Power Unit Design And Control For Endurance Testing Of Horns

P-530

PROJECT REPORT

SUBMITTED BY

V.R.KARTHIK
R.BALAJI
B.ADHAVAN
N.THANGARAJAN

GUIDED BY
Mrs.D.SOMASUNDARESWARI,
M.E, AMIE.,MISTE.,MSSI
LECTURER IN EEE

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
KUMARAGURU COLLEGE OF TECHNOLOGY
Coimbatore- 641006

Certificate

KUMARAGURU COLLEGE OF TECHNOLOGY
COIMBATORE - 641 006

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CERTIFICATE

This is to certify that the Project Report entitled

POWER UNIT DESIGN & CONTROL FOR THE ENDURANCE TESTING OF HORNS

has been submitted by

V.R. KARTHIK
R.BALAJI
B. ADHAVAN
N.THANGARAJAN

in partial fulfillment of the requirement for
the award of the Degree of

BACHELOR OF ENGINEERING
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of the Bharathiar University

during the academic year 2000-2001

Guide

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

Certified that the candidate with Univ. Reg No.____________

was examined in project work viva-voce on ____________

Internal Examiner

External Examiner

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10-Mar-2001

PROJECT WORK CERTIFICATE

This is to certify that **Mr.V.R.Karthik, Mr.R.Balaji, Mr.B.Adhavan and Mr.N.Thangarajan,** Final year EEE students of Kumaraguru College of Technology, Coimbatore have done a project work on **'Power System Design and Control for Endurance Testing of Horns'** in our organisation from 15.12.2000 to 09.03.2001.

During the period of the Project Work their character and conduct were found to be good.

KAVIDASAN
AGM - Corporate HRD

R.K.G. INDUSTRIAL ESTATE,
GANAPATHY,
COIMBATORE - 641 006
INDIA

TEL : 0091 - (0) 422 - 532100 6 Lines
FAX : 0091 - (0) 422 - 532107
E-MAIL : info@roots-india.com
INTERNET : www.rootsworldwide.com

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Parents, Teachers and

all the People of Gujarat.

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Acknowledgement

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Synopsis

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Horns are electromechanical devices, which are used for generating sounds. The performance of each horn can be analyzed by monitoring various parameters such as load current, frequency and sound level. For this purpose we require a dc power supply, which can produce different voltages and current values. A single horn could be tested with the existing power supply. The system we have designed and installed can provide power for testing six horns simultaneously with adjustable voltage, over- current protection and ON-OFF timer. The display unit consists of a digital voltmeter and ammeter. A provision for the frequency testing of horns is also available.

Contents

CONTENTS

CHAPTER - 1

Introduction

CHAPTER-1

Introduction

The design of a power unit used to supply power and control the output parameters, such as voltage and current, plays an important role in testing any equipment or product. Horns are electromechanical devices which require dc regulated voltage inputs, at the same time they draw large amount of current.

Hence for testing simultaneously six horns, requirement for an adjustable dc power supply with heavy load carrying capacity is necessary. Another facility that is warranted is timer control or switching on and off the supply to the horns. This project aims at fulfilling the above requirements for the power system for endurance testing of horns.

The advantages of this power system are reduced production cost, improved product quality, increase in productivity, isolated from human errors and optimized use of available facilities.

1.1 Block Diagram:-

The block diagram of the power system for horn testing process is shown in fig. 1.1

1.1.1 Power Circuit Unit:-

This unit is one in which the input 230VAC is rectified to delivery a constant regulated dc output voltage. It consists of transformers, MCB, rectifying unit, filtering network and driver stage.

1.1.2 Control circuit unit:-

This unit is responsible for the regulation of the output voltage. This works on the principle of a series voltage regulator where output is controlled through base drive circuit. It consists of the following IC's - IC 741, IC 7905, IC 7812, SL 100.

1.1.3 Timer Control Unit:-

In order to control on/off cycles of the power input to the horns, a timer control unit working on the principle of an astable multivibrator with variable resistor, is employed.

The timer circuit is connected to a dc switch eg: power transistor whose base is controlled by the o/p of the timer circuit.

1.1.4 Over-current Protection:-

Protection of horns from drawing large load current is performed using an over-current relay circuit. The current setting is previously set to a particular permissible value, and when the current exceeds this limit than the relay is energized which triggers a beeper and LED., cuts the power for a period three seconds. Again the process continues until the faulty horn is removed.

1.1.5 Display Unit:-

Two digital display units are used, one for voltage and other for current are fixed on the control panel for monitoring the fluctuation in voltage and current. A provision is also provided so that power supply for the frequency meter can be given and the efficiency of a single horn can be tested.

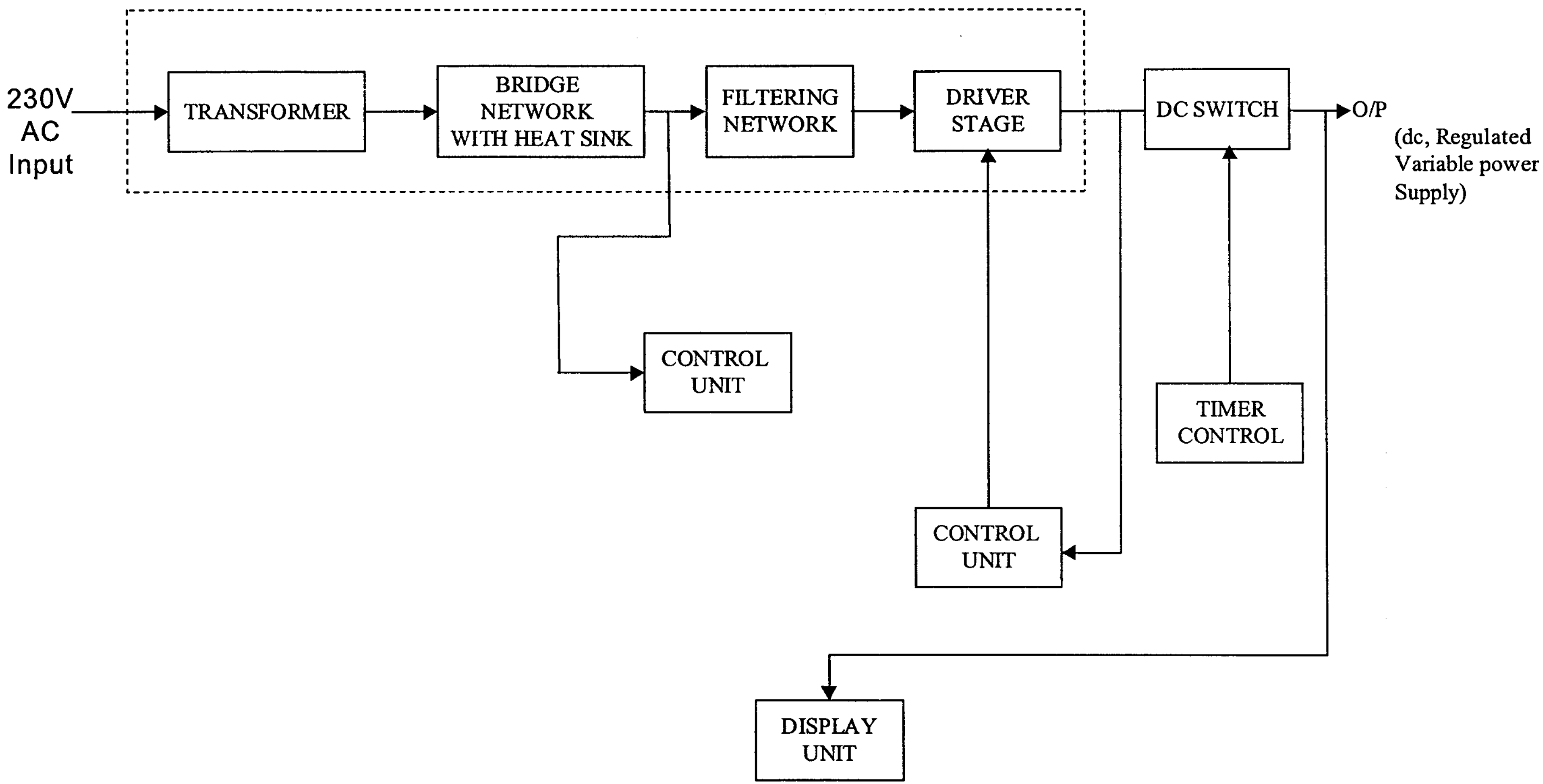

Fig. 1.1 Block Diagram

CHAPTER - 2

Overview of Horns

CHAPTER-2

Overview Of Horns

2.1 Classification Of Horns:-

The horns manufactured can be broadly classified into two categories:-

- Electric Horns
- Air Horns

The horns classified under the electric horn categories are:-

- Mega sonic
- Clear tone deluxe
- Clear tone mini
- Vibrosonic
- Wind tone
- Super Sonic
- Super tone

The horns classified under the air horn categories are

- Jumbo Horn
- Triton
- Pentasonic

2.2. Horn Arrangement:-

The cup houses the spool and core. The spool is would with copper wire and above this the diaphragm assembly is present. The diaphragm assembly connects to the spindle. Beneath the spindle and above the core is the point assembly. The Grill protects the diaphragm and tone disc setup from any physical damage. The horn arrangement is shown in fig. 2.1.

2.3 Operating Principle:

The horn's working principle is similar to that of a speaker. When power is supplied to the electromagnetic coil via the normally contact assembly the core of the electromagnet is magnetized. As a result it pulls the spindle, which is connected, to the diaphragm and the tone disc. The spindle strikes hardly against the magnetic core at the same time opens the contact point, thereby de-energizing the electromagnet coil. Due to this, the diaphragm and armature plate will return to its original position. Again the contact will be made resulting in current flow to the electromagnetic coil.

This process continues as long as the power is supplied to the horn. Thus a rhythmic sound is produced due to the repeated striking of the spindle against the electromagnetic core. The presence of the tone disc is to alter the frequency in order to product a pleasant sound.

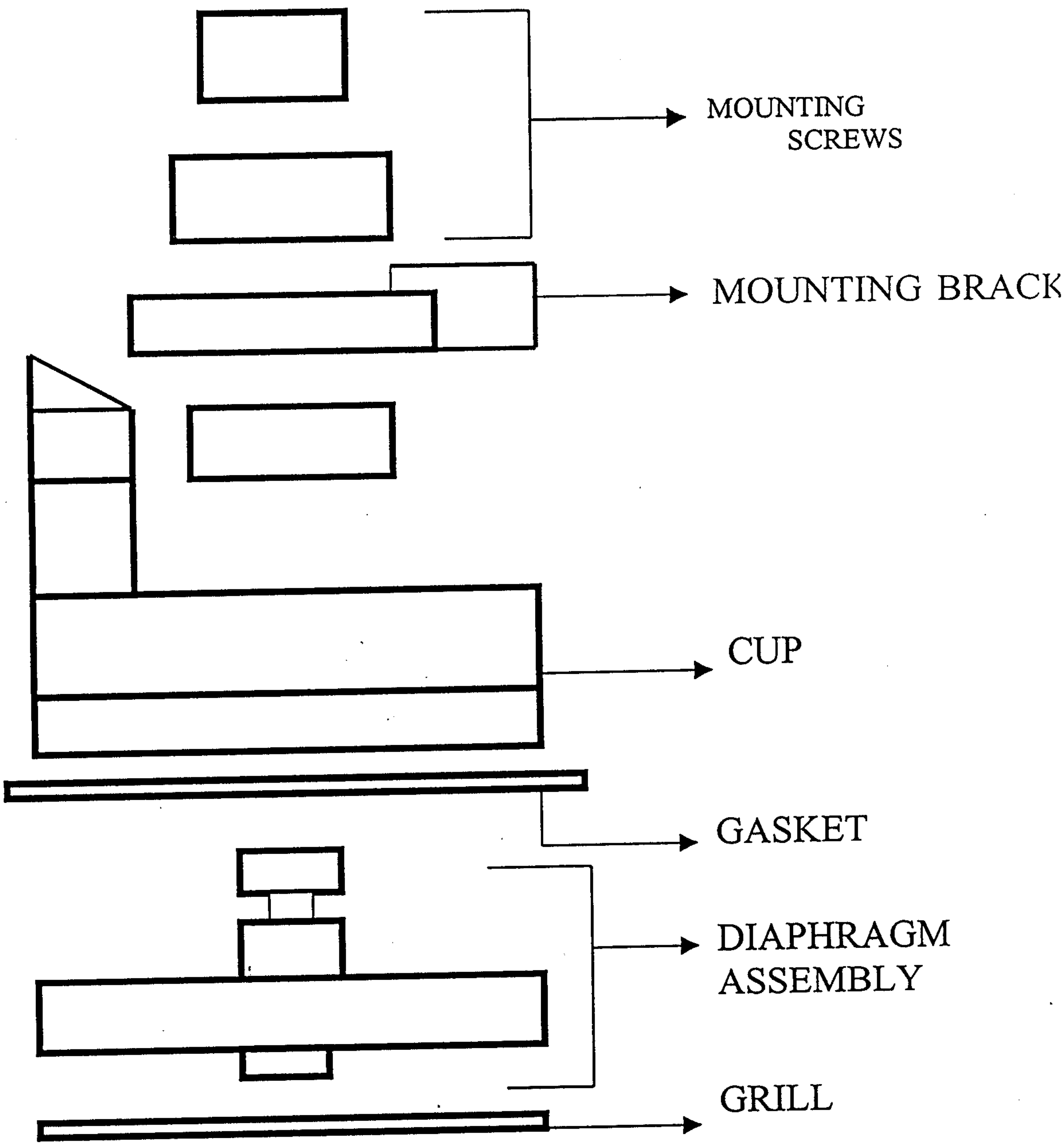

FIG-2.1. EXPLODED VIEW OF HORN

CHAPTER - 3

Power Unit Design

CHAPTER-3

Power System Design

3.1. Power Supply Circuit Analysis

Power supplies, which are used extensively in industrial applications, are often required to meet all or most of the following specifications:-

