DESIGN AND CONSTRUCTION OF 200 WATTS AUDIO AMPLIFIER

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DEDICATION

This thesis is dedicated to Almighty God in whom I got my strength and to my lovely parents Lady Evang. Mrs. Abigeal Aderonke Oduntan and Chief. Com. Olawale Aremu Oduntan [JP]. This is a dream come true in your live.

DECLARATION

I, Oduntan Temitope Olatunde declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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To the creator of heaven and earth, you have been there for me all these while, giving me wisdom, knowledge and understanding. By your grace 'am doing all these. Thank you God.

I am indebted to my able project supervisor Eng. Majii. E. Eronu for his help and assistance throughout the duration of this project. May God bless u abundantly sir.

To my Dad I say you are one in a million father and to let u know that you are a blessing to me. To my Mum, just to let you know that you are a special gift to me from above. If not for both of you that always stand by me no matter what I will not be here today.

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Last but not the least, my guys in the class NLC say see you all at the top. Love you all.

ABSTRACT

Amplifier comprises of various classes. The were listed on some articles on net as class A, B, C, D, E, F, G, AB and other classes. Each class is defined in terms of the amount of bias which is applied to the transistor. Class A is permanently and fully biased on, but Class C only conducts for small part of the input cycle. In designing of this amplifier I adopted class AB. Its design is mainly to amplify sound input by using pre-amplify stage, differential amplify stage and power amplify stage [class AB]. The pre-amplify stage is mainly to build up the weak signal from music player or microphone, so that its amplitude can be amplify by the power amplifier. This amplifier is used to drive two speakers of 8Ω, 100 watts as out-put.

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CHARPTER FOUR: TEST, RESULT AND DISCUSSION

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CHAPTER ONE

INTRODUCTION

1.1INTRODUCTION TO AUDIO AMPLIFIER

The term amplifier is very generic. In general the purpose of an amplifier is to take an input signal and make it stronger (or in more technologically correct terms. Increase its amplitude). [1]

Therefore an amplifier can be define as an electronic circuit, which accepts input signal and produces an electrical output such that there is prescribed relationship between the input signal whether they are voltage or current, While amplification can be said to be the process whereby the power of a signal is increased without altering its original information carrying characteristics, which may be electronic, acoustical or in some other form. [4]

Amplifier finds application in all forms of electronic devices designed to perform any number of functions. There different type of amplifiers, each with a specific purpose in mind. For example a radio transmitter uses RF amplifier (RF stands for radio frequency); such an amplifier is design to amplify a signal so that it may drive an antenna. [2]

This research focused on audio amplifier (audio power amplifier)

1.2AUDIO AMPLIFIER

Audio amplifiers are those amplifiers which are design to drive loud speakers. in other words, they are designed to amplify the power of electrical signals in the audio frequency range (the range of frequency that can be detected by normal human ear.) the purpose of an audio amplifier in very simple terms is to take a signal device (typically wires from preamplifiers or signal processes) and make it suitable for driving a loud speaker. I the real world, no amplifier do exactly the ideal, but may do a very good job. it operated correctly

within their design power ratings. However no amplifier is 100% efficient so some of the energy from the wall outlet is wasted. the vast majority of the energy wasted by an amplifier shows up in form of heat, which is one of the greatest enemies to electronic equipments so it is important to ensure adequate air flow around equipments (especially so for those units using the convectional) most amplifier in the 200 watt per channel range and up have air cooling via fans built in the circuit in other to prevent excessive heat build up.

In audio amplification, the first stage is the input stage .the general purpose of the input stage of an audio amplifier is to receive and prepare the input signal for amplification by the output stage .the last stage is the output stage this portion actually converts the weak input signal into a much more powerful replica which is capable of driving high power voltage the speaker [3]

Audio amplification comes in different classes and each class whit peculiar characteristics that makes it suitable for particular application. They include class A class AB, class B, class C, class D, class E and other classes such as G, H, S, etc.

1.3PROJECT OBJECTIVES

It is the aim of this project to design and construct 200 watts audio amplifier that will have an efficient and effective means of amplifying sound to an audience within inclusive and in an open air. This has become very important due to the noisy atmosphere usually prevalent in most large gatherings, which tends to contribute to the corruption of the audibility of the person trying to make an address or pass across information. This is due to the limitation in human audio capacity that any individuals can discharge.

1.4 METHODOLOGY

The method used in designing and construction of this project is Modular design approach, which is subdivided into other different modules. All these matched together to achieve the objective of this project.

1.5 SCOPE OF STUDY

The scope of designing of this project is class AB audio amplifier and works from -15v to +15v.

1.6PROJECT OUTLINE

This project is based on the design and construction of 200 watts audio amplifier.

Chapter one contains the introduction of audio amplifiers, the aim and objective of the design, method adopted, scope of the project and project design out line.

Chapter two deals with the literature review and the theoretical background governing the design steps employed in the project work.

Chapter three deals with the project design and implementation.

Chapter four focuses on steps carried out to test the project, result obtained and the discussion of the result of the performance of the project.

Chapter five gives the summary of the work, the results obtained, problems encountered and how they were handled.

Figure below shows the completed block diagram of the 200 watts audio amplifier and all the stages involved.

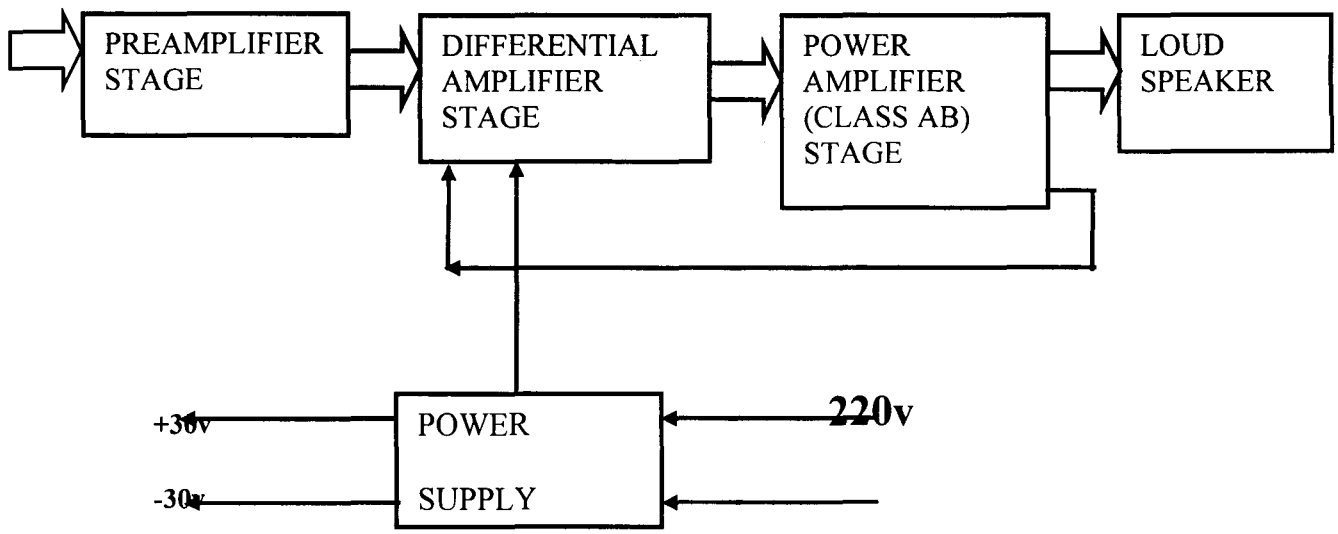


Fig. 1.1 Schematic Block Design of 200 watts Audio Amplifier.

