

**DESIGN AND CONSTRUCTION  
OF  
TWO STATION INTERCOM  
TELEPHONE SYSTEM**

**BY  
IBRAHIM HARUNA**

**97 / 6021EE**

**DEPARTMENT OF ELECTRICAL/ COMPUTER  
ENGINEERING**

**SCHOOL OF ENGINEERING AND ENINEERING  
TECHNOLOGY,  
FEDERAL UNIVERSITY OF TECHNOLOGY,  
MINNA NIGER STATE.**

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IN PARTIAL FULFIMENT OF THE REQUIREMENT FOR THE  
AWARD OF THE BACHELOR OF ENGINEERING (B.ENG) DEGREE  
IN THE DEPARTMENT OF ELECTRICAL AND COMPUTER  
ENGINEERING,

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA .

## DECLARATION

I hereby declare that this project is written by me, **IBRAHIM HARUNA** and that the content are result of my own design and calculation. Information obtained from published and unpublished works of others have been well acknowledged by means of reference.

*Ibrahim Haruna*

IBRAHIM HARUNA

*16/10/23*

SIGN

DATE

## CERTIFICATION

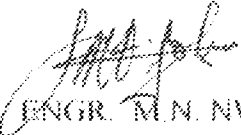
This work is to the best of my knowledge carried out by IBRAHIM HARUNA and presented to the department of electrical / computer engineering in partial fulfillment for the award of bachelor of engineering degree in electrical and computer engineering.

DR. Y.A. ADEDIRAN

SUPERVISOR

.....  
SIGN

DATE

  
ENGR. M.N. NWOH

H O D. OF THE DEPARTMENT

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SIGN

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EXTERNAL EXAMINER

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SIGN

DATE

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## ABSTRACT

This project is based on the design of a system that converts sound signals into electrical signals, amplifies these signals, transmit the signal over wire and reconvert the electrical signal into sound signals.

The design allows for bi-directional transmission of information. It has two stations, which can equally transmit and receive information.

The design is built around an audio amplifier circuit, switching circuit and has a signaling facility, which consists of a delay circuit and a tone generator.

## TABLE OF CONTENTS

Title page.....	ii
Declaration.....	iii
Certification.....	iv
Dedication.....	v
Acknowledgement.....	vi
Abstract.....	vii
Table of contents.....	viii
CHAPTER ONE	
1.0 Introduction.....	1
1.1 Literature Review.....	1
1.2 Basic Telephone System.....	2
1.3 The Exchange.....	3
1.4 The telephone principle.....	4
1.5 Categorization of telephone system.....	6
1.6 Objective of study.....	7
1.7 Scope of study.....	7
1.8 Project methodology.....	7
CHAPTER TWO	
2.0 Intercom.....	8
2.1 Intercom system.....	8
2.2 Type of intercom system.....	8
2.3 Traditional types of intercom.....	8

2.4 Modern intercom system.....	10
 CHAPTER THREE	
3.0 Circuit design.....	12
3.1 Mode of operation.....	12
3.2 The stage of design.....	13
3.3 The signaling circuit.....	13
3.4 Design calculation.....	18
3.5 The amplifier.....	20
3.6 Operational amplifier.....	21
3.7 Dual role of speakers.....	22
3.8 Amplifying circuit.....	22
3.9 Switching circuit.....	26
 CHAPTER FOUR	
4.0 Layout and construction.....	29
4.1 The construction of the circuit.....	29
4.2 Construction of the casing.....	30
4.3 Precautions.....	30
4.4 Some of the precautions followed.....	31
4.5 Cabling.....	31
4.6 Testing.....	31
 CHAPTER FIVE	
5.0 Conclusion.....	32
5.1 Problems encountered and limitations.....	32



5.2	Achievement.....	33
5.3	Recommendations.....	33
5.4	Summary.....	34
	References.....	35

## CHAPTER ONE

### **1.0 INTRODUCTION**

Communication is the transfer of information between two or more points. Communication in electrical Engineering terms refers to the sending, processing and reception of information using electrical means. The information or message to be sent, processed and received may take different forms. It may be voice, picture, written message, electrical signal, etc. Communication system is a technique or equipment used to send process and receive messages. The means of communication can be in the form of a radio link optical fibre, and satellite and telephone network. Communication system plays a vital role in the development of the society. The need for information exchange between people separated by a considerable distance makes communication technology necessary.