1. Isolation between the source and load.
2. High power density for reduction of size and weight.
3. Controlled direction of power flow.
4. High conversion efficiently
5. Controlled power factor if the source is an Ac Voltage.

Depending on the type of output voltages, the power supplies can be categorized in to two types:-

1. Dc power supplies
2. Ac Power supplies

Testing of horns require a variable voltage regulated dc power supply with the following parameters:-

Voltage :- 24V, 36V, 48V, 72V

Current:- (0-20)A

To meet the above requirements, our power system has four sections, each section will provide a particular voltage. The basic circuit of each section consists of the following parts:-

(i) A MCB alongwith a fuse

(ii) Transformer unit

(iii) Bridge rectifying unit

(iv) Filtering unit

(v) Driver stage

Each unit of the sections have been clearly explained. Fig. 3.1 shows the power circuit.

3.2. Transformer Unit:-

3.2.1. Transformer Design Specifications

The Purpose of this unit is mainly for two reasons:-

a. Step-down the input Ac voltage

b. Isolation of the source and load.

As we require different voltages such as 24V, 36V, 48V, 72V, we have decide the transformer specifications and the way we have to connect them. For the first section where the output voltage required is 24v dc we use a single transformer with the following name plate details:-

Primary	Secondary
0v	32v
20v	24v
220v	18v
230v	12v
240v	0v

Next for the sections supplying 36V, 48V we use a combination of transformer used for the first section such that the sum of their output voltages equals 36V/48V.

3.2.2 Construction:-

A transformer is a static (or stationary) piece of apparatus comprising coils coupled through a magnetic medium connection two ports at different voltage levels in an electric system allowing the interchange of electric energy between the parts in either direction via the magnetic field. The most important tasks performed by transformers are

(i) Transfers electric power from one circuit to another.

(ii) It does so without a change of frequency

(iii) It accomplishes that by electromagnetic induction.

(iv) Where the two electric circuits are mutual inductive influence to each other.

(v) Matching source and load impedances for maximum power transfer in electronic & control circuitry.

(vi) Electrical isolation (isolating one circuit from another or isolating dc while maintaining ac continuity between two circuits).

The type of construction adopted for transformers is intimately related to the purpose for which these are to be used. The construction has to ensure efficient removal of heat from the two sets of heat generation, core and windings, so that the HMP rise is limited to the class of insulation employed.

To prevent damage to insulation, moisture must not be allowed. These two objectives are simultaneously achieved in power transformer by immersing the built up transformer in a closed tank filled with non-inflammable insulation oil called transformer oil. Power transformers are provided with a conservator through which the transformer breathes into atmosphere. The magnetic core of a transformer is made up of stacks of thin laminations of cold rolled grain oriented silicon steel sheets lightly insulated with varnish.

Before building the core, the punched laminations are annealed to relieve the mechanical stresses set in at the edges by the punching process, stressed materials has a height core loss. Two types of cores are core type & steel type. In core type construction the windings are would around the two edges of a rectangular magnetic core, in shell type windings are wound on the central leg of a three-legged core. The core type construction has longer mean length of core and shorter mean length of coil turn.

The core type is best suited for EHV (extra high voltage) requirement since there is better scope for insulation. The shell type construction has better mechanical support and good provision for bracing the windings. The shell type transformer required move specialized fabrications facilities than core type, while the latter the additional advantage of permitting visual inspection of oils in the case of a fault and case of repair at substation site. For these reasons, the present practice is to use the core type transformers in large high voltage installation.

3.2.3 Working:-

The voltage is induced in the transformer. The r.m.s. value of the inducted e.m.f. of transformer is

$$E = 4.44\ f\ N_1 \varphi max.$$

The ideal transformer is containing following characteristics.

(i) The primary and secondary windings have zero resistance. It means that there is no ohmic power loss and no resistive voltage drop in the ideal transformer.

(ii) There is no leakage flux so that all the flux is confined to the core and links both the windings.

(iii) The core has infinite permeability so that zero magnetizing current, is needed to establish the requisite amount of flux in the core.

(iv) The core-loss is considered zero.

The transformation ratio of transformer is given by

$$K = \frac{N_2}{N_1} = \frac{E_2}{E_1} \longrightarrow \quad (3.1)$$

'K' is transformation ratio.

N_2 sy winding turns

N_1 py winding turns

E_2 sy induced voltage in volts.

E_1 py induced voltage in volts.

The impedance on the secondary side when seen (referred to) on the primary side is transformed in the direct ratio of square turns. So in an ideal transformer voltages are transformed in the direct ratio of turns, currents in the inverse ratio and impedances in the direct ratio squared.

3.2.4 Transformer Losses:-

Core loss: These are hysteresis and eddy current losses resulting from alternations of magnetic flux in the core. The hysteresis loss is proportional to the frequency and (magnetic flux density). The eddy current loss is proportional to the square of frequency and the magnetic flux density.

Copper loss: This loss occurs in winding resistances when the transformer carries the load current.

Stray loss: It largely results from leakage fields including eddy current in the tank wall.

Dielectric loss: The seat of this loss is in the insulation materials, particularly in oil and solid insulations.

The rated capacity of a transformer is defined as the product of rated voltage and full load current on the output side. The power output depends upon the power factor of the load.

Here the capacity of transformer is 650KVA.

The voltage regulation is defined as the change in magnitude in secondary voltage, when full load of specified power factor supplied at rated voltage is thrown off.

It must be understood that a transformer is not an energy conversion device but a device that transforms electrical energy from one (or) more primary dc circuits to one (or) more secondary ac circuits with changed values of voltage and current.

However, depending on its applications, transformers have been classified to many varieties. Here we are using single phase step down core type transformer with 4 tappings in secondary. The tappings are connections provided at different places in the windings and therefore, the number of turns included in the circuit at one tap is different from the number of turns at another tap. Hence the turns ratio is different at different tappings and as different voltages and obtained at different tappings.

3.3. Bridge Network:-

The name comes from the similarity of connection to that used in the fundamental bridge circuit. The chief advantages of this circuit over the center tap type are the reduction in peak inverse voltage per diode and the improved utilization factor of the supply transformer.

When the transformer secondary terminal a is positive with respect to b, current starts flowing from terminal a, through diode -1, the load resistance and diode-4 to the terminal b. Again when b is positive with respect to a, conduction takes place from terminal b through diode -2, the load resistance and diode 3 to the terminal a. So in each half cycle, the circuit provides a path for current flow in an alternative direction through the supply, but in the same direction through the load.

Since the entire transformer is used in each half cycle, the total voltage of the secondary needs only be half as great as for the center tapped (transformer) rectifier for the same output voltage.

3.4 Filtering Network:-

Generally, a rectifier is required to produce dc supply for suing at various places in the electronic circuits. However, the output of a rectifier has pulsating character ie. it contains ac and dc components. The ac component is undesirable and must be kept away from the load. To do so, a filter circuit is used which removes the ac component and allows only dc component to reach the load.

We can use capacitor filer, because its low cost, small size, little weight and good characteristics.

Below figure shows a typical capacitor filter. It consists of a capacitor placed across the rectifier output, in parallel with load R_L. The pulsating direct voltage of the rectifier is applied across the capacitor. As the rectifier voltage increases, it charges the capacitor and supplies current to the load. At the end of quarter cycle, the capacitor is charged to the peak value of the rectifier voltage.

Now the rectifier voltage starts to decrease as this occurs the capacitor discharges through the load and voltage across it decreases as shown by the line AB in the fig. The voltage across load will decrease only slightly because immediately the next voltage peak comes and recharges the capacitor. This process is repeated again and again and the output voltage waveform becomes ABCDEFG. It may be seen that very little ripple is left in the output. Moreover, output voltage is higher as it remains substantially hear the peak value of the rectifier output voltage.

3.5 Driver Stage:-

The driver part consists of a parallel combination of power transistors. The regulation of the voltage is attained by the base control of these transistors. The steady state characteristics, switching characteristics and base drive control of power transistors have to be understood in order to realize their function in the power circuit.

Power transistors have controlled turn-on and turn-off characteristics. The transistors which are used as switching elements, are operated in the saturation region, resulting in low on-state voltage drop. The switching speed of modern transistors is much higher than that of thyristors and they are extensively employed in dc-dc and dc-ac converters. However, their voltage and current ratings are lower than those of thyristors and transistors are normally used in low to medium power applications.

The power transistor which we are using is a bipolar junction transistor (BJT) whose pin No. is ----- 2N3773.

3.5.1. Steady-State Characteristics

Although there are three configuration common-emitter, common collector and common-base , the common-emitter configuration for an NPN transistor is generally used in switching applications. There are three operating regions of a transistor: Cut-off, active and saturation. In the cut-off region, the transistor is off or the base current is not enough to turn it on and both junctions are reverse biased. In the active region the transistor acts as an amplifier, where the collector current is amplified by a gain and the collector emitter voltage decreases with the base current. In the saturation region, the base current is sufficiently high so that the collector-emitter voltage is low, the transistor acts as a switch. The steady state characteristics are shown in fig 3.3

3.5.2 Switching Characteristics

A forward biased PN-junction exhibits two parallel capacitances; a depletion-layer capacitance and a diffusion capacitance.

On the other hand, a reverse biased PN-junction has only depletion capacitance. Under transient conditions, they influence the turn-on and turn-off behavior of the transistor.

Due to these internal capacitances, the transistor does not turn on instantly. As the input voltage V_b rises from zero to V_1

And the base current rises to IB_1, the collector current does not respond immediately. There is a delay known as delay time td, before any collector current flows.

The base current is normally more than that required to saturate the transistor. As a result, the excess minority charge is stored in the base region. When the input voltage is reversed from V_1 to $-V_2$ and the base current is also changed to $-IB_2$, the collector 'IC' does not respond for a time, t_s, called storage time, when the extra charge is removed from the base. The switching characteristics of the power transistor is shown in fig 3.4.

