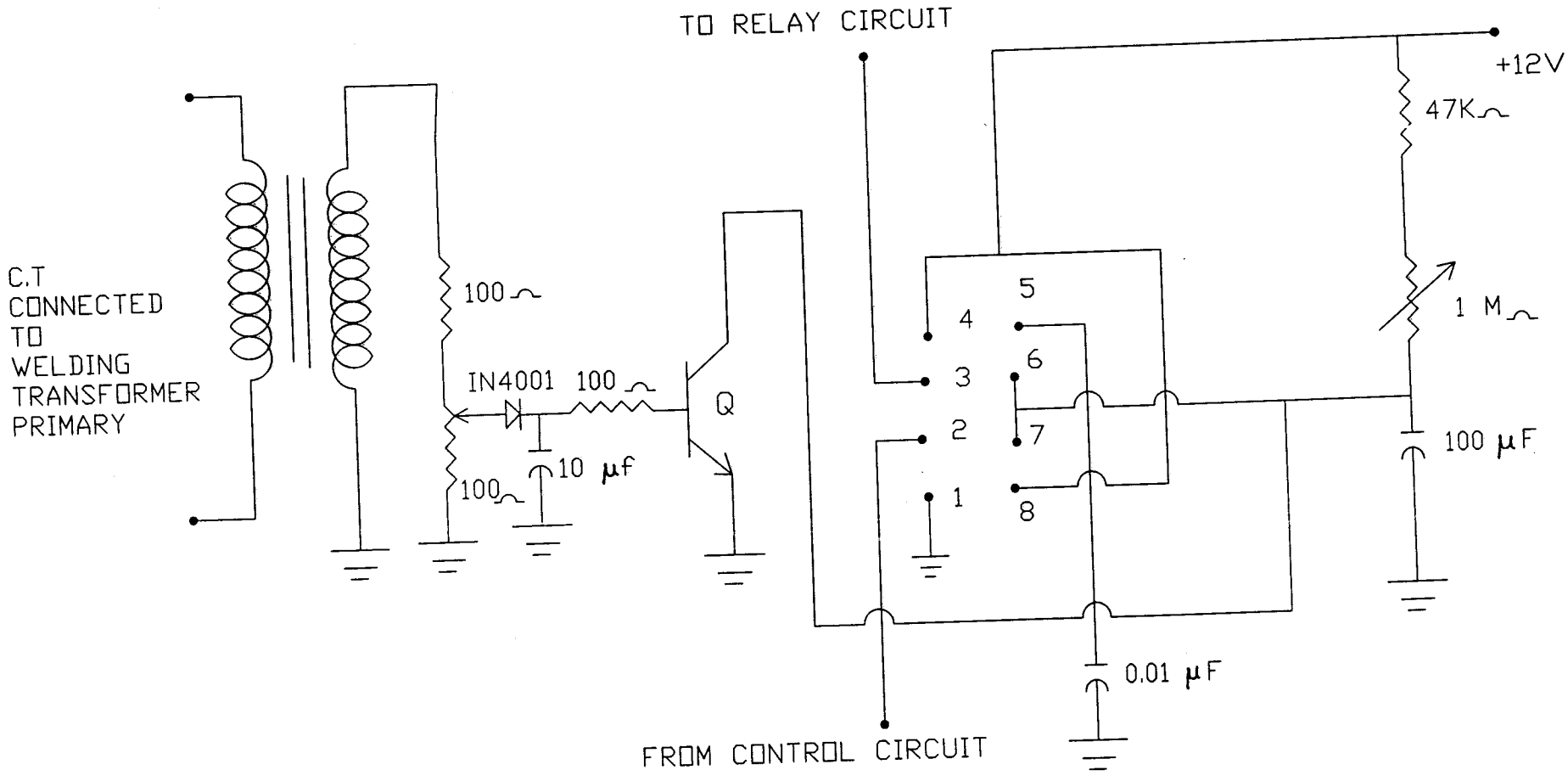


Fig 5.1 TIMING CIRCUIT

DESIGN OF SENSOR

CHAPTER VI

DESIGN OF SENSOR

The sensing circuit consists of a current transformer which is connected in series with the primary of the welding transformer. The secondary of the current transformer is connected to the transistor Q through the resistor as shown in the circuit in fig.6.1.