### **1.1 LITRETURE REVIEW**

The concept of communication between people came to existence by careful study of sound by Alexander Graham Bell. In 1876 Alexander Graham Bell Whirred in a new era of voice and sound telecommunication when he uttered to his Assistant the words, "Mr. Watson, come here; I want you", using a prototype telephone. Bell received the patent for the first telephone, but he had to fight numerous legal challenges to his patent from other investors with similar devices. Bell was able to make his prototype telephone work and to attract financial backers, and his company grew. The telephone was a vast improvement over the telegraph system, which could only transmit coded words and numbers, not sound of human voice.

Telephone messages had to be deciphered by trained operators, written down and then delivered by hand to the receiving party, all of which took time. The Telephone transmitted actual sound messages and made telecommunication immediate. Improve switching technology (used to transfer calls from one Local network to another) meant individual telephones could be connected for personal conversations. The first commercial telephone was installed in Boston, Massachusetts, in 1877. Early Telephones required direct connections to other telephone, but this problem was solved with telephone exchange switches, the first of which was installed in New Haven, in 1878. A telephone exchange links telephones in a given area together, so a connection between the telephones and the exchange was needed.

### 1.3 BASIC TELEPHONE SYSTEM

A simple two-point telephone circuit uses a single pair of wires (or one wire with ground return) and two telephone sets of self-contained type. Each set is self-contained and does not use any control office equipment. This arrangement is illustrated in the Fig. 1.3 with the handset hanging on the hook switches. The signaling circuit is complete and putting the switch on at one set will ca exchange automatically bigger up to provide a common +Vcc voltage to the two use the bell at the other set to ring. When the handsets are picked up, the exchange automatically bigger up to provide a common +Vcc voltage to the two amplifiers, thus giving rise to establishment of conversation between the people.

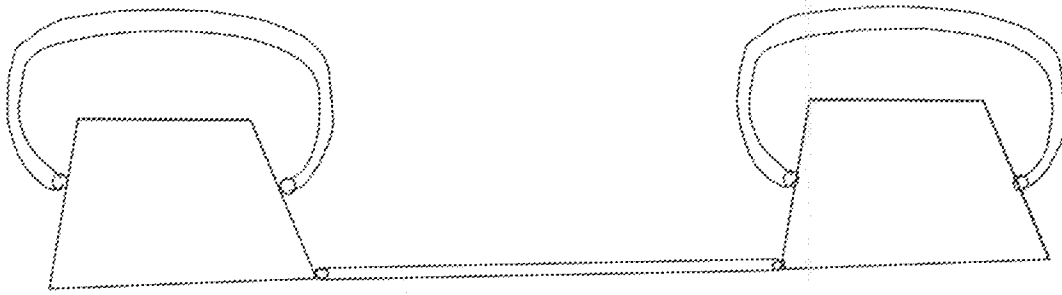


Fig. 1.1 Title: - A simple two- point telephone.

This fully interconnected system has a limit, both in terms of number of subscribers, and geographical location that can be covered. As could be seen, it will be difficult in the arrangement to connect a subscriber to several other subscribers. To overcome this problem, a central point to which all subscribers are connected is provided. Thus, this central point is called switching centre or exchange.

#### 1.4 THE EXCHANGE

The Exchange is the switching centre where a person with a line would be able to speak to any other person with a similar connection.

There have been three generations of exchanges.

1. The analog exchange, which is purely mechanical, is considered as the first generation. In this type of exchange an operator makes the connection between subscribers (A, strawger, 1879)
2. The semi-Exchange: Here mechanical and electronic circuits are combined. It is an example of semi-electronic exchange; we have the cross bar switching system (D. Conolly, T.A, Connolly and T.J. Metighe 1879).

3. The third generation of exchange is purely electronic one. In this digital system, the interconnections are made by the exchange central processor which is usually with the aid of decoders, gates PROMS, etc.

### 1.5 THE TELEPHONE PRINCIPLE

The Telephone comprises transmitter, Receiver and Several other components such as gravity switches, the alarm (Ringing Generator) inductor coil, attaining current source and direct current source. The principle that governs the concept of the telephone are those of sound (varying air pressure) electricity and magnetism.