CHAPTER TWO
LITERATURE REVIEW

2.1 THEORITICAL BACKGROUND

The contribution of communication into the modern world cannot be over emphasised when comparing the standard of living between the early ages with the present age we are now. In early days, audio amplifier used device called vacuum tubes. With the help of advancement in communication technology, communication has been made easy throughout the world. One cannot just imagine what world would have looked like, if there is no means of communication which amplification is part of. Broadcasting word-wide has been made easy. In order for information to be transmitted successfully from one source to other, amplification of the signal cannot be ruled out, it is necessary. [5].

In the early days of amplifiers, it is always difficult to design high quality audio output, which is very large, heavy and expensive. Modern amplifiers almost always use transistors (instead of tubes); in the late 60's and early 70's, the term "solid state" was used (and often engraved on the front panel as a "buzz word") [9]. The signal path in a tube amplifier undergoes similar processing as the signal in a transistor amplifier; however the devices and voltages are quite different. This gives rise to the invention or technological advancement that gives rise to the design of transistor power amplifier. Transistor amplifier are opposite of tube amplifier, it is of low voltage high current, smaller in size, more rugged (physically). It does not need any audio out put transformer. All amplifiers increase the amplitudes of the input signals. There are many types of amplifiers. The mode of their characteristic is based on [1].

1. TRASISTOR CONFIGURATION

(a) Common Emitter Amplifier

(b) Common Collector Amplifier

(c) Common Base Amplifier

2. **CLASSES OF AUDIO AMPLIFIER**

Class A

Class B

Class C

Class D

Class AB

Class E, F, G and etc. [1].

NUMBER AND STAGES

(a) single stage amplifier

(b) multistage amplifier

FREQUENCY RESPONSES

(a) radio frequency amplifier

(b) audio amplifier

The design of this project is audio amplifier making use of class AB. In order to reduce distortion and at the same time to maintain reasonably high conversion efficiency, it is usual bias the output transistor so that under quicent conditions they are not quite cut off. [8]

2.2 BRIEF HISTORICAL BACKGROUND

The first record player that was invented was a rotating drum, which made use of only the mechanical excitation of the needle in production of sound. It was the movement of the needle that were transferred to a diaphragm in a horn, which was the genesis of audio

amplifier. But along the line movement of the needle was converted into electrical signal which were amplified by means of vacuum tubes and fed to the loud speakers (loads). Tubes are generally high voltage, low current device, which are generally not very efficient and tends to generate a lot of heat. During the reigning of tube amplifier an audio out put transformer is always used due to the fact that the out impedance of a tube circuit is far too high to properly interface directly to a low impedance loud speaker. [1].

A 60 watts audio amplifier was designed and constructed previously having only one out put channel, because its design mode is only to drive a load through single channel. It makes use of non operational amplifier, but transistors and have just only single signal out put. (i.e. connected to only one speaker). [7].

Also, another 100 watts audio amplifier was designed and constructed using mainly transistors and operational amplifiers. This time around it has dual input signals, but just to drive a single load through only one out put channel. [5]

Due to the technical advancement in manufacturing and availability of electrical and electronic components an IC JRC 4558D was used in this project. Its composition is that of two operational amplifiers (i.e. it perform operation that two operational amplifier will perform). Its power rating is higher than the other two above project mentioned above and it has dual out put channel in which the speakers were connected to (i.e. two speakers). Each speaker was expected to be working with 100 watts per channel, which makes the additional of the two terminals to be 200 watts.

2.3 TRANSISTOR AMPLIFIER

In designing and construction of an amplifier transistor are the major basic building blocks. A transistor power is the amplifier which raises the power level of the signal that has audio frequency ranges. In the early age, transistors were made from doped germanium with other

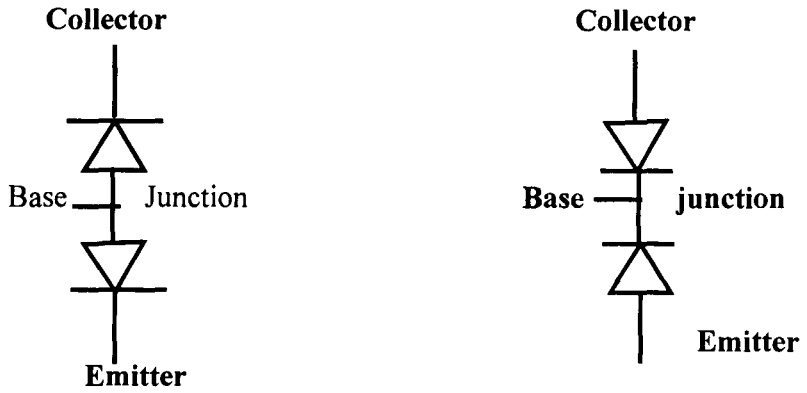
materials which gives the required properties for a semiconductor but in the modern age it has easy to make PNP and NPN transistors that are almost identical in performance from silicon. We have three elements in every transistor which are as follows:

EMITER: this only emits only electron in an NPN device.

BASE: this serves as the controlling terminal of the transistor.

COLLECTOR: this collects the emitted electrons.

The figure below can be used to represent a transistor, two diodes with a junction in the middle.



(a) NPN transistor signal unit (b) PNP transistor equivalent unit

Fig. 2.2 Analogue representation of transistors.

The above diagram representation is shown for both polarities. To make transistors operate effectively it is necessary to bias it correctly. It must be noted that the resistor determine the end point impedance of a transistor amplifier. [7]

2.4 TRANSISTOR CURRENT AMPLIFIER

In transistor circuit, the current amplifier is more common than in values and this is known as emitter followers or at times called common-collector. the voltage gain of an emitter follower circuit is less than 1 (or unity) .typically, the gain of an emitter follower circuits is about 0.95 to 0.99 depending on the operating current .using of a feed back to have this is very common and output impedances that is less than 1dm are very possible.

The standard configuration for an emitter follower current amplifier stage is shown in fig 2.3 .one of the greatest reason why transistor are having attraction is their flexibility , which is considerably enhanced by having two polarities of the device to work with.