3.5.3 Parallel Operation Of Transistors:-

Transistors are connected in parallel i+ one device cannot handle the load current demand. For equal current sharing, the transistors should be matched for gain, trans-conductance, saturation voltage, and turn-on time and turn-off time. The resistors will help current sharing under steady state conditions. Current sharing under dynamic conditions can be accomplished by connecting coupled inductors. If the current through Q_1 rises, the L(di/dt) across L_1 increases, and a corresponding voltage of opposite polarity is induced across inductor L_2. The result is a low-impedance path, and the current is shifted to Q_2. The inductors would generated voltage spiked and they may be expensive and bulky, especially at high currents. The circuit is shown in fig. 3.5

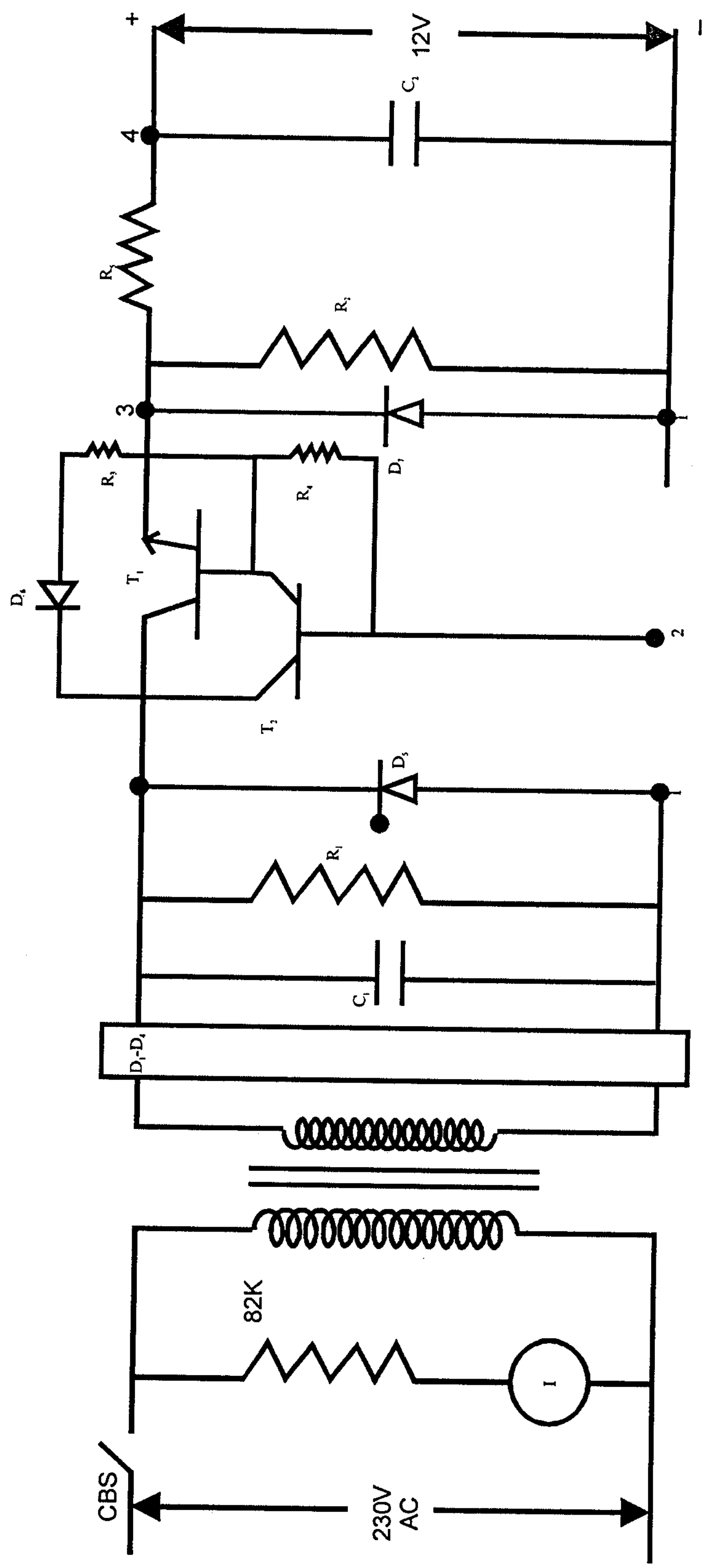

Fig 3.1. POWER CIRCUIT

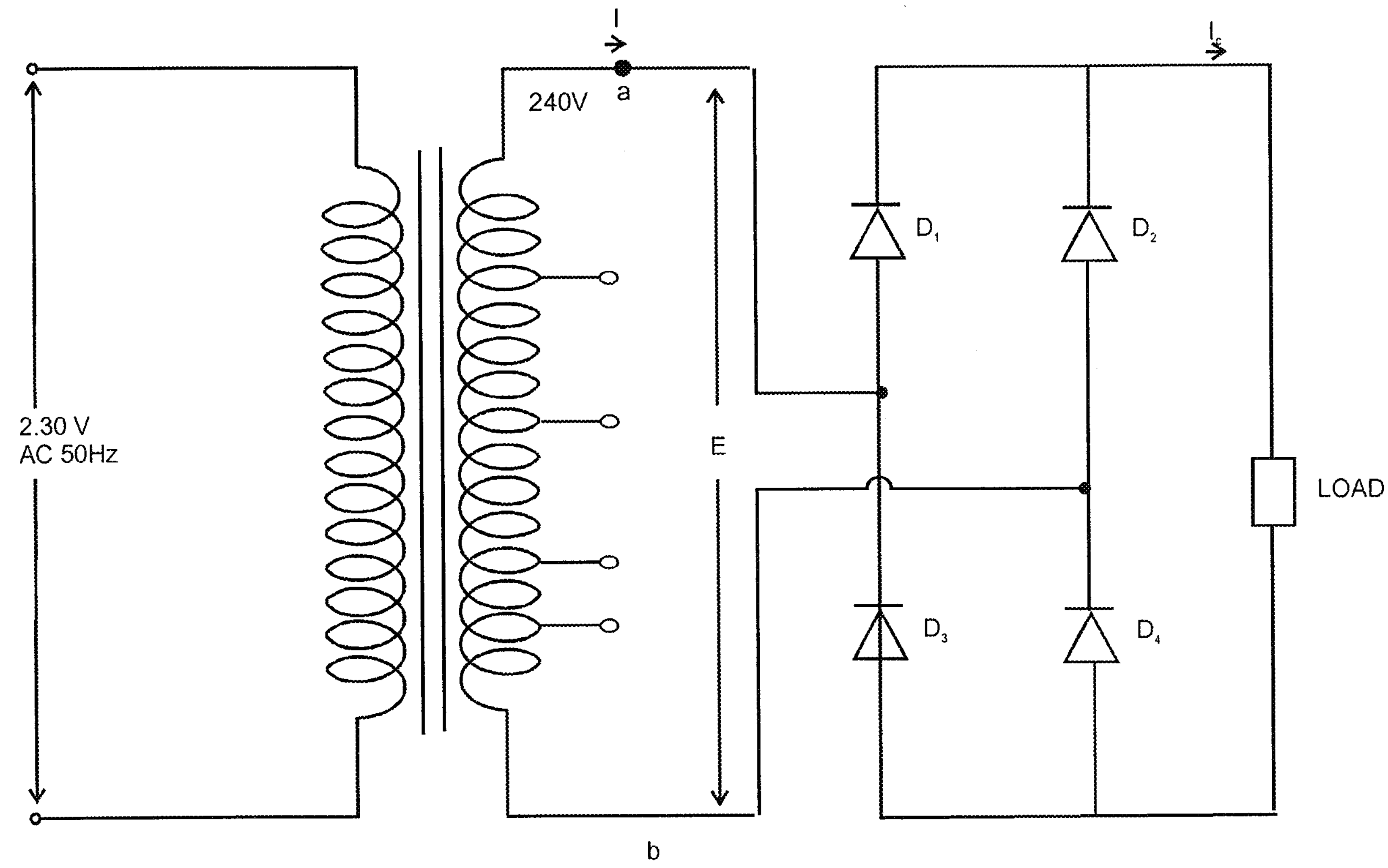

Fig. 3.2 Bridge Network

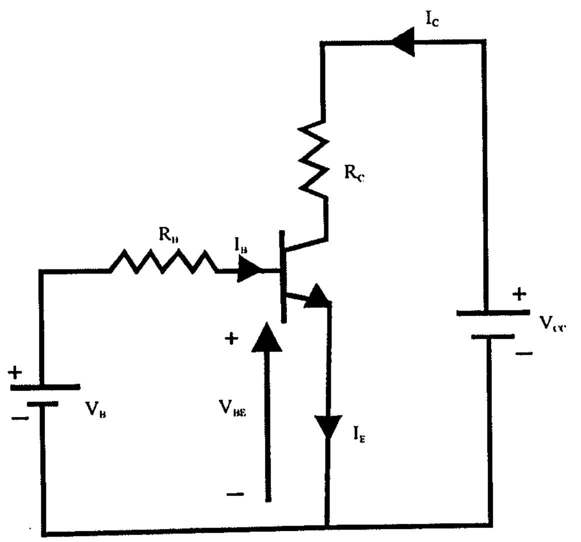

Fig. 3.3 (a) CIRCUIT DIAGRAM

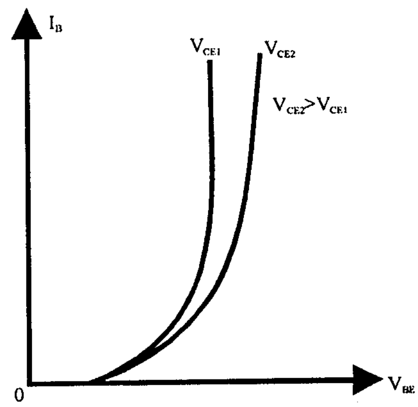

Fig. 3.3 (b) INPUT CHARACTERISTICS

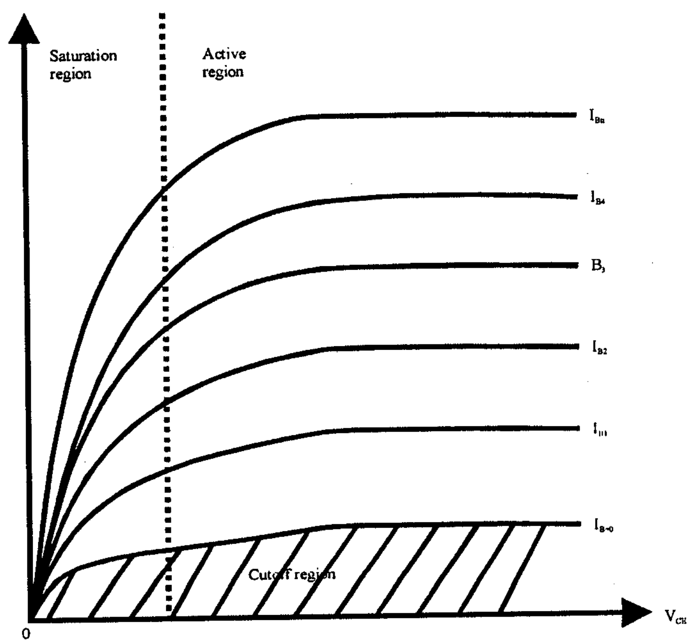

Fig. 3.3. (c) OUTPUT CHARACTERISTICS

Fig. 3.3. STEADY STATE CHARACTERISTICS

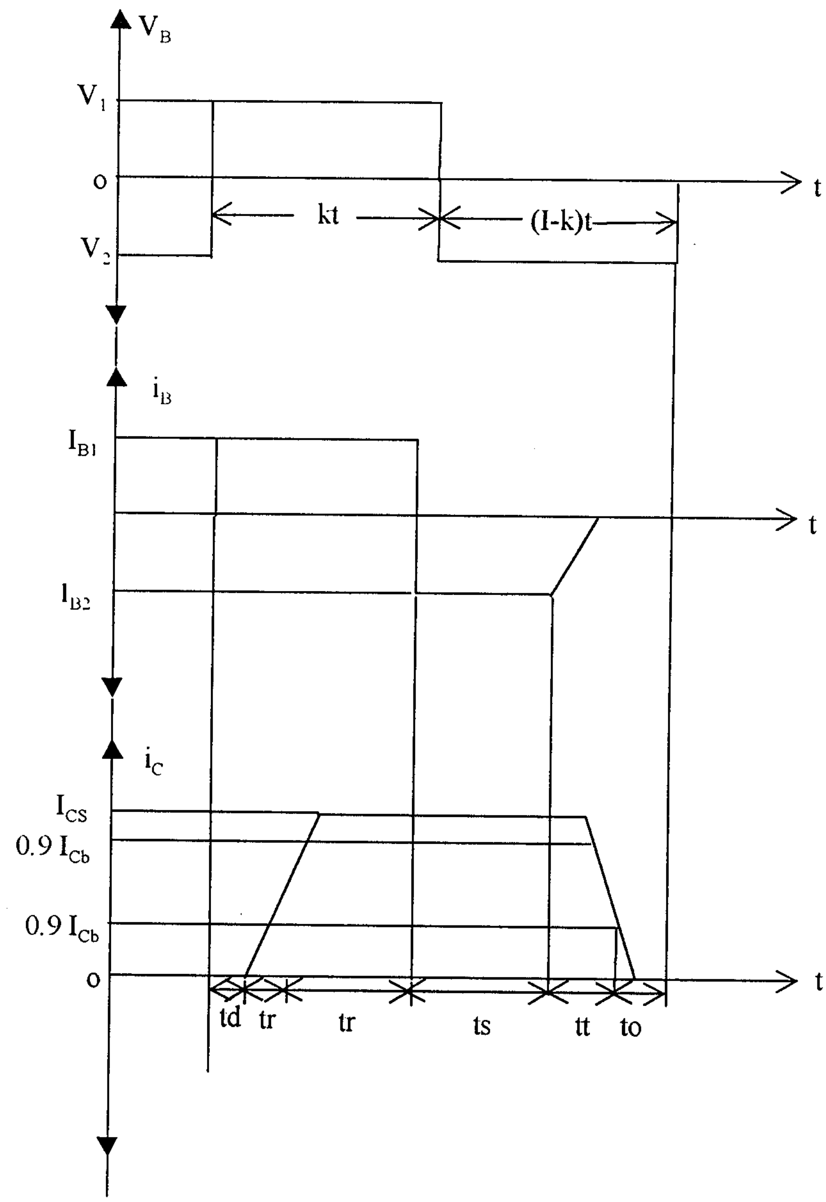

Fig. 3.4. SWITCHING CHARACTERISTICS

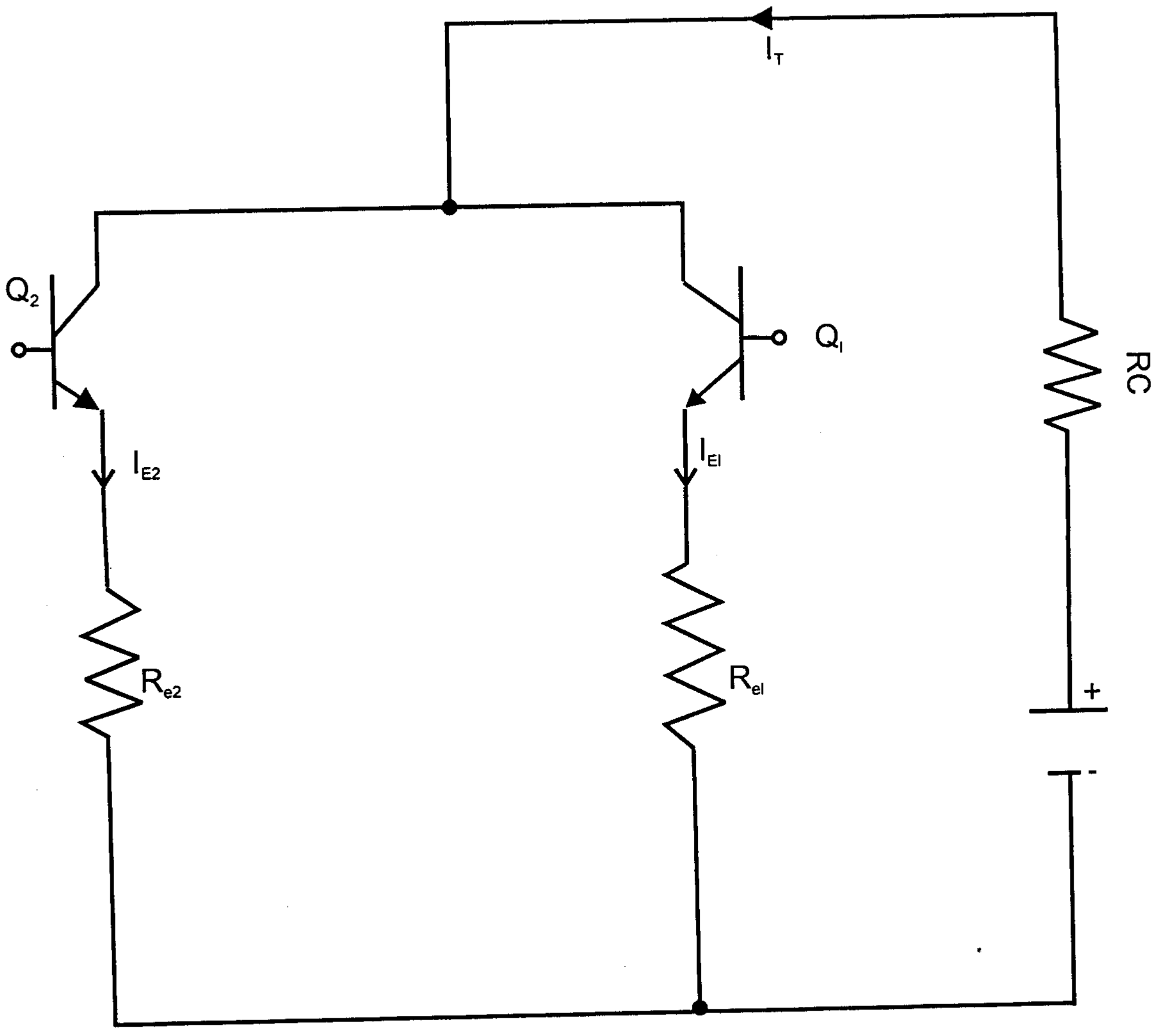

FIG. PARALLEL CONNECTION OF TRANSISTORS

CHAPTER - 4

Control Unit

CHAPTER – 4

Control Unit

4.1 Control Circuit Description :-

This control circuit is the processor of this circuit. It contains separate operational amplifiers for current and voltage operation. The operational amplifier 741 requires +ve and –ve supplies. For that purpose the +12 and –5v supply circuit is shown in a fig 4.1. The regulator I C's IC 7905, IC 7812 are used here for get –5v and +12 v respectively.

The constant voltage operation is obtained by a potential divider arrangement. The IC_1 is a differential amplifier and it senses (pin No.3 non inverting input) the output voltage continuously through a resistive potential divider chain. The No. 2 is tied to output positive through 1k resistor IC_2 is a current error amplifier and it senses the load current continuously by sensing the drop across the resistor 10mΩ.

This varies as soon as drop across 10mΩ resistance exceeds the set voltage level decided by the divider chain IC_2 sinks the drive of transistor T3, resistor (potential) 1k is for current limit adjustment and fine controls.

The control power supply consists of a transformer. In the input, 230v 1 ph Ac supply of 50H2 is given and the secondary of the auto-transformer is 18-0-18 V and is connected to a bridge rectifier which uses the diode IN4002. The output from the bridge network are connected through the IC regulators. The regulated supply which we obtain are +12 V and –5V and -12V and +5V.Fig. 4.2. shows the control power supply circuit.

The IC regulators have high reliability, reduced in size, economical. Examples of monolithic regulators are 78XX/79XX Series. The 78XX series are positive voltage regulators, 79XX are negative voltage regulators.

4.2. Study On Op-Amp:-

The operational amplifier is a multi-terminal device which internally is quite complex. The performance of an op-amp can be completely described by its terminal characteristics, and those of external components that are connected to it.

4.2.1. Circuit Symbol:- The circuit schematic of an op-amp is a triangle as shown in the figure. It has two input terminals and one output terminal. The terminal with a (-) sign is called inverting input terminal & that with a (+) sign is called the non-inverting input terminal.

There are three popular packages available.

(i) The metal can (TO) package.

(ii) The dual-in-line package (DIP)

(iii) The flat package or flat pack.

4.2.2. Op-Amp Terminals:-

The op-amps have five basis terminals, i.e., two input terminals, one output terminal and two power supply terminals. The significance of other terminals varies with the type of the op-amp.

The details of the op-amp terminals are shown in the figure as a DIP.

4.2.3 Ideal Operational Amplifier:-