When a person speaks, sound is produced by puff of air from the vocal chard of the mouth. The changes in air pressure are caused by puffs due to vibration. However, for proper transmission of such messages through a long distance, modern communication systems were developed through research.

The Block diagram of Fig. 1.2 shows a modern communication system.

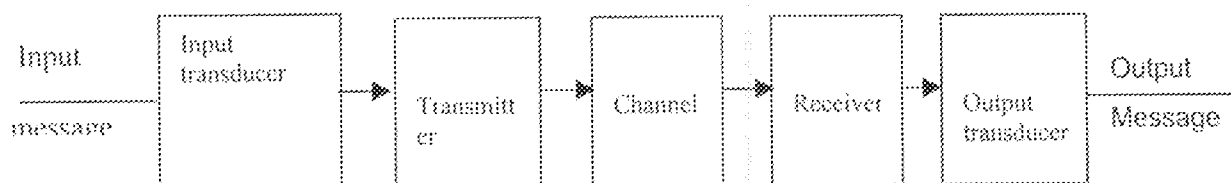


Fig. 1.2: Title Simple block diagram of a communication system.

#### 1.5.0 Input Transducer: -

A transducer is a device that converts energy from one form into electrical energy. The input message, being in the form of sound waves in the frequency range of 0.3KHz-3.4KHz, is sent into the transducer by means of acoustic signal from a person. The carbon microphone, which serves as the

input transducer convert the immediate waves to voltage variation, which is sent through the intermediate wire to the transmitter.

#### 1.5.1 Transmitter: -

The telephone transmitter contains tiny particles of carbons the size of grain called carbon granules. They are closely held in small compartment between a piece of carbon which is cup-shaped and another piece which is dome shaped with the aid of moving first electrode which moves only when the diaphragm converges as a result of changes in air pressure, the carbon granule compresses thereby increasing their contact area which causes the resistance of the circuit to reduce thereby giving rise a high flow of current. The carbon transmitter is carefully designed to ensure that the current follows the intricate changes in air pressure so that original sound can be reproduced at the distance end. However, it is necessary that sound waves are passed through the transmitter for the following reasons.

1. To reduce interference especially at low frequency.
2. To overcome equipment limitation e.g. weights and size.
3. For channel Assignment.
4. Multiplexing.

#### 1.5.2 THE CHANNEL: -

The channel is the medium through which the transmitted signal sets into receiver. It may have many different forms ranging from ground, underground or overhead cables, or sky and space. The transmitter can either wire or wireless to the receiver. The common characteristics of all channels is that the signal passing through undergoes degradation which results to noise, interference, fading etc because of its peculiar adverse effect on the quality of

the received signal noise and their sources in communication systems are a separate topic which calls for more attention that is beyond the scope of this project.

### **1.5.3 RECEIVER: -**

The receiver in a communication system extracts and processes the desired signal from the various signals received at the output of the channel. The desired signal is converted into suitable form for the output transducer stage. This includes amplification of the reduced signal if the signal level is low. Demodulation occurs at the receiver and a good characteristic of a good receiver is its ability to select the desired signal and reject any unwanted signal.

### **1.5.4 OUTPUT TRANSDUCER**

This device converts the electrical output signal into the form desired by the user. For instance, a Loudspeaker convert electrical signal to sound waves for the listener to hear, the cathode ray tube, meter and oscilloscopes are also example of an output transducers.

## **1.6 CATEGORIZATION OF TELEPHONE SYSTEM.**

Telephone system may be categorized by the nature of transmission used.

1. Simplex system: the system allows transmission in one direction at a time. It provides communication in either direction alternatively in instances where transmission is unidirectional.
2. Duplex: -This allows simultaneous transmission in both directions. This is normally accompanied by using two separate circuits, one circuit for each direction.

## **1.7 THE OBJECTIVE OF STUDY**

The study was carried out in order to develop a cheap, affordable and efficient means of communication within a short distance in an office, building or home.

## **1.8 SCOPE OF STUDY**

The project focuses on transmission of information or messages within a short distance. The transmission was limited to wired telephone transmission with a provision for only two-stations which operates from one caller to the other.