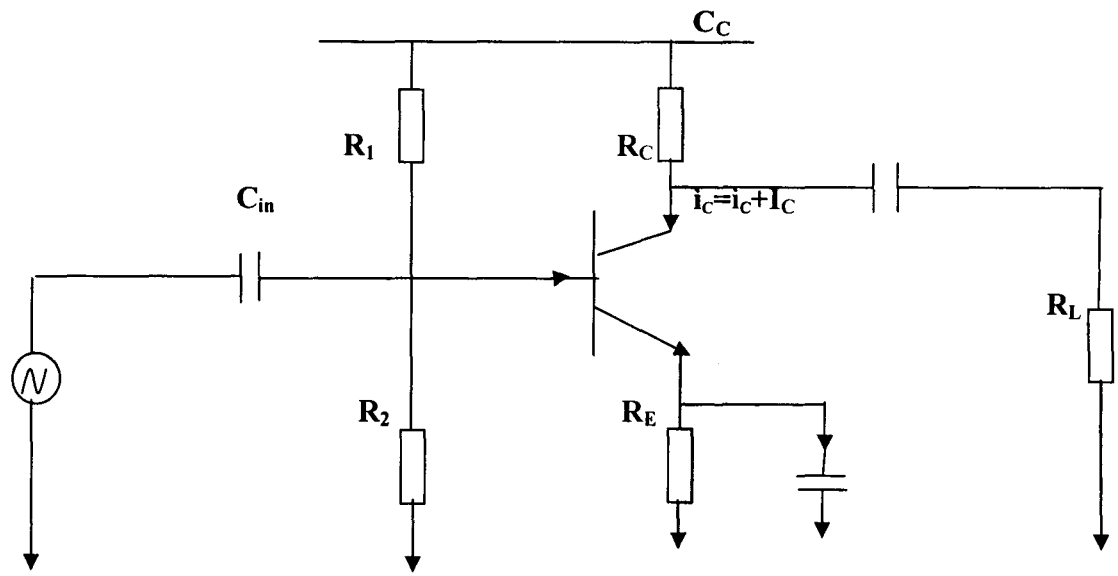


Fig 2.3 Standard configuration of an emitter follower current Amplifier.

The gain is another major characteristic of an amplifier i.e. the amount of amplification the device can provide. the gain of the amplifier is the ratio of ac output to the ac input signal there are adjustment of the gain in most amplifiers in order for the amplifier to be able to handle signals of different amplitudes .How this adjustment is made can be vary, the current may be adjustable and a fixed gain may be provided with a level adjustment before or after the gain stage .How this is established makes a difference, because a fixed gain amplifier is more easily overloaded if the gain adjustment is made after the gain stage instead of before.

All these characteristics described the gross level performances of amplifiers, but interest is how amplifier actually sound in practice. The general believe that any amplifier is completely distortion free and alters nothing from the original signal, but such amplifiers do not exist in then real world. Distortion, noise and so on contribute to the sound in amplifiers. [5]

2.5 AUDIO TRANSDUCER

In a simple term transducer is a device that do the conversion of a physical quantity into an electrical signal examples of transducer are microphones, loudspeaker and so on. These transducers are generally operates under linear input output conditions and with relatively small signals. A transducer may match to the input of the system with which it is design to work. At times this means ensuring maximum voltage transfer between transducer and system or (vice-versa) .sometimes we are only concerned with transforming of maximum power , but in all cases the impedance of the transducer compared with the input/output impedance of the system is a critical factor. E.g. microphone and an amplifier .where in a transducer, maximum voltage transfer occurs between an output transducer (e.g. microphone) and a system (e.g. amplifier) when the input I impedance of the system is much larger than that of the transducer .in an application system, the maximum transfer of a power system (e.g. an amplifier) to an output transducer (e.g. a loud speaker) occurs when the output impedance of the system equals to the impedance of the transducer. [5]

This are among the most critical of audio circuits, known as microphone amplifiers usually called pre-amplifiers. It is necessarily mandated that any signal recorded through a microphone must pass through a pre amp, definitely the sound recorded will contain any alteration generated by the preamp and its interaction with the microscope .at times, a specific pre amp and At times a specific preamps and the choice of the two may also change from one recording job to the other .sometimes the difference subtle and at times noticeable, so experimentation is very necessary. It is practically known that a good microphone should response more or less equally to all sounds in the in the frequency range of 20Hz to about 200Hz or else, the electrical signals it passes on for amplification and conversion back to sound by the output transducer e.g.(loudspeakers) will not be identical.

Sometimes it is believe that tube amplifiers are inherently different-sounding from solid-state amplifiers if circuit are properly designed and constructed their sound differences are relatively small. Both type of amplifier can produce quite and clean amplification or gritty distorted sound depending on the way the circuit are been implemented. in as much that both types of sound are at times durable we will have to make sure that we are able to select the type of amplifier that best suit the job we are trying to execute or accomplish. Voltage amplifier can be classified into many ways, it may be according to the gain element type, the circuit topology or the function of the device (mic preamplifier, power amplifier, etc) the circuit topology determines much of how circuit will sound .also amplifier can be can be classified according to what portion a soft ware the out put devices conduct current. The choice of amplifier can be made based on many reasons but the final decision is quality of sound. By understanding the performance characteristics of the particular amplifier we are using, we can then obtain the behaviour we desire [7]

2.6 NOISES

In electrical terms, noise can be defined as an unwanted signal which is present at the out point of a system or at any point within. it is very important and necessary in communication recovers that noise are kept to a minimum ,or else the out point information will be lost within the noise. In the real world we are, no amplifier does exactly the ideal but many do a very good job when operated within power ratings. The out put signal of amplifiers contain additional unwanted components that are not present in the input signal, these additional characteristics may be hurped together and are generally known as distortion.

There are many types of distortion, however the two most common type of distortion are known as harmonic distortion and inter-modulation distortion. in addition to the 'garbage' traditionally known as distortion ,all amplifiers generate a certain amount of noise which can

be heard as background 'hiss' when no music is playing. Another source of noise is interference from audio transmitters and this is called second channel and image channel interference. [1]

CHAPTER 3

DESIGN AND IMPLEMENTATION

3.0 DESIGN AND CONSTRUCTION MODE

The design and construction of a practical audio amplifier is done in phases (i.e. consist of stages), the first phase was when the components were laid on the bread board .the component were then bled and soldered according to the circuit diagram of 200 watts audio amplifier design. The meaning of audio is the range of frequency that human ear can hear, which extends from 20 Hz to 20 kHz. Therefore this project (200 watts audio amplifiers) amplifies electrical signal that have the frequency range that human ear can hear.

Each of the stages involved in designing and construction of this project were all mounted and soldered on the Vero board. Flexible wires were used where necessary to supply voltages to various necessary points. Where connections of two or more points were necessary flexible wire were used.

As specified in the departmental hand book the modular design approach was employed in designing and construction of this project work.

The casing of this project was made by using ply-wood. It was made in a square form, but at the top there were holes that were made for the purpose of free movement of air into and out of the amplifier, so that it will prevent it from damage that can be caused by overheating.

The design of this project was broken into different module as specified by departmental hand book, which makes the job easier.