An op-amp has two input signals V_2 and V_1 applied to the (-) input and the (+) input terminal respectively. This op-amp is said to be ideal if it has the following characteristics.

Open loop voltage gain, AOL $= \propto$

Input impedance $R_i = \propto$

Output impedance $R_0 = 0$

Bandwidth $B_w = \propto$

Zero offset, i.e. $V_0 = 0$ when $v_1 = v_2 = 0$. It can be seen that,

(i) an ideal op-amp draws no current at both the input terminals, (ie) $I_1 = I_2 = 0$. Because of infinite input impedance, any signal source can drive it and there is no loading on the preceding driver stage.

(ii) Since gain is $\propto$ the voltage between the + and – terminals, (ie) differential input voltage $V_d = V_1 - V_2$ is essentially zero for finite output voltage V_0.

The output voltage V_o is independent of the current drawn from the output as $R_0 = 0$. The output thus can drive an infinite number of other devices.

4.3 Operation Modes:-

4.3.1. Open Loop Operation Of Op-Amp:-

The simplest way to use an op-amp is in the open loop mode, which is shown in the figure, wherein signals V_1 and V_2 are applied at non-inverting and inverting input terminals respectively. Since the gain is infinite, the output voltage V_o is either at its positive saturation voltage (+

V_{sat}) or negative saturation voltage ($-V_{sat}$) as $V_1 > V_2$ (or) $V_2 > V_1$ respectively. The output assumes one of the two possible output states, that is $+V_{sat}$ (or) $-V_{sat}$ and the amplifier acts as a switch only. This has a limited number of applications such as voltage comparator, zero crossing detector, etc. which are discussed later.

4.3.2. Feed Back In Ideal Op-Amp:- The utility of an op-amp can be greatly increased by providing negative feedback.

The output in this case is not driver into saturation and the circuit behaves in a linear manner.

There are two basic feedback connections used. In order to understand the operation of these circuits, we make two realistic simplifying assumptions.

1. The current drawn by either of the input terminals is negligible.
2. The differential input voltage V_d between the non-inverting and inverting terminals is essentially zero.

4.4 Applications Of Op-Amp:-

4.4.1. The Inverting Amplifier:-

This is perhaps the most widely used of all the op-amp circuits. The circuit is shown in the fig.4.4.(a). The output voltage V_0 is fed back to the inverting input terminal through the R+-R_l network where R+ is the feedback resistor. Input signal V_l is applied to the inverting input terminal through R_l and non-inverting input terminal, of the op-amp is grounded.

4.4.2. The Non-Inverting Amplifier:-

If the signal is applied to the non-inverting input terminal and feedback is given as shown in the fig. 4.4.(b). the circuit amplifies without inverting the input signal. Such a circuit is called the non-inverting amplifier.

4.4.3. Voltage Follower:-

In the non-inverting amplifier of figure shown, if R_f=0 and R1=$\propto$, we get the modified circuit as shown, wherein $v_0 = v_l$ (ie) The output voltage is equal to the input voltage both in magnitude and phase, (ie) the output follows the input. Hence it is called the voltage follower. Its input impedance is very high and output impedance is zero. Hence it draws negligible current from source. Thus it is used as a buffer for impedance matching. Its circuit is shown in fig. 4.3.(a).

4.4.4. Differential Amplifier:-

A circuit that amplifies the difference between two signals is called a differential amplifier. This type of the amplifier is very useful in instrumentation circuits. The circuit is shown in the fig.4.3(b) for a differential amplifier

$$V0 = \frac{R_2}{R_1} (V_1 - V_2). \longrightarrow \qquad \text{Eqn.(4.1)}$$

Such a circuit is very useful in detecting very small differences in signals, since the gain R_2/R_1 can be chosen to be very large.

4.5. 741 Op-Amp:

741 OP-AMP has become an industry standard today. The complete schematic circuit diagrams and pin configuration for 741 is shown in the appendix. Since this circuit is quite completed compared to MC1530.