## **1.9 PROJECT METHODOLOGY**

This device operates with direct current when the line is not locked on. When a caller lifts his handset and calls the other, direct current flows to the second station and operates the signaling circuit of the called party and a ringing will be heard. When the called party picks his/her handset the signaling circuit will stop ringing and the link is "ON" through the Amplifiers.



## CHAPTER TWO

### **2.0 INTERCOM**

This is an acronym of INTERNAL COMMUNICATION. This signifies a system of communication that establishes a link between two or more people for the purpose of conversation.

### **2.1 INTERCOM SYSTEM:**

This is like a telephone system that enables two or more people to talk to each other within a building, office, an aircraft, ship etc without using the direct line from telephone line provider, say NITEL.

The basic intercom system consists of three distinct parts, namely:-

1. Signaling Stage
2. Amplifying Stage
3. Switching Stage.

### **2.2 TYPES OF INTERCOM SYSTEMS:**

There are different types of intercom System. But they can generally be classified into two, namely: Traditional and modern types.

### **2.3 TRADITIONAL TYPES OF INTERCOM.**

Intercom systems are generally classified into two in this category namely: Master-slave Intercom and Independent Station Intercom.

#### **2.3.1 MASTER-SLAVE INTERCOM.**

In the Master-slave type, the whole circuitry of the intercom is built in one box called the MASTER-STATION. The others stations only have transducers in for of speakers, indicators, microphones and switches. The other stations are called the SLAVES.