3.1 OPERATING PRINCIPLE

The input signal in the audio amplifier is an electrical signal in form of voltage at low level. The variable resistors used as volume control and were used to control the input signal before

it enters the pre amplifier in other to prevent it from being over driven. The pre amplifier was connected to the low level signal source was responsible for noise filtering and frequency discrimination. Also it was responsible for presenting suitable input of output impedances and provides gain in other for the signal to be further processed without appreciable degradation in the signal –to-ratio. The voltage amplifier is design to achieve maximum voltage amplification. The next stage is power amplifier that is rendering necessary amplification to the output device. The output devices are two 8 ohms speakers.

Power Supply: The system adopted in designing the power unit of this project is called bridge voltage –doublers circuit. There are two half – wave circuits involved in the design. They were connected in way that conduction takes place through one diode during one half of the power cycle and the other diode at the second half of the cycle. The conduction diode is shown in graphical form in figure 3.1

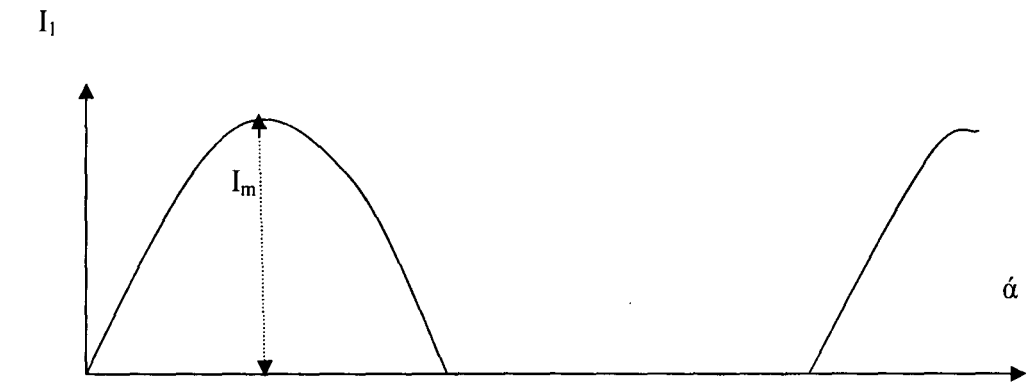


Fig 3.1a Current Wave-form in Positive Direction.

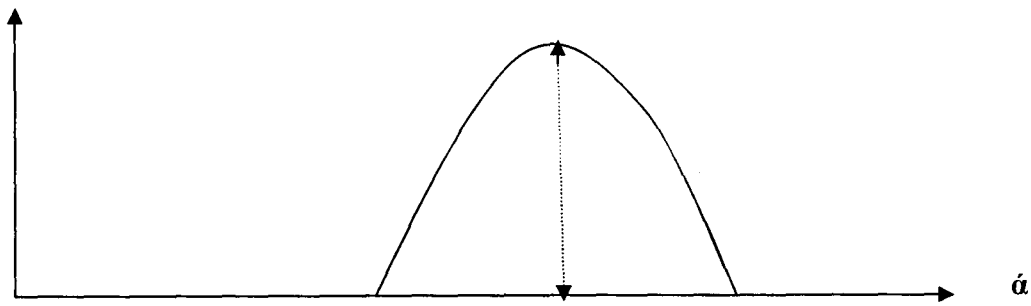


Fig.3.1b Current Wave form in Negative Direction.

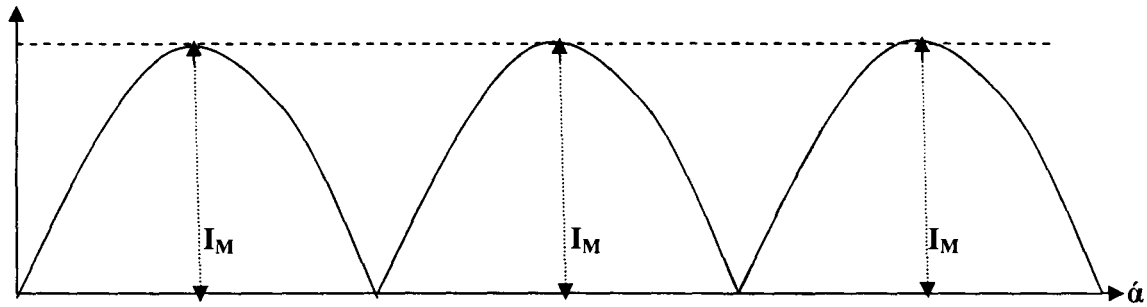


Fig 3.1c the Current output wave form

The filtering is frequently affected by shunting the load with a capacitor and the action of the system depends upon the fact that the capacitor only stores energy during conduction period and delivers this energy to the loads during inverse known as non-conducting period. Through this, there was a prolonged in the time during which the current passes through the load and the ripple was considerably decreased. [5].

The ripple voltage can then be defined as the derivation of the load voltage from its dc value and its current diagram is given below.

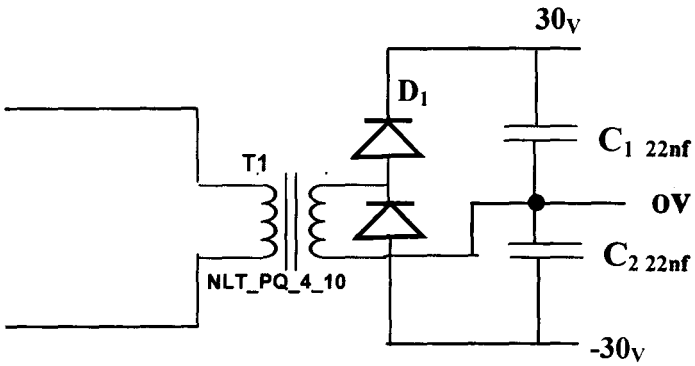


Figure 3.2 Circuit Diagram of Power Supply units of 200 watts Amplifier.

Fan :-for audio amplifier that has **a** power rating from 200watts upward it is very necessary for it to have in built fan so that there would be enough air cooling the components in the amplifier .so that they will not burn up due to the heat generated.

During the connection of fan 7812 voltage regulator was used to regulate the voltage from 15v to 12v and a 1000uf capacitor was used to increase the transient respond of the regulator

.light emitting diode was also used that brings on light when ever the amplifier is on the circuit is given below.