The input stage diff-amp consists of transistors Q_1-Q_3 and Q2-Q_4. Transistors Q_{16} and Q_{17} provide the second stage voltage gain. Transistors

Q_1Q_3 and Q_2Q_4 are in cascade (CE-CB) configuration. Two transistors in series (Q_1 feeds Q_3) provide high gain per stage needed to achieve the adequate open-loop gain in a two stage amplifier. The transistor Q_5, Q_6 and Q_7 form the active load for Q_3 and Q_4. Transistors Q_5 and Q_6 also function as a differential amplifier for the external offset null signal. Bias currents for the input stage are provided by a complicated arrangement of current mirror pairs. Q_{12} generates current in Q_{11}. This current is reflected over to Q_{10}. This in turn generates a series current in Q_9 which is reflected across another mirror pair to Q8. The bias current of Q_3 and Q_4 is effectively driven by the mirror pair Q_{10} and Q_{11}. The output of the first diff-amp is taken at the function of Q_4 and Q_6, which acts as a complementary symmetry amplifier. The output at this point is proportional to the differential input signal.

The output of the CC amplifier formed by Q_{16} and R_9 drives the CE – amplifier composed of Q_{17}, R_8 and a constant current load Q_{13}. The output of CE-amplifier is a bias source for transistors Q_{18} and Q_{19}. Transistors Q_{12} and Q_{13} form a current mirror and supply current to transistors Q_{17}, Q_{18} and Q_{19}. Transistor Q_{22} performs two functions.

It serves as a buffer between Q_{17} and Q_{20} and also provides a negative feedback to Q_{16}. The final output is taken at the junction of R6 and R7.

Transistors Q_{15}, Q_{21} and Q_{23} protect the circuit by limiting current to the output complementary stage. If the output current exceeds the safe limit, the voltage drop across R_6 and R_7 increases. This turns on Q_{15} and Q_{21}, which in turn makes Q_{23} on. This turns off the amplifier $Q_{16} - Q_{17}$, which reduces the IE in Q_{22} and in turns in Q_{18} and Q_{19}. Hence, this lowers, the currents in Q_{14} and Q_{20}. The diode-connected transistor Q_{24} is a temperature compensation diode for transistor Q_{23}. Finally the internal 30 – PF capacitor provides the high frequency roll-off to stabilize the circuit.

4.6. Voltage Regulators:-

A Voltage regulator is an electronic circuit that provides a stable de voltage independent of the load current, temperature and ac line voltage variations.

This voltage is used for powering other electronic circuits. The voltage regulator should be capable of providing substantial output current.

4.6.1 Types Of Regulators

The voltage regulators can be classified as

- Series Regulator
- Switching Regulator.

4.6.2. Series Regulator:-

Series regulators use a power transistor connected in series between the unregulated dc input and the load. The output voltage is controlled by the continuous voltage drop taking place across the series pass transistor. Since the transistor conducts in the active or linear region, these regulators are also called the linear regulators. Linear regulators may have fixed or variable output voltage and could be positive or negative. The schematic, important characteristics, data sheet, short circuit protection, current fold back, for linear regulators such as 78XX series, are discussed.

4.6.3. Switching Regulators:-

Switching regulators, on the other hand, operate the power transistor as a high frequency on/off switch, so that the power transistor does not conduct current continuously. This gives improved efficiency over series regulator.

4.6.4. Series Op-Amp Regulators:-

A Voltage regulator is an electronic circuit that provides a stable dc voltage independent of the load current, temperature and ac line voltage variations. The fig. 4.5. shows a regulated power supply using discrete components.

The circuit consists of the following four parts:-

1. Reference voltage circuit
2. Error amplifier
3. Series pass transistor
4. Feedback network.

It can be seen from the figure that the power transistor Q_1 is in series with the unregulated dc voltage V_{iu} and the regulated output voltage V_o.

So it must absorb the difference between these two voltages whenever any fluctuation in output voltage V_o occurs. The transistor Q_1 is also connected as an emitter follower and therefore provides sufficient current gain to drive the load. The output voltage is sampled by the R_1-R_2 divider and fed back to the (-) input terminal of the op-amp error amplifier. This sampled voltage is compared with the reference voltage

V_{ref}. The output V_o of the error amplifier drives the series transistor Q_1.

If output voltage increases, say due to variation in load current, the sampled voltage β V_o also increases where

$$\beta = R_2/(R_1+R_2)$$

This in turn reduces the output voltage V_0 of the diff amp due to the 180 phase difference provided by the op-amp amplifier. V_o is applied to the base of Q_1, which is used as an emitter follower. So V_o follows V_0', that is V_o also reduces.

Hence the increase in V_o is nullified. Similarly, reduction in output voltage also gets reduced.

4.7. IC Voltage Regulators:-

With the advent of micro-electronics, it is possible to incorporate the complete circuit of a regulated power supply on a monolithic silicon chip.

4.7.1. Fixed Voltage Series Regulators:-

78XX series are these terminal, positive fixed voltage regulators. There are seven output voltage options available such as 5,6,8,12,15 and

24v. In 78XX the last two numbers (XX) indicate the output voltage. This 7815 represents a 15v regulator. There are also available 79xx series of fixed output, negative voltage regulators, which are complements to the 78xx series devices. There are two extra voltage options of –2v and –5.2v available in 79XX series. These regulators are available in two types of packages.

The fig. 4.6. shows the standard representation of monolithic voltage regulator. A capacitor C_i (0.33MF) is usually connected between input terminal and ground to cancel the inductive effects due to long distribution heads. The output capacitor C_o (1 μF) improves the transient response.

4.7.2. Features of IC Regulator

1. V_0: The regulated output voltage is fixed at a value as specified by the manufacturers. There are a number of models available for diff. Output. Voltage for ex, 78xx series has output voltage at 5,6,8 etc.

2. $|V_{in}| \geq |V_0| + 2$ volts ; The unregulated input voltage must be atleast 2v more than the regulated output voltage. For ex, Vo = 5v then Vin = 7V.

3. I(0) max : The load current may vary from 0 to rated maximum output current.

The IC is usually provided with a heat sink. Otherwise it may not provide the rated maximum output current

4. Thermal shut down: The IC has a temperature sensor (built in) which turns off the IC when it becomes too not (usually 125 C to 150 C) The output current will drop and remain there until the IC has cooled significantly.

5. The diodes D_{21} and D_{22} in the control power supply circuit, is to protect the regulator against the short circuit occurring at its input terminals.