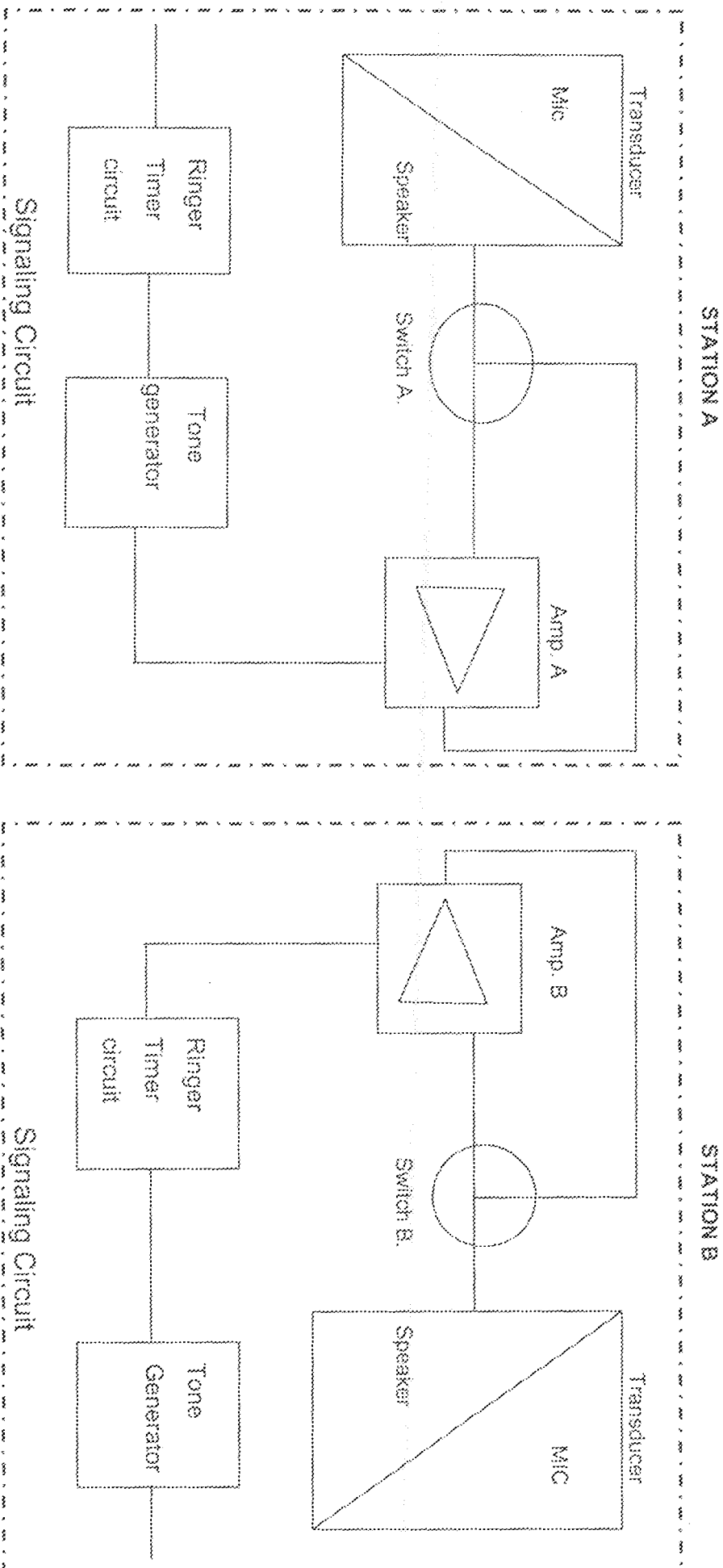


Fig. 2.1 Block Diagram of a two Station Intercom Telephone System.

The MASTER STATION contains the circuitry for the whole operations, that is the three distinct parts of the Intercom:- Switching, Amplifier and the signaling circuit.

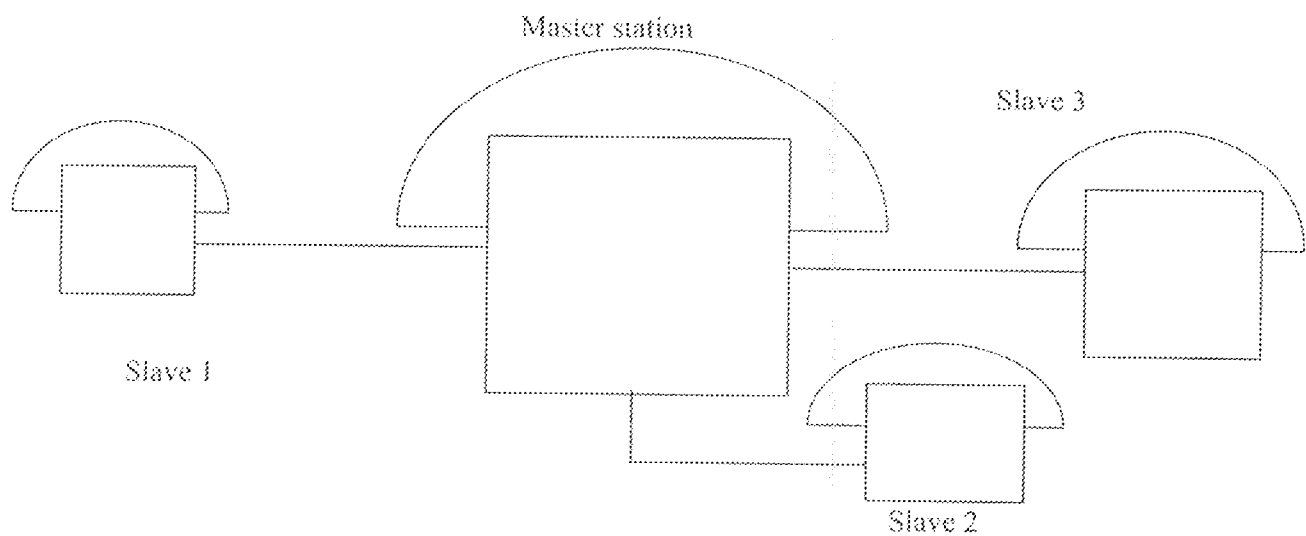


Fig. 2.2: Master-slave Intercom

It can be noticed that the master station has access to all the other stations and the slaves have access to the Master in one way.

### 2.3.2 INDEPENDENT STATION INTERCOM.

In this type, each station has its own power supply, amplifier, signaling unit and switching. They have equal access to each other in terms of making a call. This independent type is further divided into two types:-

- i. Conference Type
- ii. Secretary Type.

#### 2.3.1-0 CONFERENCE TYPE

The Conference Type is designed in such a way that only one station has access to others. However, other people interfere or participate in the discussion, maximum security and convenient switching is done in this type of

intercom. All other stations in the intercom system that are free can talk to one another simultaneously.

Conference type are used in big offices, ships, banks, large building it is most usefully in offices, may be between Managing Director and his Managers. for example. when they have to discuss a simple but urgent matter and take decisions without necessarily leaving their desk or offices.