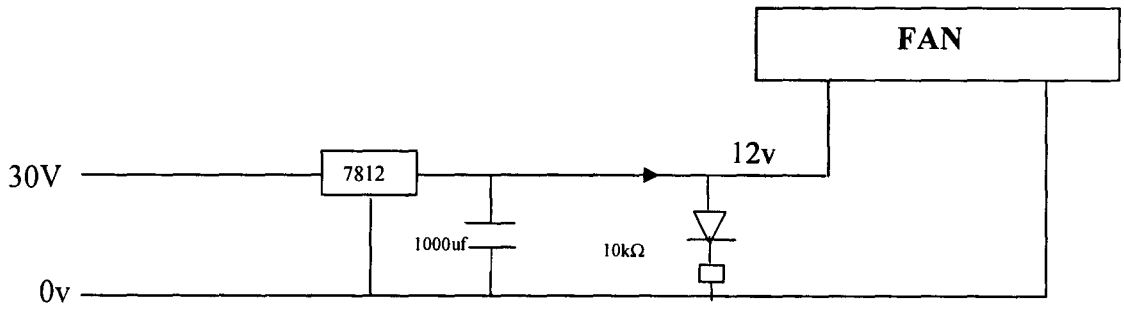


Fig. 3.3 Circuit diagram of inbuilt fan and On indicator of 200 watts amplifier

Pre-amplifier: Pre-amplifier amplifies a low signal to a higher level power which is enough to drive the power amplifier to its maximum allowable power level. Figure 3.3 shows the current diagram of the construction of pre-amplifier stage of 200 watts audio amplifier.

During the designing of this mentioned stage, some factors were taken into consideration:

(a) Signal to noise factor: There are many ways in which noise could be introduced, but for pre-amplifier, the two major sources of externally generated noise interference were noise from the input signal and that generated due to the power supply hum.

(b) On the other hand there is noise ge ated from input and output. This was taken into consideration due to the fact that the pre-amplifier stage is the stage that matches the signal source. It is necessary that the input impedance of each stage in pre-amplifier match the output of the next preceding stage.

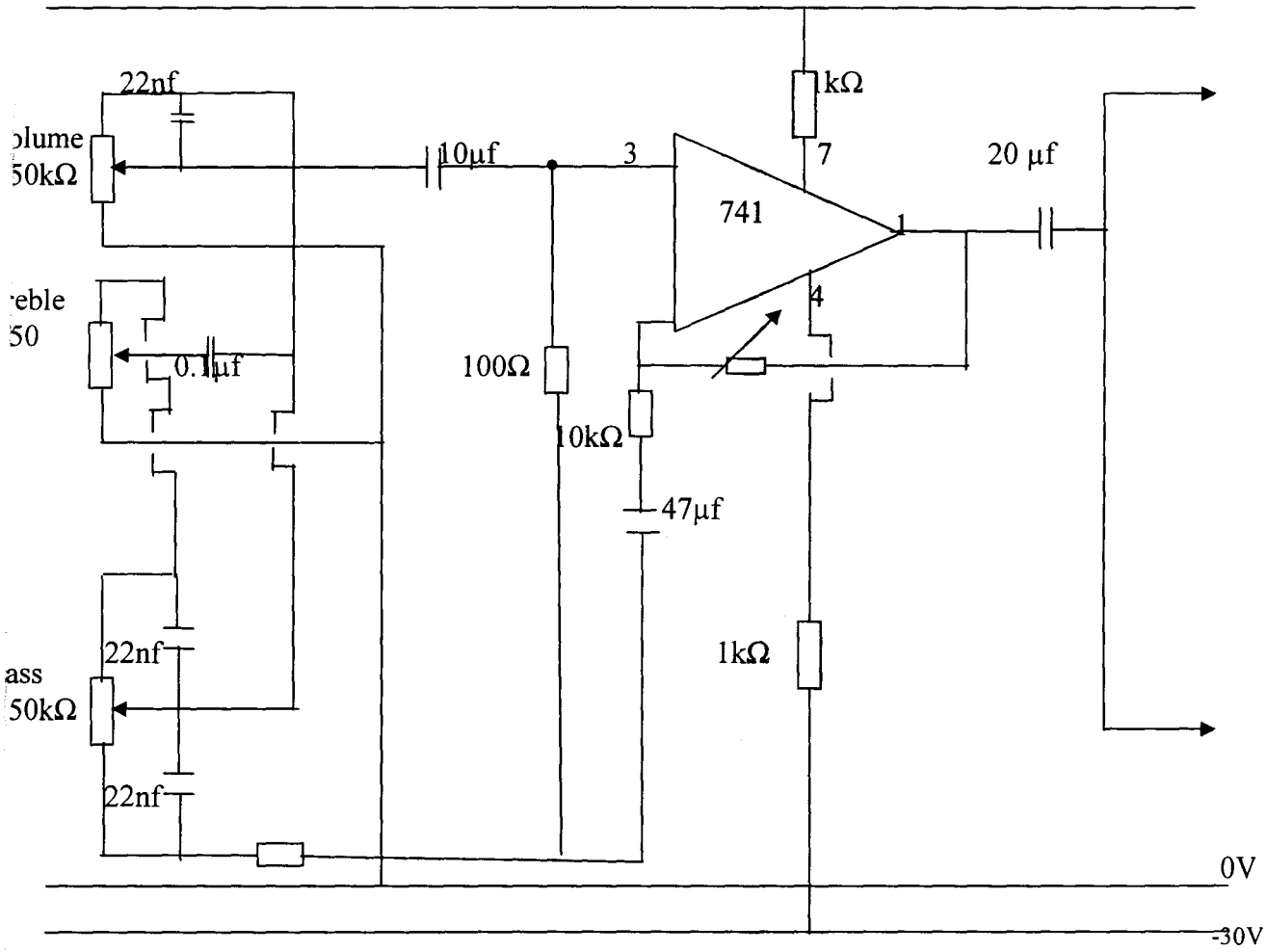


Fig 3.3 circuit diagram of preamplifier stage of 200 watts audio amplifier.

In designing pre-amplifier of an audio amplifier, all potential signal degradation from source of noise, either internal generated by pre-amplifier itself or externally generated.

To achieve the main objective of this project, the design of the pre-amplifier circuit is an oscillator with filter circuit and the type of capacitor used is coupling capacitor C1 (also known as dc from blocking capacitor). These capacitors are often used where only an ac signal important as in audio amplifiers, where it is only need to amplify frequencies from 20Hz because that is the only range human being can hear. Its value is chosen such that capacitive reactance X_c approaches infinity as frequency approaches zeros. [1]

Differential amplifier: The output from the pre-amplifier stage serves as the input to the differential amplifier stage. The figure 3.4 below shows the circuit diagram of the stage.