Under no load condition, the primary current of the welding transformer is very less. This current is sensed by the current transformer. The secondary of the current transformer is designed in such way that under no load condition, voltage drop across the resistor is not enough to turn on the transistor Q.

Under this condition, the level of the transistor become low. Due to this capacitor in the time circuit gets unclamped. According to the position of the potentiometer after a specific delay 440 V supply to the welding equipment is switched off.

Under on load condition the primary current of the welding transformer becomes high. Due to this the current in the current transformer becomes appreciable and hence the voltage drop across the resistor becomes large enough to turn on the transistor. As the level of the transistor become high the capacitor in timing circuit is clamped . Thus the operation of the relay to switch off the 440V supply to the welding equipment is avoided.

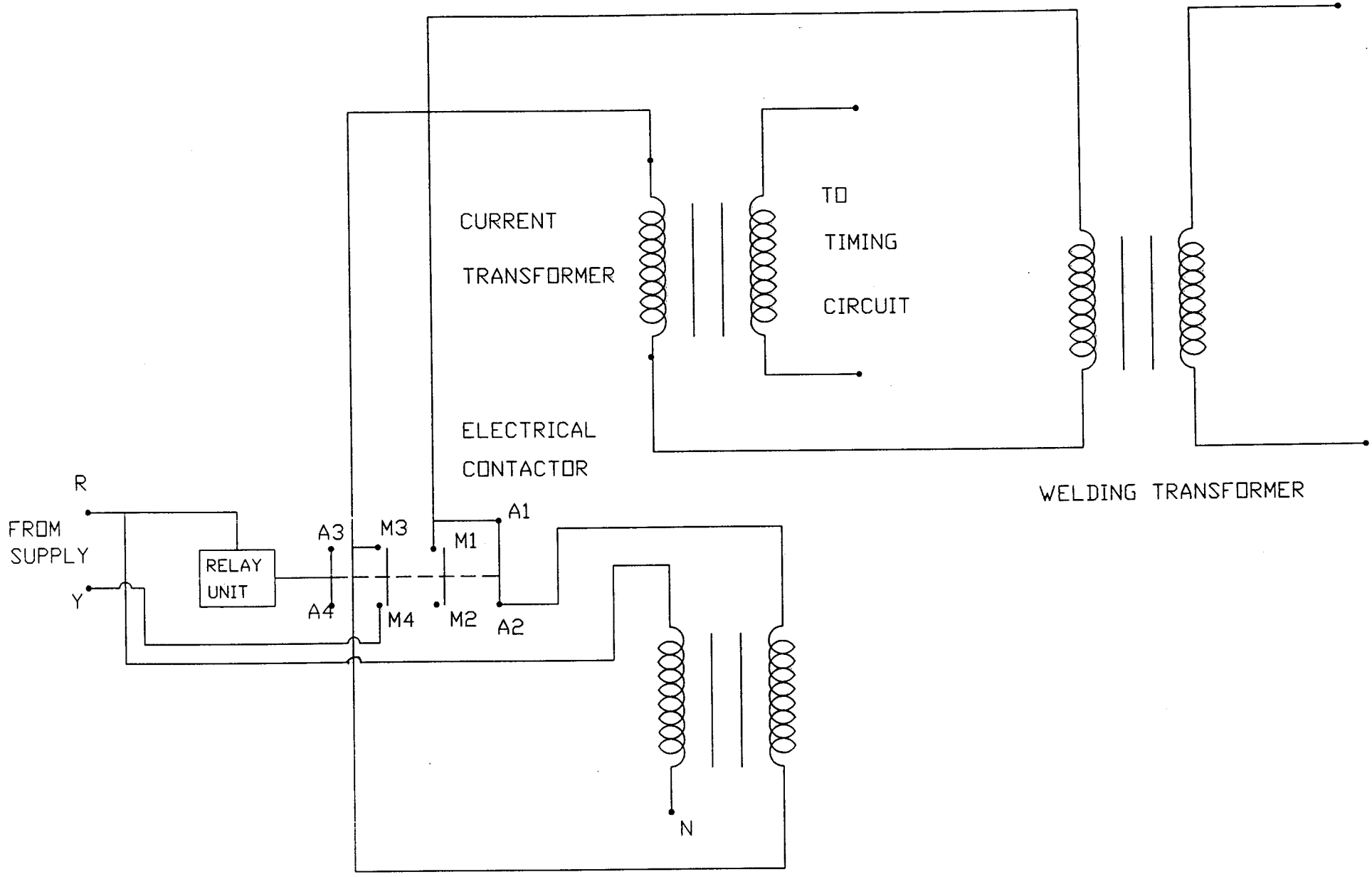


Fig.6.1 SENSOR CIRCUIT

DESIGN OF CONTROL UNIT

CHAPTER VII

DESIGN OF CONTROL UNIT

7.1 WORKING OF CONTROL UNIT:

The control unit comprises of relay unit, electrical contactor and transistor circuit as shown in the fig 7.1.

Under no load condition 18V supply is given to the primary of the welding transformer. The no load secondary voltage which is approximately 3V is rectified and given to the transistor Q2. This transistor gets saturated and the level of transistor becomes zero whenever the electrode is touched to the workpiece (basemetal) to start the work the voltage at the secondary drops to zero and the level of transistor Q2 becomes one and hence the level of the transistor Q1 becomes zero. This negative triggering pulse is given to the time circuit to operate the relay and 18V supply to the welding equipment is switched off and 440V supply is given to the welding equipment to through the electrical contactor.

When the welding equipment is under no load condition, the contacts A1 A2 and A3 A4 will remain closed whenever the work is started, the relay is operated so that normally closed contacts A1 A2, A3 A4 opens and the contacts M1 M2, M3 M4 gets closed thereby connecting 440V supply to the primary of the welding transformer. A voltage about 90V is available at the secondary to carry out the welding process.