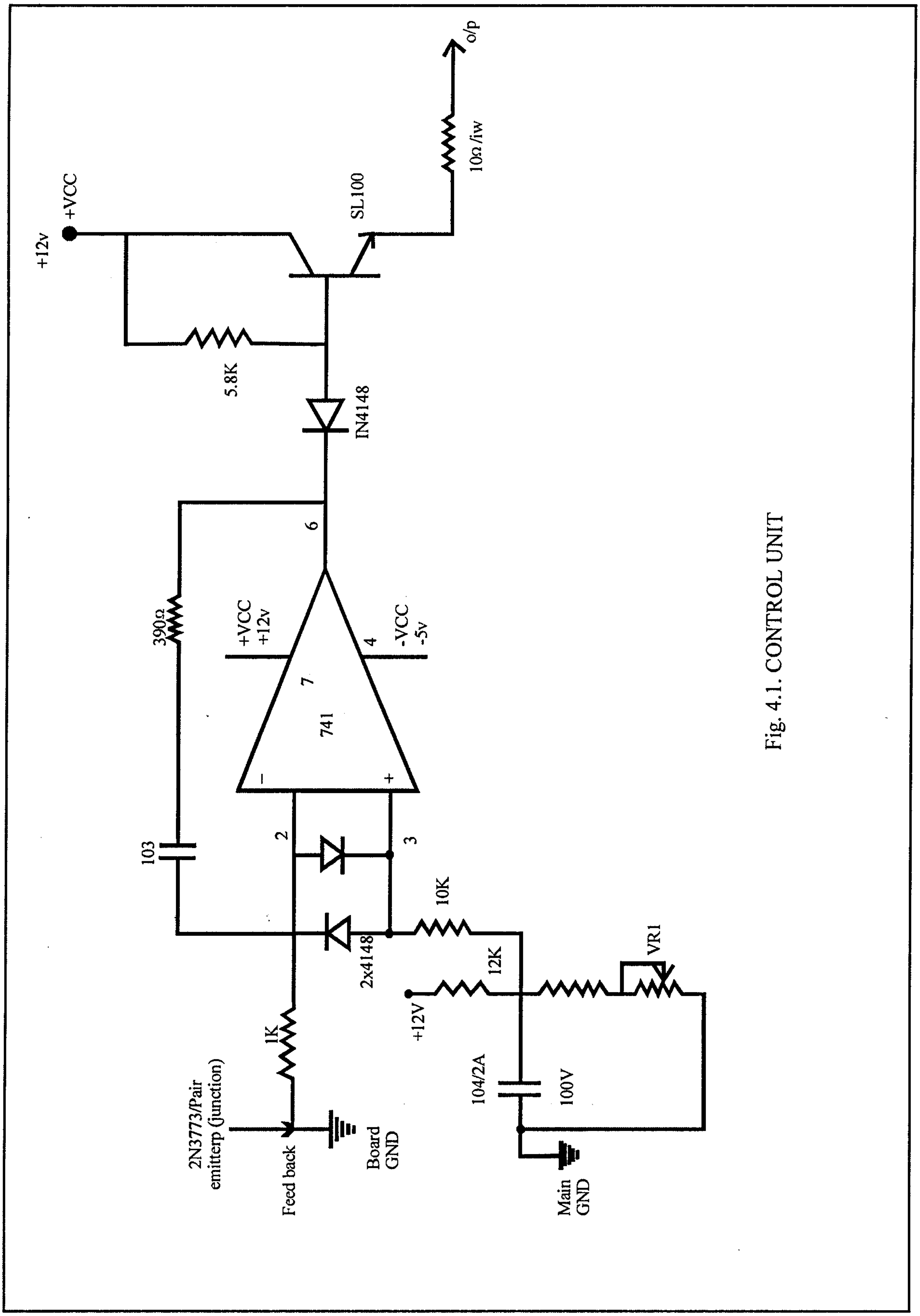

Fig. 4.1. CONTROL UNIT

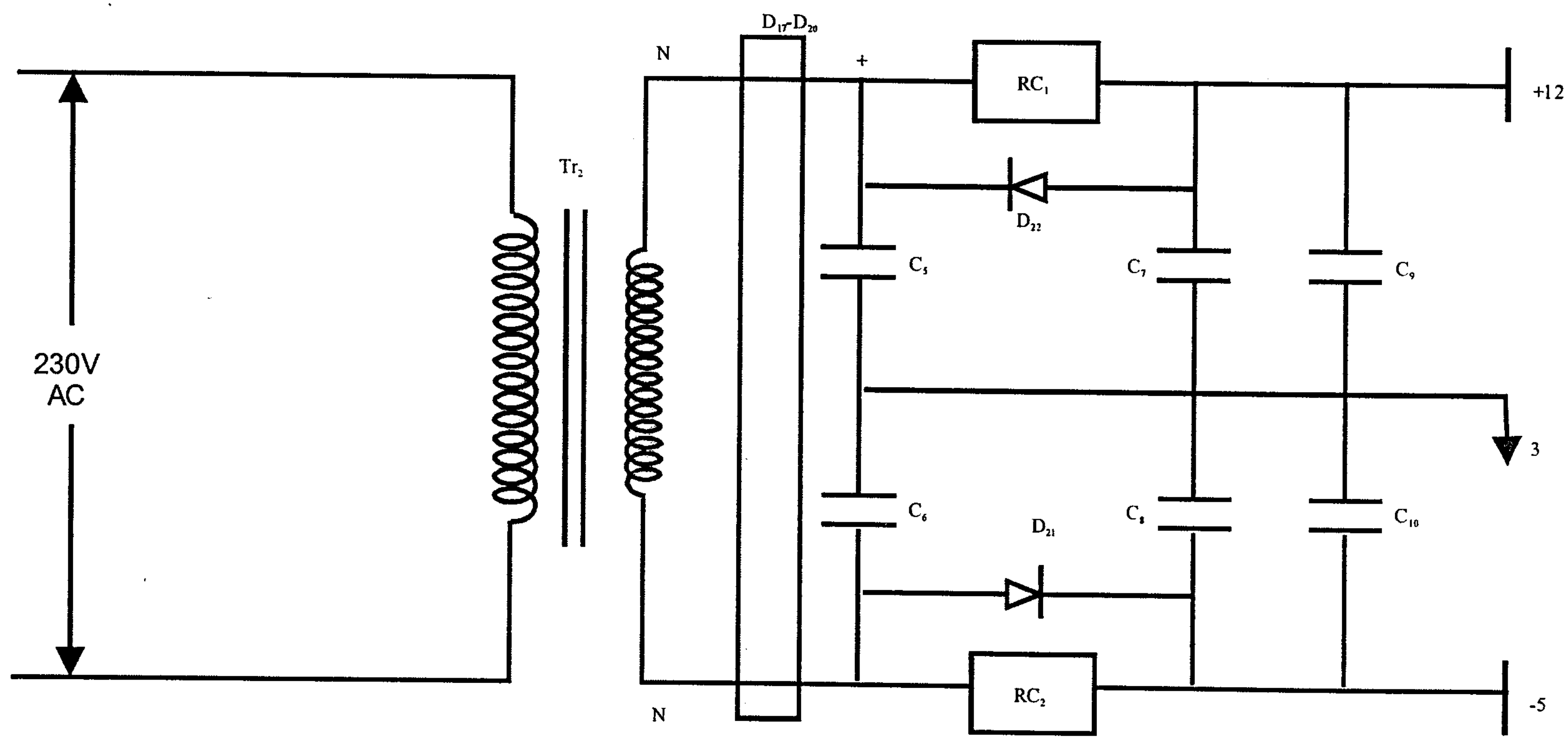

Fig. 4.2. CONTROL CIRCUIT POWER SUPPLY

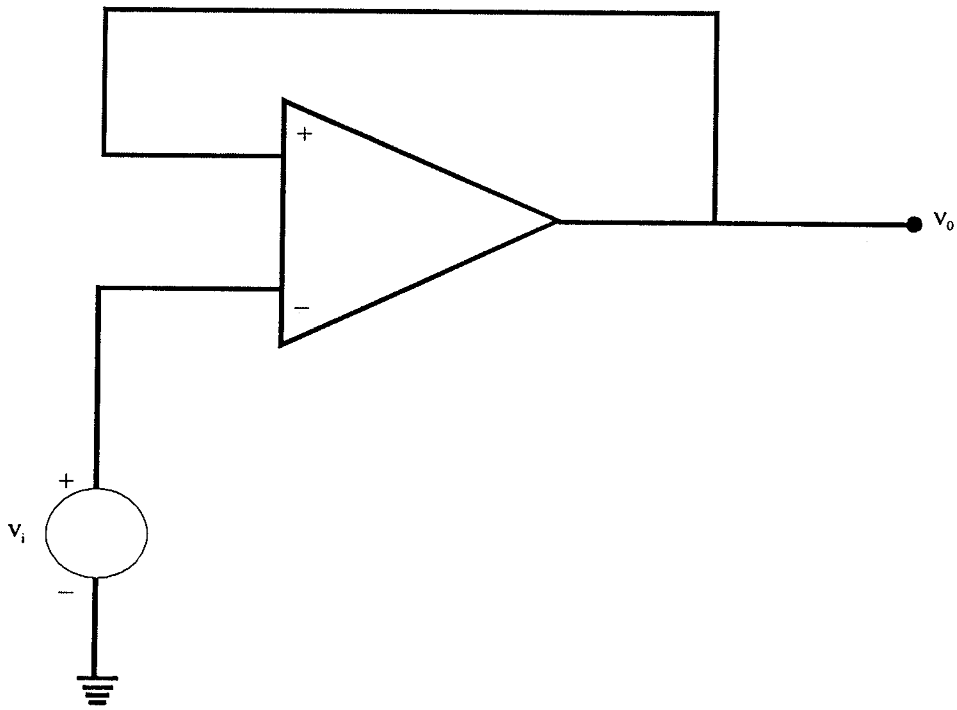

Fig. 4.3 (a) VOLTAGE FOLLOWER

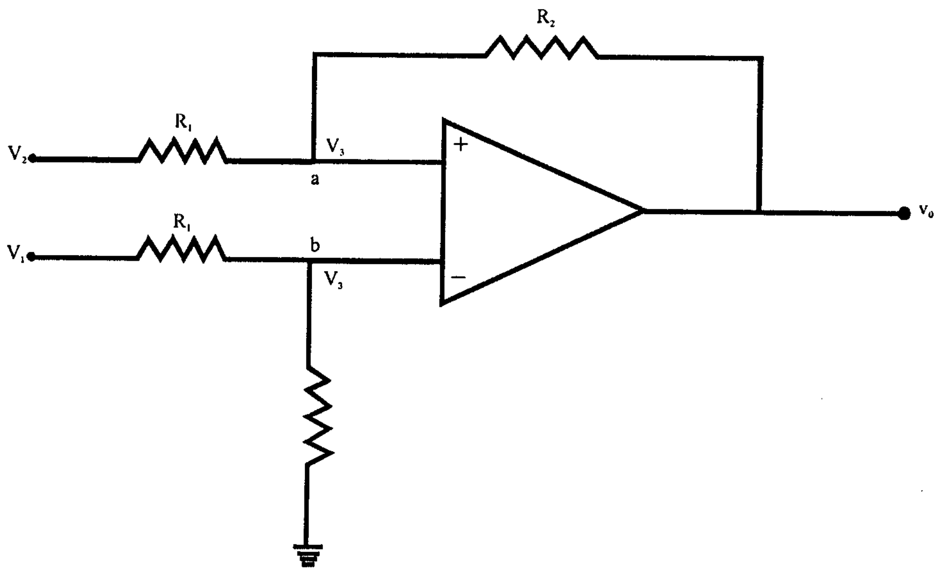

Fig. 4.3 (b) DIFFERENTIAL AMPLIFIER

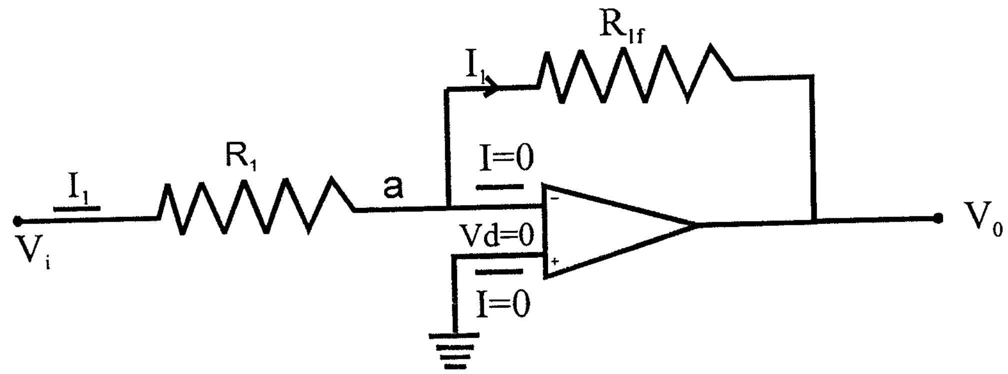

Fig. 4.4. (a)INVERTING AMPLIFIER

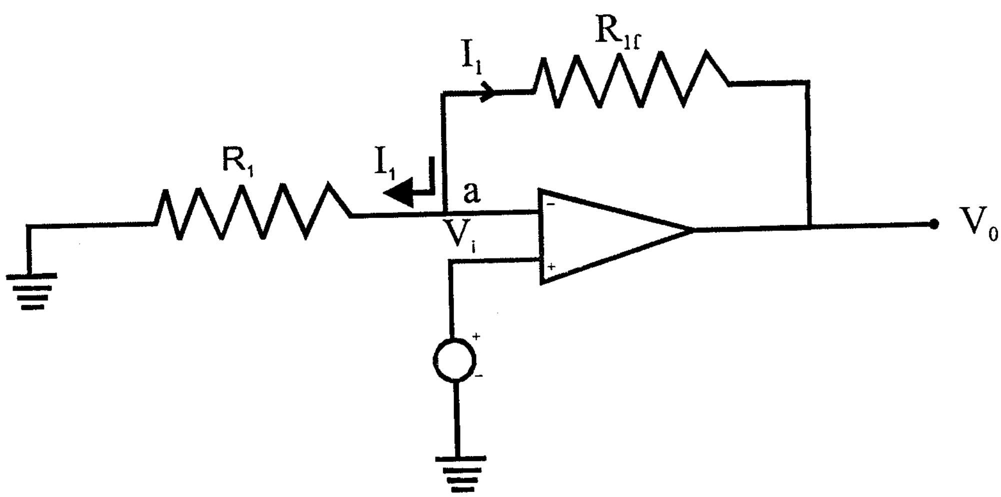

Fig. 4.4 (b) NON - INVERTING AMPLIFIER

Fig. 4.4 APPLICATIONS OF OP-AMP

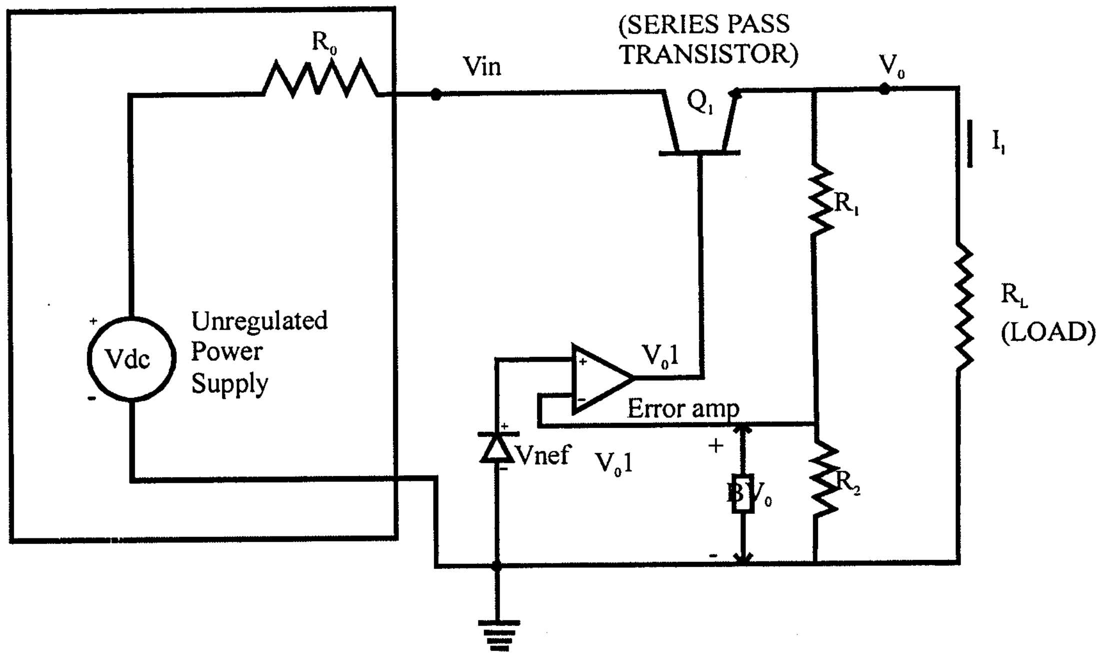

Fig. 4.5. A REGULATED POWER SUPPLY

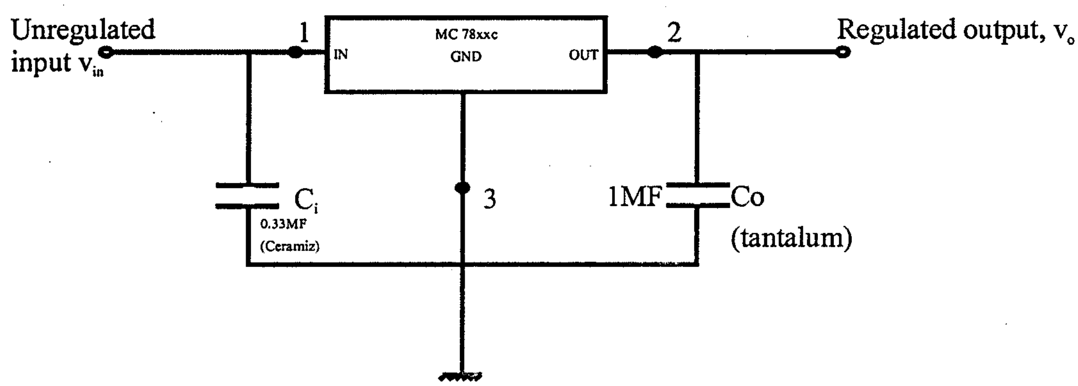

Fig. 4.6 3- TERMINAL MONOLITHIC REGULATOR

CHAPTER - 5

Over - Current Protection and Timer Control

CHAPTER –5

Overcurrent Protection And Timer Control

5.1 Current Sensing Circuit:-

The current sensing circuit is used for over-current protection for horns. The circuit consists of two buffer amplifiers and a comparator circuit. The output of the comparator is connected to the base of a transistor, through a diode. When the transistor is switched on, then a relay operates to start a buzzer, turn on a LED and to switch off the supply for three seconds with the help of a preset timer. The fig. 5.1 shows the over current protection circuit

The IC op-amp used is TL082 which is a dual op-amp. The current setting is done using a 1MΩ pot. A SL100 transistor is used to energize the relay. The forward resistance that is used is 10mΩ. The current setting is made by the error-amplifier whose resistance is varied. The fig. shows the buzzer relay circuit.