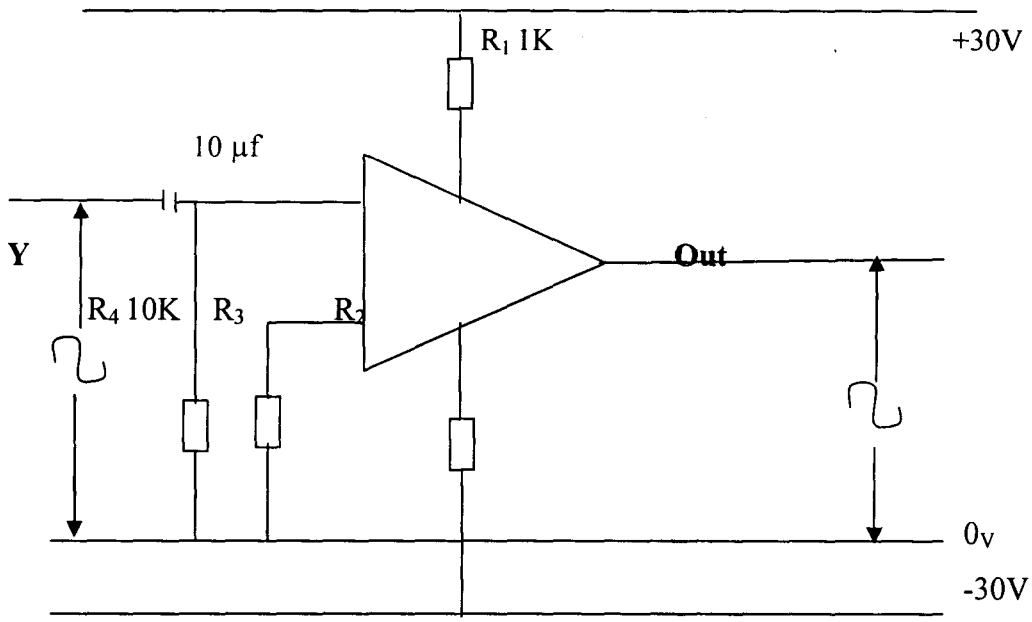


Fig 3.4 Circuit diagram of differential amplifier stage of 200 watts audio amplifier.

The above circuit is designed twice in the complete system to achieve maximum voltage amplification. The voltage gain of an amplifier is given by

$Av = B * R_C/R_{IN}$ 1

During the construction of this differential amplifying stage, in order to achieve high voltage amplification, there are some features that are incorporated in this amplifier:

[a] The R_{IN} (input resistance) of the transistor is sought to be quiet low as compared to the collector load R_L.

[b] The transistor with high B (>50) is used in the circuit i.e. the transistor used has a thin base.

[c] A high load resistor was used in the collector. Putting all these conditions into consideration the output wave shape from this stage is exactly similar o the input wave shape, it has least distortion.

From differential amplifying stage the output then serves as an input to power amplifier through the driver amplifier stage.

Power Amplifier: The main task of a power amplifier is to boost its input signal that is high enough to do physical works e.g. operate some forms of electromagnetic radiation a transmitting signal. This stage is the final stage of an audio amplification in which the amplified signal was matched to the load. This stage is the last driver output stage amplifying unit and designed to deliver a large amount of power to the load. To achieve full amplification, the following consideration must be followed:

[a] Distortion must be kept minimum

[b] At no time must the maximum specification for the circuit component should be exceed.

[c] The efficiency of the circuit must be as high as possible.

This stage comprises of driver amplifier stage and the output stage.

Driver amplifier stage: This is the stage that got its input from the output of differential amplifier for power amplifier. This stage renders power amplification in the usual way. The main consideration here is the maximum power gain the schematic is of driver amplifier staple is shown in fig. 3.5 below.

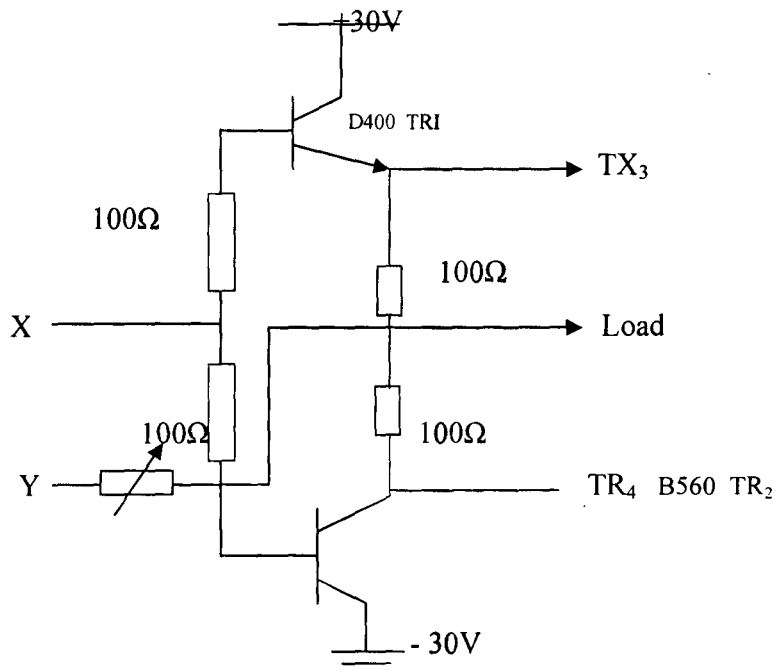


Fig 3.5 Circuit Diagram of Driver Amplifier

The driver amplifier is also design and constructed twice according to the way it was show the completed circuit diagram of the system.

Output stage: This stage was designed and constructed to convert the weak input signal into much more powerful "replica" which is capable of driving high power. This portion of the amplifier typically uses a number of power transistor and is also responsible for generating the most heat in the unit (unless the amplifier happens to have a very bad power supply design, in which case it too generates a lot of heat). The transistors used were both biased slightly ON so that the crossover distortion (associated with class B amplifier) is largely eliminated. This stage interfaces to the speakers. In order to obtain high output power at high frequency, push-pull arrangement was used in output stage. The circuit diagram 3.6 below shows the schematic design of the output stage.

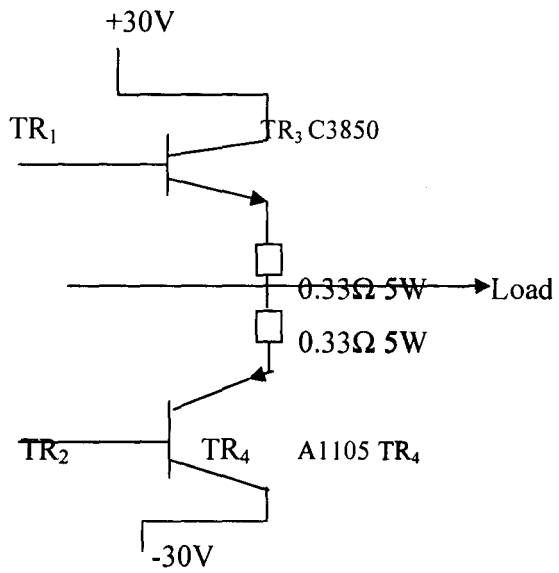


Fig.3.6. Circuit Diaram of out put stage of 200watts Audio Amplifier

Tow transistors in class B operation were employed in this stage one transistor employed the half-cycle of the signal, while the other transistor amplifier the negative half cycle. By the way, the output voltage is a completed sine wave. At the same time the circuit deliver high output power to the load, due to points of class A and class B amplifier combined. They have the improved efficiency have the improved efficiency of class B amplifier and the distortion performance that is a lot closer to that of a class A amplifier.