### **2.3.1-1 SECRET OR PRIVATE TYPE**

The Secret Type is similar to the conference type but the only difference is that, when two subscribers are "ON" conversing, the third party cannot get access to their discussion. The private type could be used the same way as the conference type since privacy of communication is maintained in this type of intercom. Confidential matter could be discuss.

## **2.4 MODERN INTERCOM SYSTEM**

### **2.4.1 EXCHANGE TYPE INTERCOM.**

This type of Intercom is the same as the traditional type except for the circuit, which is modern in which most of the circuitry parts are integrated circuitries. This type of Intercom is found in business premises; it is called PRIVATE BRANCH EXCHANGE (PBX). It is private because only your business Communication switches over it and is a branch because it is a substructure of the switching network.

The mains function of the PBX is to redirect calls internally in the business offices without going out to the local telecommunication to complete the call. Another function of it, is to save money on the number of business lines you need to get to the local telecommunication

#### 2.4.2 WIRELESS INTERCOM.

In this type of intercom, interconnecting wires are completely avoided; free space is used as transmission link. This type of intercom system consists of a base station transmitter with an antenna and a number of other stations tuned to different frequencies. The base station can communicate with any other stations by selecting the corresponding specific frequency of that unit. This type may be designed like a Walkie-talkie.

#### 2.4.3 WIRE INTERCOM.

The Wire Intercom system is a two-way station arrangement in which the stations are connected to each other by using twisted pair cabling wire. The mains wire is used as transmission link.

What is normally done is to code each station by allocating carrier frequencies to them. Decoders and frequency generators are also added along with the traditional parts of an intercom system.

When a station is to be called a tone that is equivalent in frequency to the station being called is sent to the mains wire.

The decoder in the station being called detects this with its detector or TONE DECORDER and aligns it to receive the call. All other stations reject it.

## CHAPTER THREE

### DESIGN AND ANALYSIS

#### 3.0 CIRCUIT DESIGN

The working of the entire project depends on the circuit and hence the design of the circuit is in fact the main focus of this project. The design of the 2-stations intercom telephone system is based on the following three stages: -

- i. The signaling stage
- ii. The Amplifying stage
- iii. The Switching stage

**3.1 MODE OF OPERATION: -** There are two stations. Each one of the stations has a unit of signaling circuit, Amplifying circuit and switching circuit.

When the handset H1 is lifted, the gravity switch is released due to the removal of the weight of the handset from it, which then sends its state to high (+vcc) at his station with the aid of pull-up resistor. He then presses button on the telephone set, which provides a high voltage to trigger the signaling circuit of the other station. The ringing is varied by tone generator using 555 timer IC connected in astable mode. The ringing is varied by 555 timer 2 with on state being 4 seconds and off state 2 seconds. The ringing period is also being controlled another 555 timer 3 at the switching circuit, connected in monostable mode the ringing tone stops after about 24 seconds.

Once, the ground of the signaling circuit is cut off, thereby isolating the ringing generator. Hence, the ringing stops and goes as a high state voltage

(+vcc) to the two amplifier circuit which leads to the instant establishment of communication the two units.

### 3.2 THE STAGE OF DESIGN.

There are three stages in the design of the intercom system. They are:-

1. The signaling circuit
2. The Amplifying circuit
3. Switching circuit

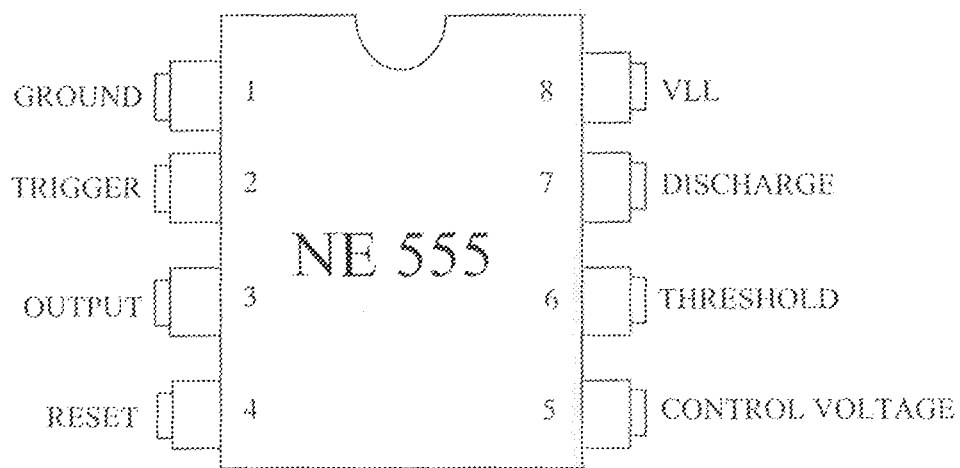
### 3.3 THE SIGNALING CIRCUIT

For the signaling in this project, 555timer IC was used on each station to alert the stations of an incoming message. The 555 Timer IC was configured in as astable mode for tone generation