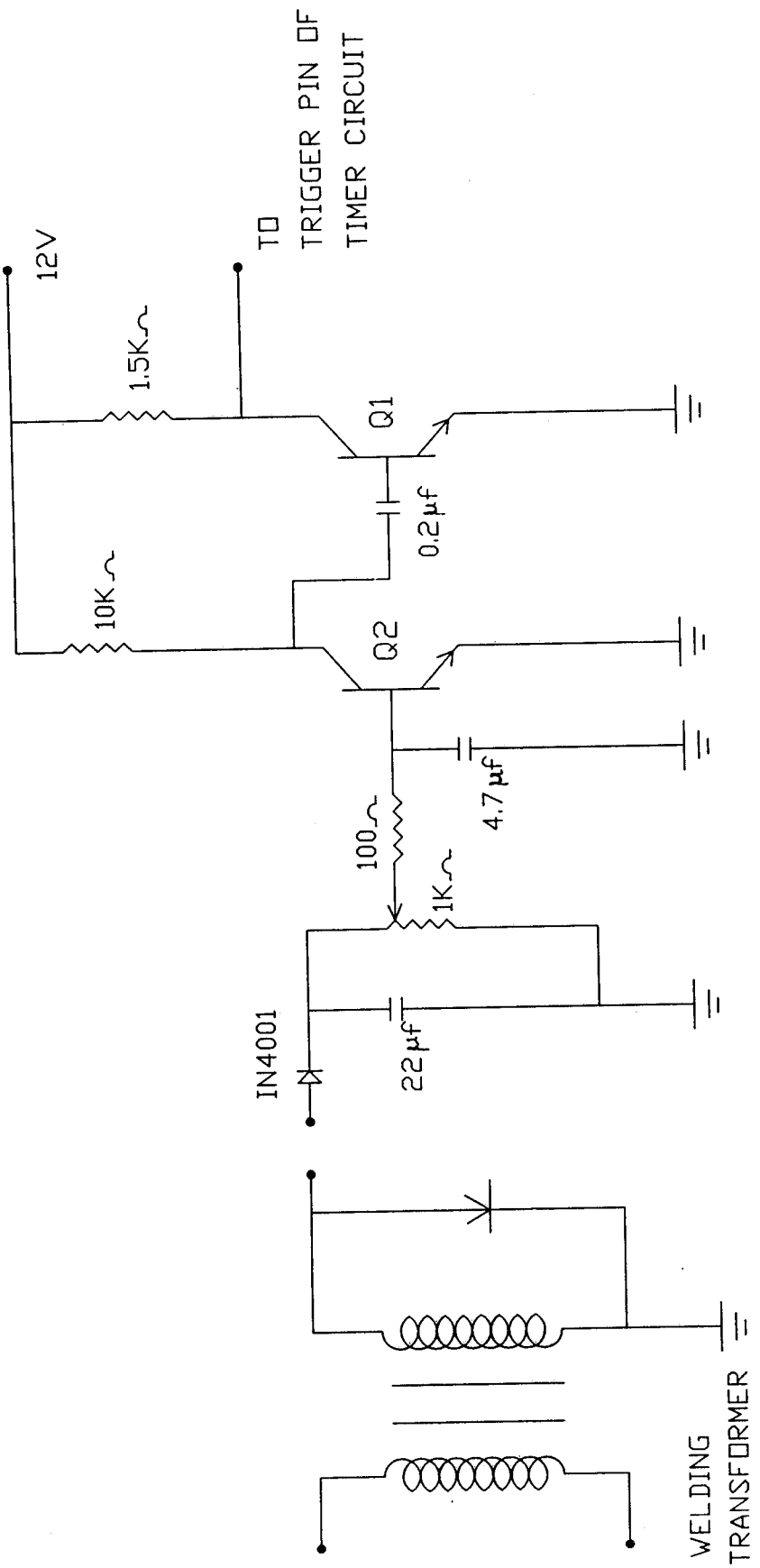


Fig.7.1 CONTROL CIRCUIT

FABRICATION

&

TESTING

CHAPTER VIII

FABRICATION AND TESTING

8.1 FABRICATION:

The sensor, timing, control unit designed are fabricated as a single unit as shown in the fig 8.1.

The design circuit was fitted on a 6 * 2 ½" hylum board. The sensor timing and control units are fabricated on this board. The PCB as in figure includes all the electronic component (Diode, Capacitors, ICs, Resistors). The transformers and electrical contactor are mounted externally. The circuit and connections are made from transformers and contactor to the other component of the circuit . Thy hylum board is mounted in a metal cabin. The metal cabin is about 15*12*5½" in size.

The front panel is designed with an on off switch and a potentiometer. The backside of the panel has the provision for wire outlets. The cabin also provides proper ventilation on the sides to desipate the heat developed inside when circuit is in operation.

The on - off switch is a provision for bypassing the automation of the system. When the equpiment is in operation it has to be put to the auto side indicated on the front panel.

Potentiometer is used to control the timing circuit of this unit. The delay time that is required to switch off the welding equipment can be adjusted by using this potentiometer as designed. In this circuit it is designed to vary the delay time from 10 Seconds to 1.5 Minutes.

8.2. OPERATING INSTRUCTIONS:

The following instructions must be followed while connecting the energy saving unit to the welding equipment and while in operation.