3.3 HEAT SINK:

This is the mental sheet that serves to dissipate the additional heat from the transistor in the circuit. Power transistors handle large current, they always heat up during operation. Since transistor is a temperature dependent device, the heat penetrated must be dissipated to the surroundings in order to keep the temperature within permissible limits. Generally, the transistors are fixed on a metal sheet which is aluminium, so that additional heat is transferred to the Aluminium sheet which was also adopted in this project.

Since most of the heat in the transistor is produced at the collector junction, the heat sink increase the surface area, this allows heat to escape from the collector junction early and the result is that temperature of the transistor is sufficiently lowered. The use of heat sink alone may not be sufficient to prevent thermal runaway under all conditions, but it contributes to the reduction of heat greatly. The path of the heat flow generated at the collector-base junction is from junction to case, from case to sink and from sink to the atmosphere. Finned aluminium heat sinks yield the best heat transfer per unit cost [6].

3.5 DESIGN CALCULATIONS

Power Supply Stage [Mode of rectification]

A full wave-rectifier network was employed to obtain a higher dc voltage out put source.

$V_{dc} = 2V_m / \prod$ ---------- 1a

$I_{dc} = 2 I_m / \prod$ ---------- 1b

The Peak Inverse Voltage [PIV]: This is the maximum voltage that can be applied in the reverse direction without breakdown of any device in a system and is given as;

$PIV = 2V_m$ [for full wave rectification] ---------- 2

Transformer selection

The Power Out Put = $V_{dc} * I_{dc}$ ---------- 3

$P_{o/p} = 2V_m / \prod * 2I_m / \prod$

$= 2V_{rms}\sqrt{2} / \prod * 2I_{rms}\sqrt{2}/\prod R$

$P_{o/p} = 8V_{rms} / \prod R$

Power out Put $* \prod^2 R = 8V^2_{rms}$

$P X \prod^2 X R / 8 = V^2 rms$

$V_{rms} = \sqrt{} (P * \prod^2 * R/8)$ ---------- 4

For this project the P_{out} = 200w and R5 has been calculated at the pre-amplification stage at page of this project to be 1.8 Ω

Therefore, $V_{rms} = \sqrt{}(200 * 3.142^2 * 1.8 / 8)$

$= \sqrt{}444.25$

$V_{rms} = 21.08v$

Also, $V_{rms} = V_{dc} / \sqrt{}2$

$V_{dc} = V_{rms} * \sqrt{}2$ ---------- 5

From equation 5, $V_{dc} = 21.08 * \sqrt{}2 = 29.8v$.

But the maximum current required to produce 200 watts is given as:

$I_c^2 R_o = P_o$ ---------- 6

From equation 6 above

$I_c = \sqrt{}[P_o / R_o] = \sqrt{} (P_o / R_o)$

Where P_o = 200 watts and R_o = 8 Ω

Therefore, $I_c = \sqrt{} (200 / 8) = \sqrt{} 25 = 5A$

From equation 2 above

$PIV = 2V_m$

$V_m = \sqrt{} 2 * V_{rms}$ ---------- 7

$V_m = \sqrt{} 2 * 21.08 V = 29.81 V = 30 V.$

Peak Inverse Voltage (PIV) = 2V = 2 * 30 = 60 V

Therefore, the break down voltage must be greater than the PIV [i.e. $B_{dv} > PIV$].

Pre-amplifier stage

Calculation of the voltage gain,

$A = V/v$ ---------- 1

$V_0 / V_1 = 1 + R_7 / R_5$ ---------- 2

$R_7 = 360\ \Omega$ (available value for R_7)

Knowing that A = 200 W.

Therefore from equation 2 above I obtain that

$200 = 1 + 360 / R_5$

$200 - 1 = 360 / R_5$

$R_5 = 360 / 199 = 1.81\ \Omega$.

But the available resistor for R_5 is 10k Ω.

To obtain the coupling capacitor,

$C_7 \geq -1 / 2\prod fR_6$ ---------- 3

Where f is known as the lowest signal frequency (audio frequency) to be amplified (i.e. f = 20 Hz and $R_6 = 10$ k Ω)

From equation 3 above,

$C_7 = 1 / 2\prod * 20 * 10{,}000 = 0.8\ \mu f$.

But capacitor greater than this in value can still be used i.e. $C_7 = 10\ \mu f$ (available capacitor).

Also, $C_7 = C_9 = C_{10}$

For C_8 = the reactance $X_{cf} = 1 / 2\prod fX_{cf}$ ---------- 4

Where f = frequency. Assuming frequency = 1000 Hz and reactance to be 200 Hz.

Then, $C = 1 / 2\prod fX_{c8} = 1 / 2*3.142*1{,}000*200 = 0.8\ \mu f$

Therefore, $C_8 = 1\ \mu f$

But available $C_8 = 47\ \mu f$

The out put power load P_o across 8 Ω resistor load is 200 watts.

$Vcc / R_o = P_0$ ---------- 5

$P_0 = Vcc / R_0$ ---------- 6

$Vcc = P_o / R_o$ ---------- 7

$Vcc = \sqrt{(P_o / R_o)}$ ---------- 8

$Vcc = \sqrt{100 * 8} = \sqrt{800} = 28.28v$

The maximum voltage supply required for full wave is equal to twice the peak value of voltage supply.

The maximum supply required to produce 200 watts is given as:

$I_c = \sqrt{P_o / R_o} = \sqrt{200 / 8} = \sqrt{25} = 5A.$

The value of the peak current is equal to the product of rms current and square root of two.

$I_{c\ peak} = 5 * \sqrt{2} = 7.07\ A$

Current rating.