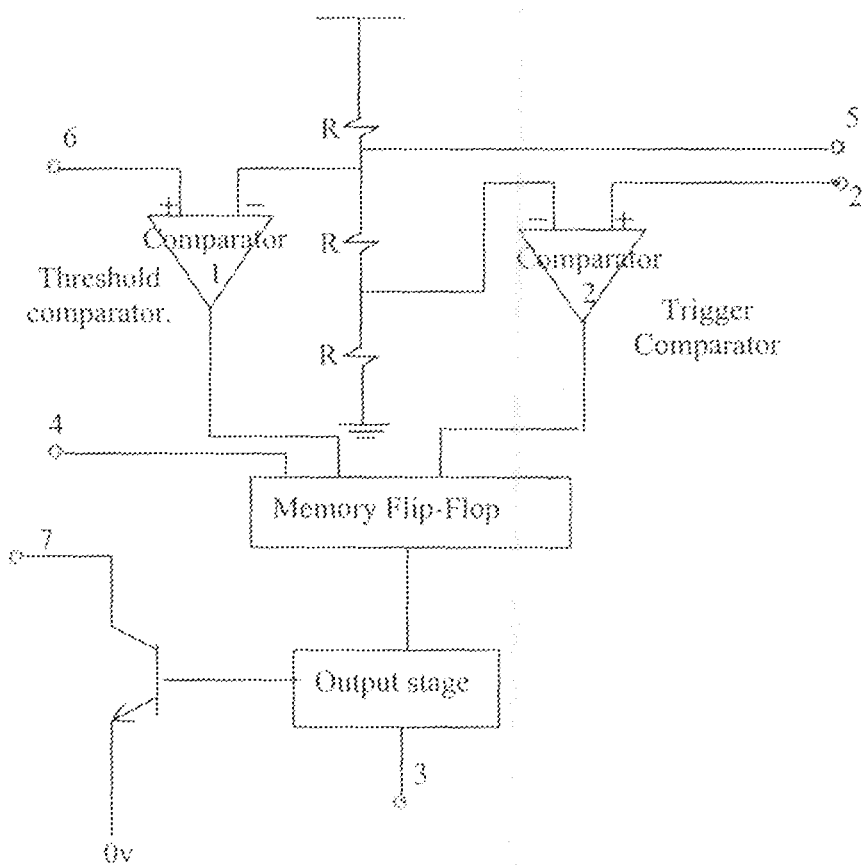
#### 3.3.0 THE 555TIMER:-

555 Timer IC is one of the most versatile electronic ICs used in industries electronic circuits requiring a time delay, and also as an oscillator to provide the pulse needed to operate computer circuits. Its ability to supply voltage between 5v and 16v, which does not affect its internal operation, makes it preferable for timing circuits.

The 555Timer IC is an 8-pin integrated circuit (IC), which can be wired to operate as a monostable or an astable as the case may be using very few external components. The figure 3.1 shows the pin layout of the 555Timer IC and the internal structure.



(a)



(b)

Fig. 3.1: 555 timer IC

(a) The pin-layout of the 55 timer

(b) Internal structure of NE555N IC



### 3.3.1 MONOSTABLE MODE.

In the monostable mode, an external capacitor and resistors are required for the timing cycle. The timing cycle being when negative going excursions are applied to the trigger input of the timer and when the trigger voltage passed through zero and becomes less than  $1/3 V_{cc}$  once the timing cycle has begun the voltage level at its trigger input has no effect until the voltage across the capacitor rises to  $2/3 V_{cc}$ , than the cycle ends. The time it takes the capacitor voltage to rise from  $v_{cc}/3$  to  $2/3 V_{cc}$  depends on the values of the external capacitor and resistors. Figure 3.2 shows the circuit connection of the 555 timer used as a monostable multivibrator and the wave form.