- The two phase supply and the neutral should be properly connected to the energy saving unit denoted by R, Y, N.
- The supply to the primary of the welding transformer should be given through the energy saving unit.
- The leads from the sensing element of the unit should be properly connected to the secondary of the welding transformer.
- The potentiometer is set to proper time delay.
- The toggle switch should be in the auto side.

8.3 TESTING:

The above circuit was designed and elecrically fabricated. It was tested on a welding equipment available at the industry (ELGI equipments). The testing was done to ensure proper switching on and off of the welding equipment. The circuit worked successfully upto our expectations with no problem.

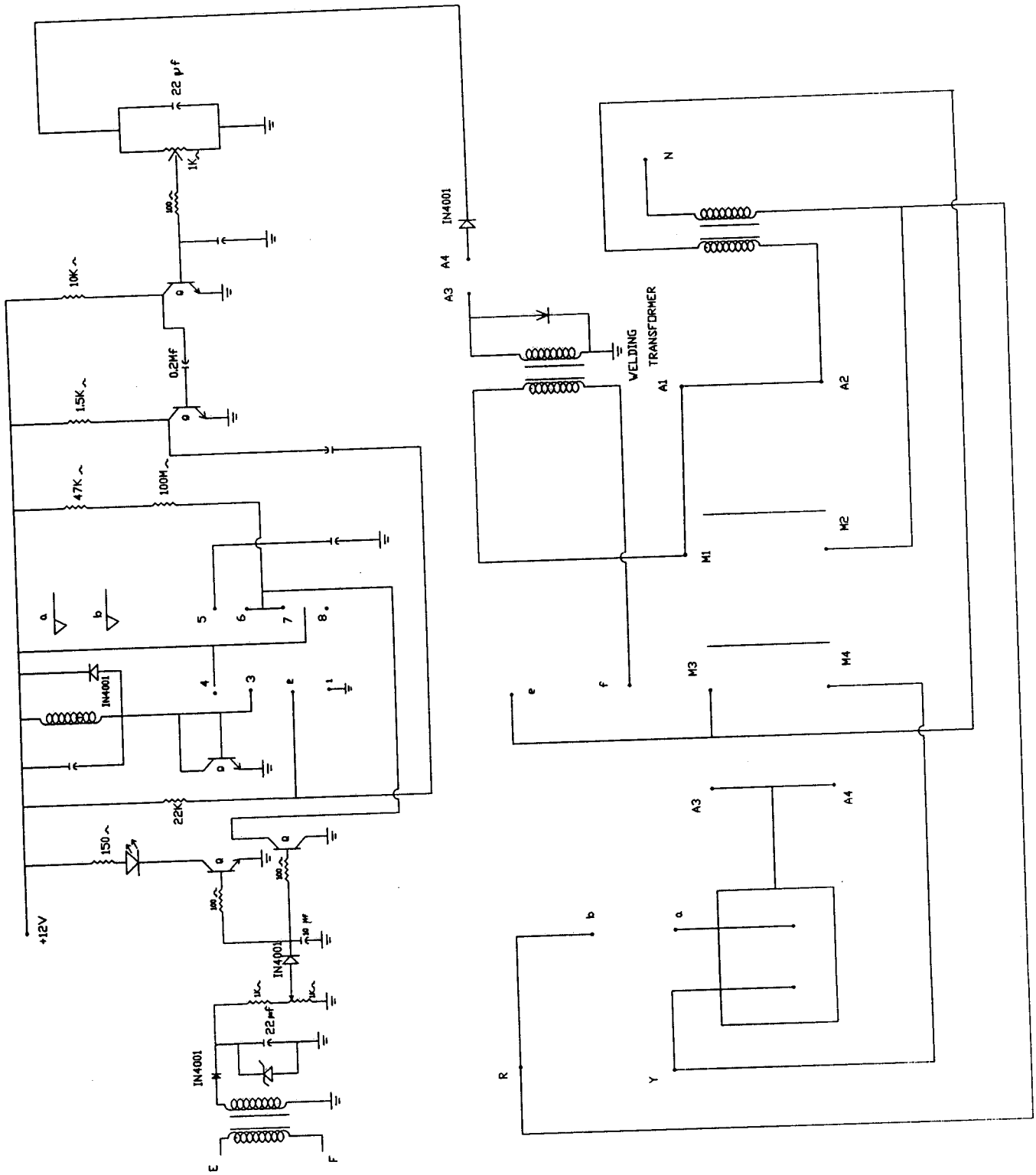


Fig.8.1 ENERGY SAVING UNIT