5.2 Timer Control :-

This circuit is used to pre-set the ON/OFF duty cycles of the supply to the horn. The control is obtained using two timers (IC555) is astable mode and a static dc switch.

The power system has two modes of operation

(i) Direct Mode

(ii) Timer mode

In direct mode the power is directly supplied to the load i.e., horn. Whereas in timer mode the supply is controlled by preset on/off times. The circuit diagram is shown in fig. 5.3.

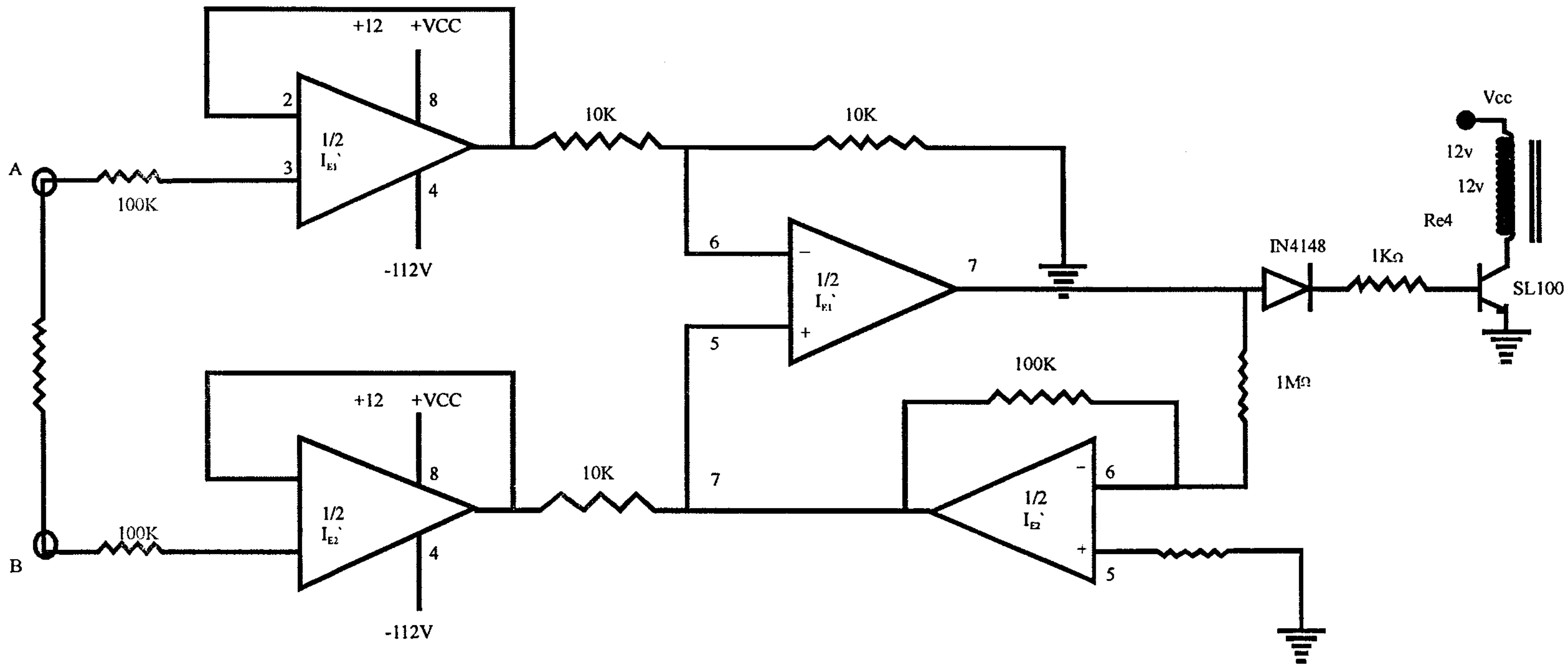

Fig. 5.1. OVER CURRENT PROTECTION CIRCUIT

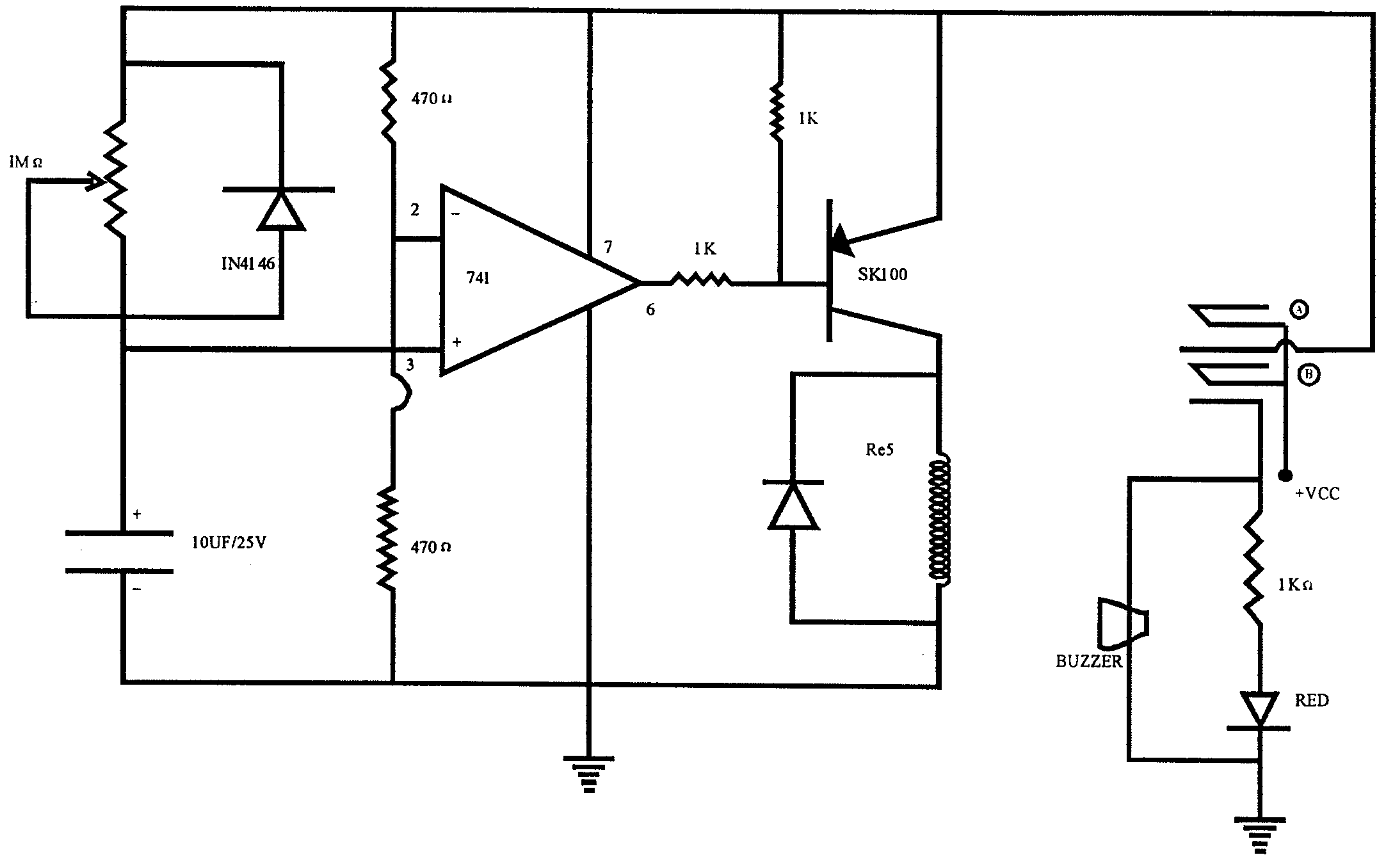

Fig. 5.2. BUZZER CIRCUIT

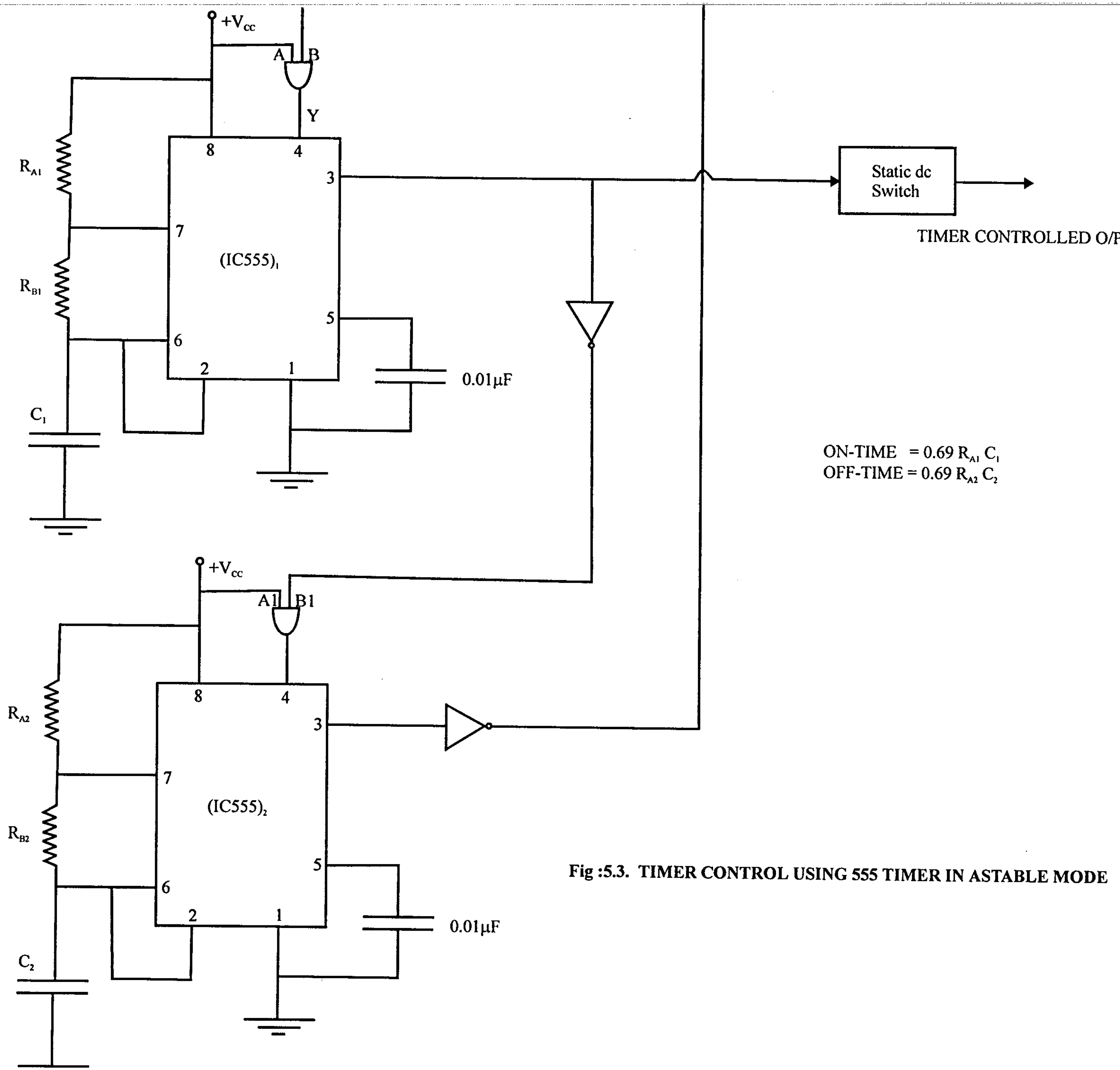

Fig :5.3. TIMER CONTROL USING 555 TIMER IN ASTABLE MODE

CHAPTER - 6

Conclusion

CHAPTER –6

Conclusion

The power unit design and control for endurance testing of horns has been done and installed. The system is capable of providing supply for various ratings of horns such as 24V, 36V, 48V, 72V. This has improved the production rate. This also proves to be an economical way of testing horns simultaneously with pre-determined switching times. The provision for frequency testing is another feature.