$I_{dc} = 2I_m / \prod$

Therefore, $I_{dc} = 59.62 / 8\prod = 59.62 / 25.13$

$I_{dc} = 2.37\ A.$

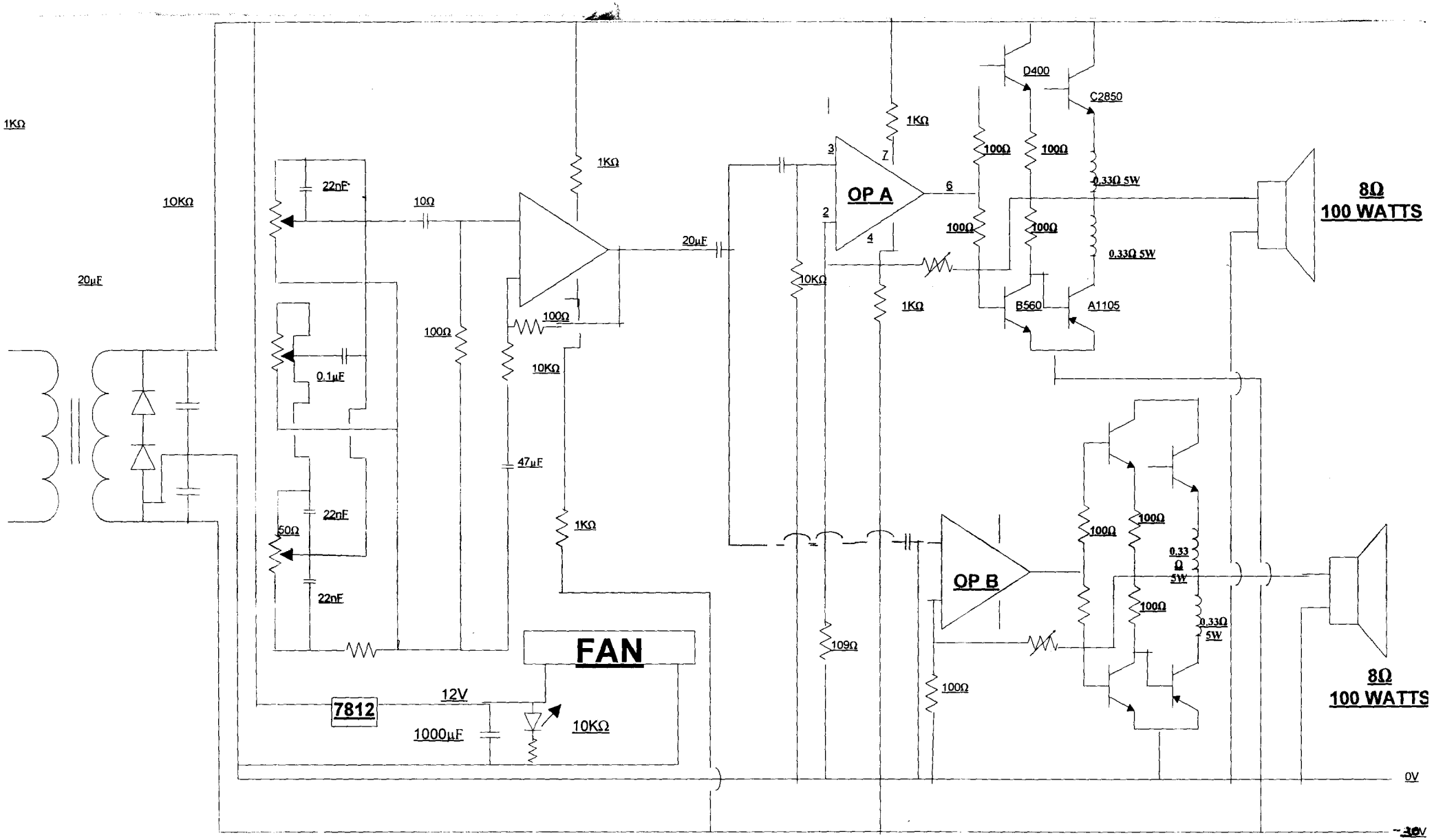


FIG 3.7 COMPLETE 200 WATTS AUDIO AMPLIFIER CIRCUIT

CHAPTER FOUR

TESTS RESULT AND DISCUSSION

4.0 TESTING

This is one of the most important stages of this project design and construction.The physical representation of the work will be seen clearly here and not in paper or software copy anymore as a finished hard-ware.

A number of amplifiers parameter were measured using a signal generator and a cathode ray oscilloscope (CRO) but the most important ones as far as this project is all about are the detection of distortion and the measurement of gain.

4.1 DETECTION OF DISTORTION

In the construction of an amplifier the final stage handles the largest amplifier signal and is therefore the stage at which signal distortion is likely to occur. It is not that this is impossible in that preview stages, because if the final voltage applied to the circuit is excessive the output current and voltage swing will be large and encroach into non-linear region of the output characteristic of the transistor. The main purpose for this is to make the output signal waveform differ from the input wave form .in order to determine the voltage which when applied to the input terminal of the amplifier causes distortion of the output waveform apparent the frequency of the generator should be set to the desire test value and the voltage be steadily increased from zero until onset of the distortion is noticed .the maximum input signal amplitude that the amplifier can handle without distortion is some what less than the value when the distortion becomes cleared.

In general, efficiency of a device is defined as the amount of useful output power divided by the amount of required input power. The maximum efficiency any circuit can have is 100%, for amplifiers, but this value can never be met. In general, audio amplifiers are not

particularly efficient. Class AB amplifiers have maximum theoretical efficiency of around 78%. High efficiency means less power is wasted in the form of heat. This means smaller heat sinks, less weight, and more output for a given input. [1]

It was discovered that the voltage at the out put stage dropped and the out put signal is more than the input signal. This shows that the amplifier has voltage drop which were converted to heat generated internally and input signal has been altered by increasing its frequency. This simply means distortion is part of amplification.

4.2 MEASUREMENT OF AMPLIFIER GAIN.

In measuring the gain of an amplifier the output voltage of the signal generator was set to a particular value at which it will not produce distortion of the output signal wave front and also the generator frequency was adjusted to the required test frequency .therefore the gain of an amplifier is the ratio output voltage /input voltage when measured with the same .this can also be done by connecting both voltage into a double beam oscilloscope and their magnitude calculated from the oscilloscope.

4.3 DISCUSSIONS OF RESULTS

It was known through the designing and construction of this project that the more powerful the amplifier is the more noise and distortion it will put out. The aim and objective of this project was achieved, even through this amplifier alter input signals by making them stronger (amplified) and add characteristic which did not exist in the original signal. The distortion in this amplifier is weaker than required signal.

4.4 SHORTCOMING/LIMITATION OF THE PROJECT AND REMEDY

This project has a total power rating of 200 watts. But during construction the out put power rated is more than 200 watts a little bit. This is just to make the amplifier still be able to stand the ability to drive a load that requires more power than its own specification.

Each power amplifier has specification this should be followed so that the amplifier can last longer and be free from untimely damage.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.0 SUMMARRY

This project which is the design and construction of 200 watts audio amplifier was designed and met the specification within the limit of available components considering some factor as economy, availability of compound research materials, efficiency of components compatibility and lost effectiveness. The performance of the project after test met design specifications. The effectiveness and efficiency of the operational performance of the project depends on the user, because human is prone to make error such as overloading of amplifier. The operation also depend on how well the soldering is done and the positioning of the components on the Vero-board soldering logic element near components that radiate heat may cause overheating and affect the performance of the entire system.

The construction and packaging was done in such a way that gives room for easy maintenance and repairs.

5.1 RESULT OBTAINED

The desired result of this of this project was achieved which is to amplify a signal with less distortion .though it has being shown previously that there is no amplifier that is 100% distortion free because distortion is part of amplification .

5.2 PROBLEMS ENCOUNTERED

1. There are some components that are very difficult to find in this our neighbour hood, which makes it difficult to find supplement for them when they spoil.
2. Many of the components got damage during the cause of soldering them to the Vero-board.

3. There was a set back during the construction, because the amplifier was generating too much noise. This set back was rectified by re-constructing the whole system.

5.3 RECOMMENDATIONS

Student on this field should be more exposed to practical electronics design and construction before their final year, which is their project year, to prevent problems of technical incompetence mostly experience during the project period. It will also be a good idea if each student from 200level impaired is given a project to work on from the beginning of a session and to submit at the end of the session.

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