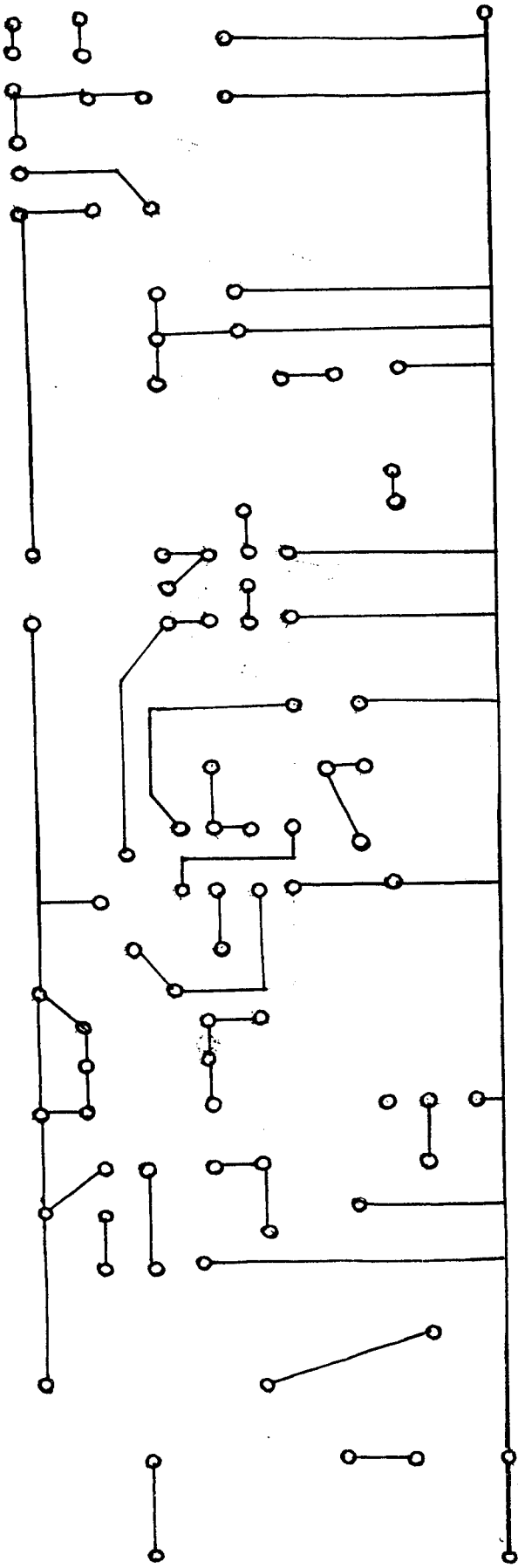


Fig 8.2 PCB LAYOUT

CONCLUSION

CHAPTER IX

CONCLUSION

A unit has been designed and developed for the automation and energy saving in ac arc welding equipment. This system is economical and reliable.

The electronic circuitry in the system has been tested sucessfully and the timer is working satisfactorily with appropriate delay period as per to the design.

The switching on and off the welding equipment is done satisfactorily according to the design.

By using this unit apprecible amount of energy is saved. The welding unit consumes 300 to 400 Watts /Hour under no load. By connecting this energy saving unit the consumption is reduced to (18 V*0.4A) 7.2Watts/Hour. The frequency of switching on and off of the welding equipment is also reduced.