6.1 Further Scope:

In future, complete computerization of the power unit for testing horns with the help of interfacing the I/O to the PC can be used to improve the efficiency of the testing system.

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References

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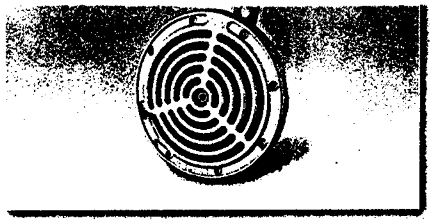
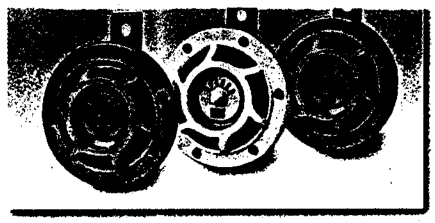
Appendices

Appendix for Horn Ratings



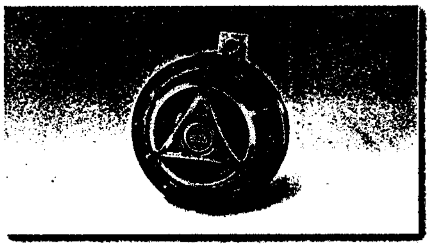
MEGASONIC

Voltage	: 12V, 24V
Current Consumption	: 4.0A, 3.0A
Fundamental Frequency	: High Tone : 395 Hz
	Low Tone : 315 Hz
Sound Pressure Level	: 125dB(A)
Weight in Kg	: 1.25
Recommended to use in	: Truck, LCVs



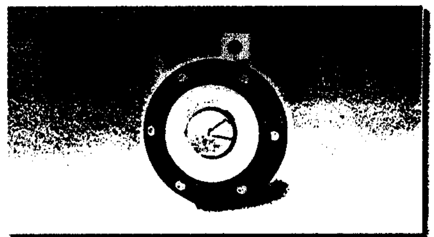
ROOTS SPIDER (available in 6 colours)

Voltage	: 6V, 12V, 24V
Current Consumption	: 5.0A, 4.0A, 2.5A
Fundamental Frequency	: High Tone : 455 Hz
	Low Tone : 405 Hz
Sound Pressure Level	: 114dB(A)
Weight in Kg	: 0.480
Recommended to use in	: Motor cycle, Car, Jeep, Van



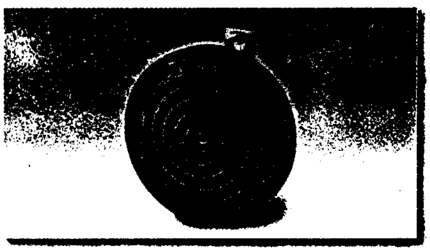
VIBROSONIC DELUX

Voltage	: 6V, 12V, 24V
Current Consumption	: 6A, 3.5A, 2.0A
Fundamental Frequency	: High Tone : 400 Hz
	Low Tone : 325 Hz
Sound Pressure Level	: 120dB(A)
Weight in Kg	: 0.950
Recommended to use in	: Car, Jeep,Truck, LCVs



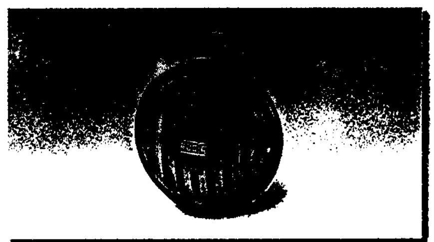
CLEARTONE DELUX

Voltage	: 6V, 12V, 24V
Current Consumption	: 3.5A, 2.5A, 2.0A
Fundamental Frequency	: High Tone : 445 Hz
	Low Tone : 405 Hz
Sound Pressure Level	: 112dB(A)
Weight in Kg	: 0.470
Recommended to use in	: Motor cycle, Car, Jeep, Van



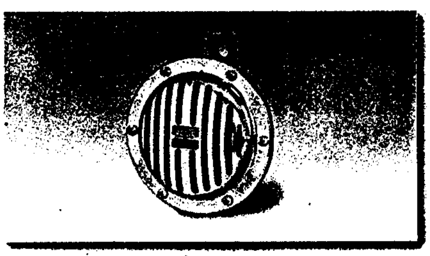
SUPERSONIC

Voltage	: 6V, 12V, 24V
Current Consumption	: 6A, 3.5A, 2.0A
Fundamental Frequency	: High Tone : 400 Hz
	Low Tone : 325 Hz
Sound Pressure Level	: 120 dB(A)
Weight in Kg	: 1.09
Recommended to use in	: Car, Jeep,Truck, LCVs



FD4 DELUX

Voltage	: 12V, 24V
Current Consumption	: 4.0A, 3.0A
Fundamental Frequency	: High Tone : 420 Hz
	Low Tone : 335 Hz
Sound Pressure Level	: 111dB(A)
Weight in Kg	: 0.40
Recommended to use in	: Car, Jeep,Van

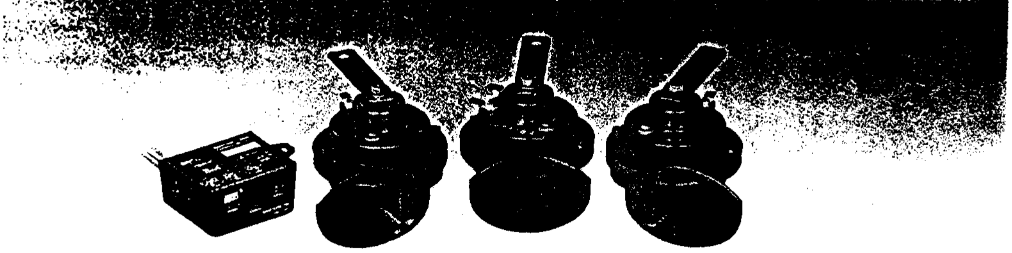


VIBROSONIC

Voltage	: 6V, 12V, 24V
Current Consumption	: 6A, 3.5A, 2.0A
Fundamental Frequency	: High Tone : 400 Hz
	Low Tone : 325 Hz
Sound Pressure Level	: 120dB(A)
Weight in Kg	: 0.985
Recommended to use in	: Car, Jeep,Truck, LCVs

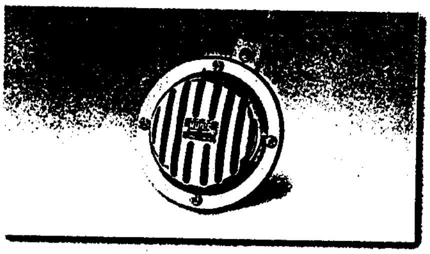
FC4

Voltage	: 12V
Current Consumption	: 4.0A
Fundamental Frequency	: High Tone : 420 Hz
	Low Tone : 335 Hz
Sound Pressure Level	: 111dB(A)
Weight in Kg	: 0.350
Recommended to use in	: Motor cycle, Car, Jeep, Van



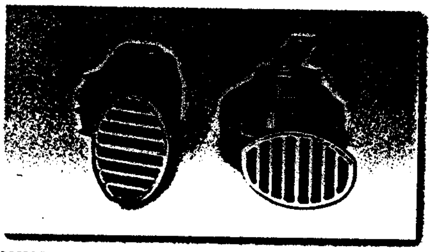
WINDTONE TRIO

Voltage : 12V
Fundamental Frequency : High Tone : 505 Hz
Midtone : 600 Hz
Low Tone : 425 Hz
Current Consumption : 4.0A
Sound Pressure Level : 110dB(A)
Weight in Kg : 1.0 (3 horns, 1 controller)
Recommended to use in : Car, Jeep, Van



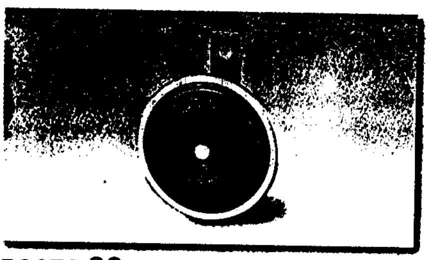
VIBRO MINI

Voltage : 6V, 12V
Current Consumption : 3.0A, 2.0A
Fundamental Frequency : High Tone : 400 Hz
Low Tone : 350 Hz
Sound Pressure Level : 110dB(A) Pair
Weight in Kg : 0.645 (Set)
Recommended to use in : Motor cycle, Car, Tractor



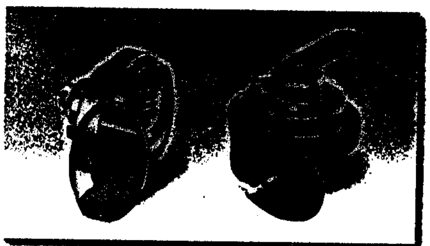
WINDTONE SUPER - DELUX

Voltage : 12V
Current Consumption : 4.0A
Fundamental Frequency : High Tone : 505 Hz
Low Tone : 425 Hz
Sound Pressure Level : 110 dB(A) Pair
Weight in Kg : 0.70 (Set)
Recommended to use in : Motor cycle, Car, Jeep, Van



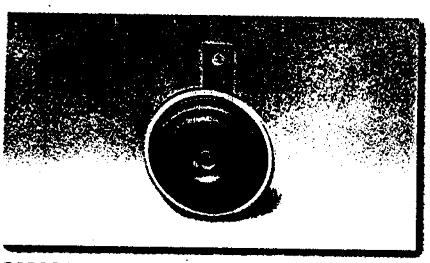
ROOTS 90

Voltage : 12V
Current Consumption : 3.0A
Fundamental Frequency : High Tone : 450 Hz
Low Tone : 350 Hz
Sound Pressure Level : 110dB(A)
Weight in Kg : 0.300
Recommended to use in : Car, Jeep, Van, Motor cycle



WINDTONE SUPER - SEALED

Voltage : 12V
Current Consumption : 4.0A
Fundamental Frequency : High Tone : 505 Hz
Low Tone : 425 Hz
Sound Pressure Level : 110dB(A) Pair
Weight in Kg : 0.70 (Set)
Recommended to use in : Motor cycle, Car, Jeep, Van



SMARTONE

Voltage : 12V
Current Consumption : 3.0A
Fundamental Frequency : High Tone : 430 Hz
Low Tone : 370 Hz
Sound Pressure Level : 110dB(A)
Weight in Kg : 0.250
Recommended to use in : Motor cycle, Car, Tractor

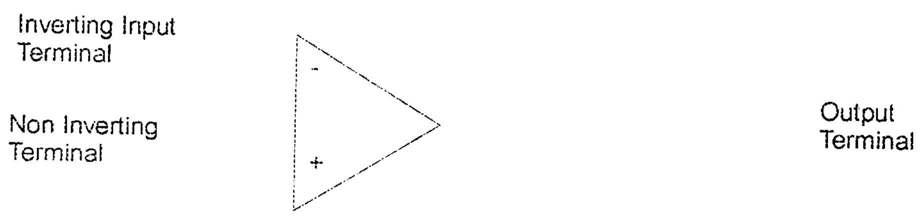
WINDTONE RAINBOW (5 colour combinations)

Voltage : 12V
Current Consumption : 4.0A
Fundamental Frequency : High Tone : 505 Hz
Low Tone : 425 Hz
Sound Pressure Level : 110dB(A)
Weight in Kg : 0.70 (Set)
Recommended to use in : Car, Jeep, Van, Motor cycle

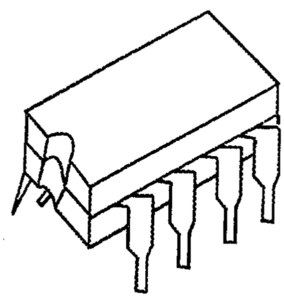
World class horns from India

Appendix for IC

Fig. a. OP - AMP Circuit Symbol :



b. Dual - In - Line Plastic Package :



C. 8 - Pin Mini DIP :