REFERENCES

REFERENCES

1. Richard L. Hittle, " Welding and Welding Technology", Tata McGraw - Hill publishing company Limited, New Delhi, 1985.
2. Roy Choudry, "Linear Integrated Circuts", New Age publication Limited, New Delhi, 1996.
3. William Stanley, " Electronic Device Circuits and Application", Prentice Hall, New Jerssey, 1989.
4. A.K. Sawhney, "Electrical Machine Design ", Dhanpat Rai & Co., Ltd., 1970.

APPENDIX

APPENDIX

RELAY DETAILS:

1	TYPE	ELECTRO - MECHANICAL
2.	SUPPLY VOLTAGE	12Volts
3.	COIL RESISTANCE	150 Ohms
4.	CONTACTS RATING	2Amps
5.	CONTACT TYPE	SPDT

TIMER DETAILS:

1.	TYPE	555 IC TIMER
2.	MODE	MONOSTABLE
3.	SUPPLY VOLTAGE	5Volts to 18Volts
4.	OPERATING TEMPERATURE SE TYPE NE TYPE	 -55° C TO +120°C 0° C TO 70°C
5.	TEMPERATURE STABILITY	 50 ppm/°C
6.	SOURCE CURRENT CAPACITY	 200mA
7.	TIMING DELAY	MICRO SECONDS TO HOURS

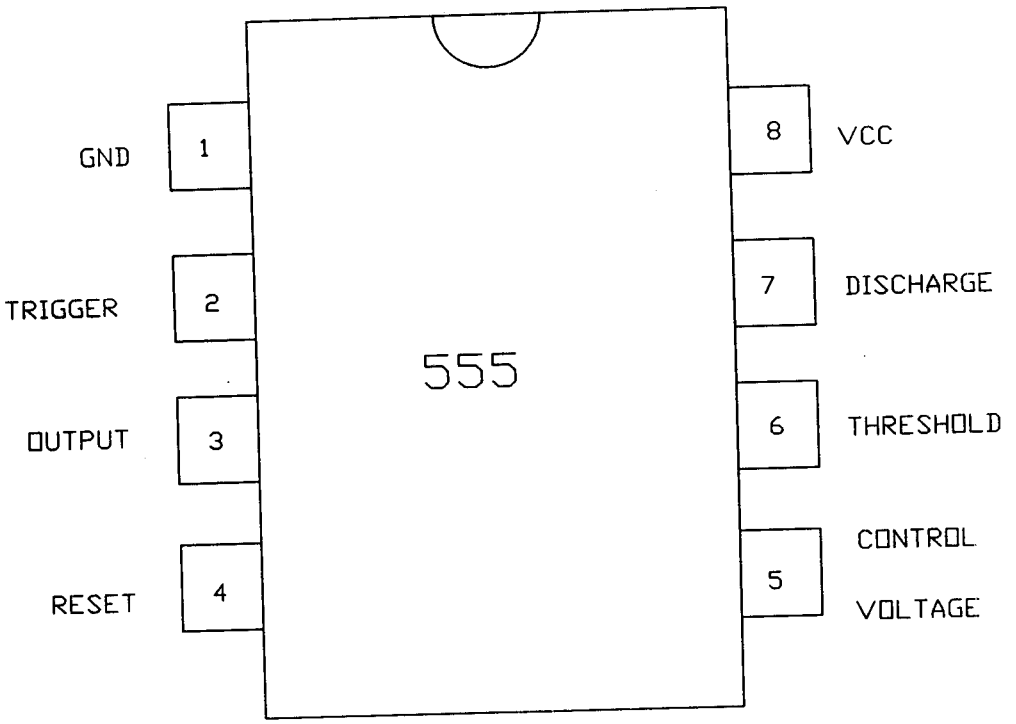


Fig A-1 555 TIMER

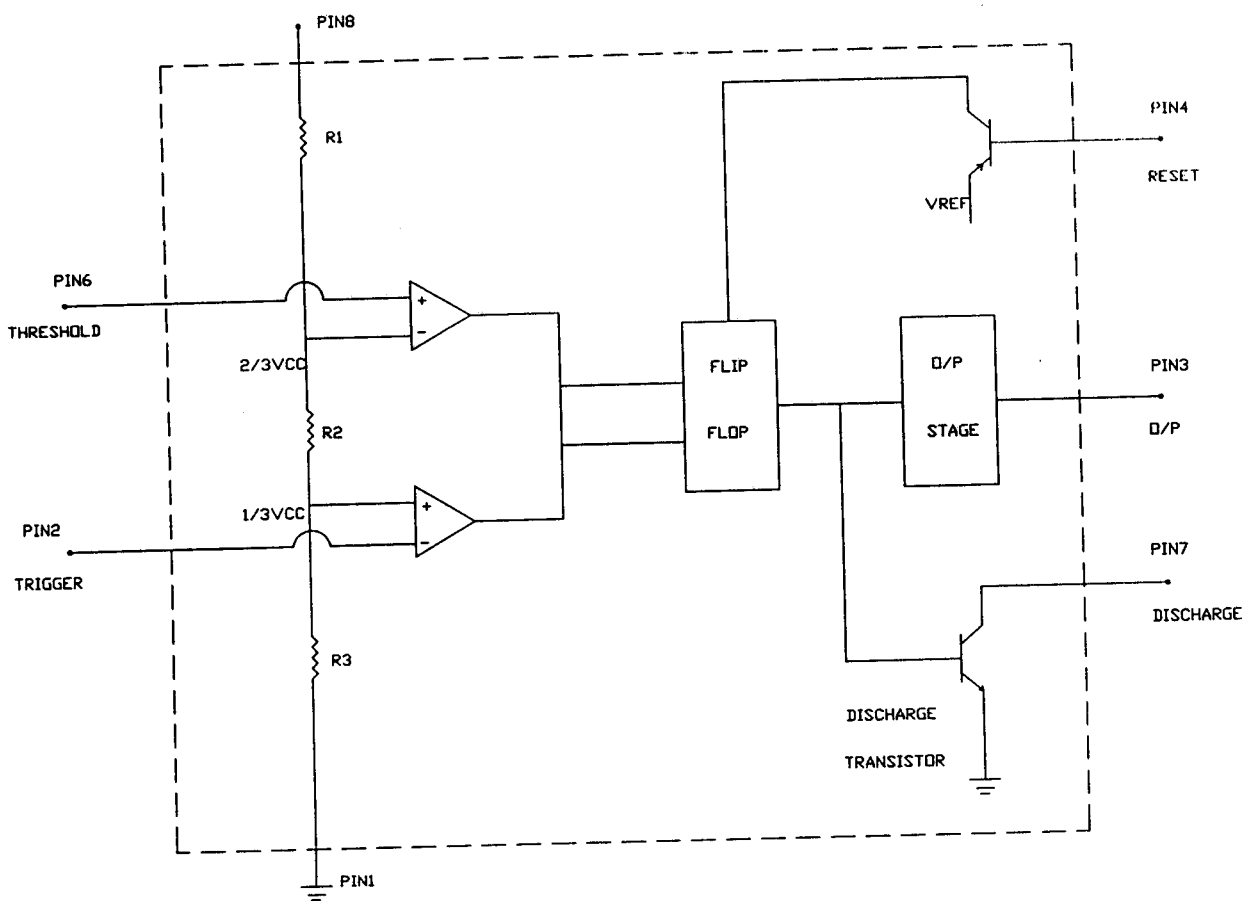


Fig A-2 FUNCTIONAL DIAGRAM OF 555 TIMER