The delay circuit in the used in the switching stage employs the 555 timer connected as a monostable multivibrator.

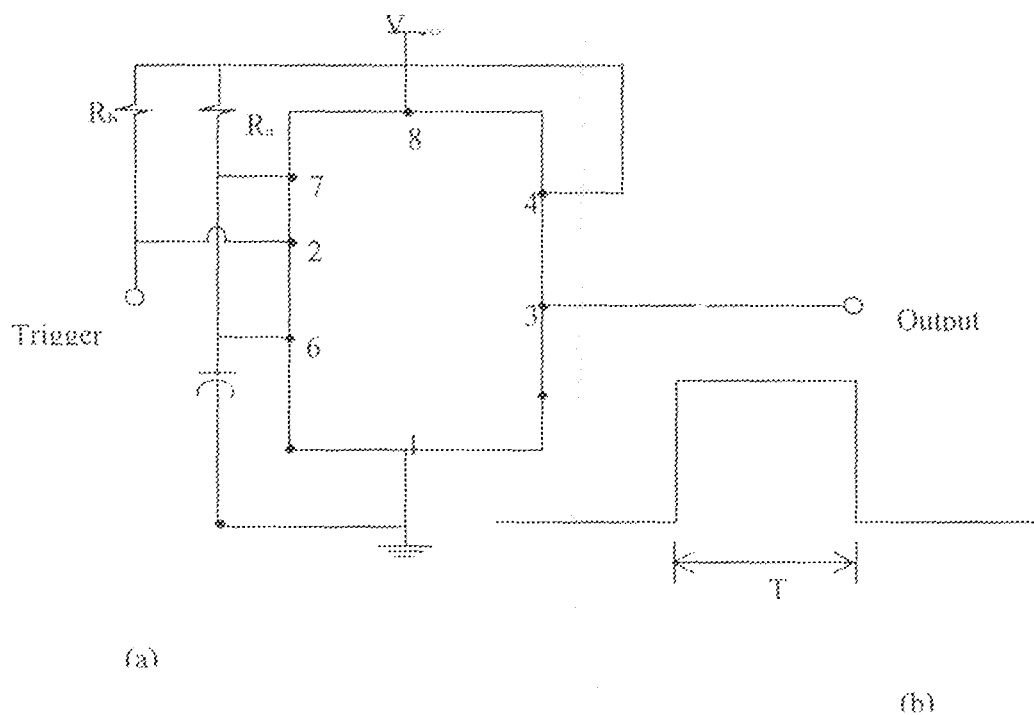


FIG. 3.2 Title 1 Monostable Multivibrator circuit  
(a) The circuit connection of the 555 timer as a monostable Multivibrator  
(b) The waveform.

### 3.3.2 ASTABLE MODE: TONE GENERATION.

For the 555 timer to operate as an astable multivibrator, the external connection is such that the timer will trigger itself and cause the capacitor voltage to oscillate between  $1/3V_{CC}$  and  $2/3V_{CC}$ . The external capacitor charges through resistors  $R_a$  and  $R_b$  to  $2/3V_{CC}$  and discharge to  $1/3V_{CC}$  through  $R_b$ . Figure 3.3 shows the circuit layout the astable multivibrator and the associated wave forms.

The charging time is given as

$$T_1 = 0.693 (R_a + R_b) C \text{-----Equation 3.2}$$

The discharging time is given as

$$T_2 = 0.693 R_b C \text{-----Equation 3.3}$$

The period,  $T$  is given by

$$\begin{aligned} T &= t_1 + t_2 \\ &= 0.693 (R_a + 2R_b) C \text{-----Equation 3.4} \end{aligned}$$

The frequency,  $f$  is given by

$$\begin{aligned} F &= 1/T \\ &= \frac{1.44}{(R_a + 2R_b) C} \text{-----Equation 3.5} \end{aligned}$$

The duty cycle is given as: -

$$\begin{aligned} D.C &= \frac{R_a + R_b}{(R_a + 2R_b)} \\ &= \frac{t_1}{T} \end{aligned}$$

The 555 timer in the astable mode is used in this project design for the signaling (tone generation).

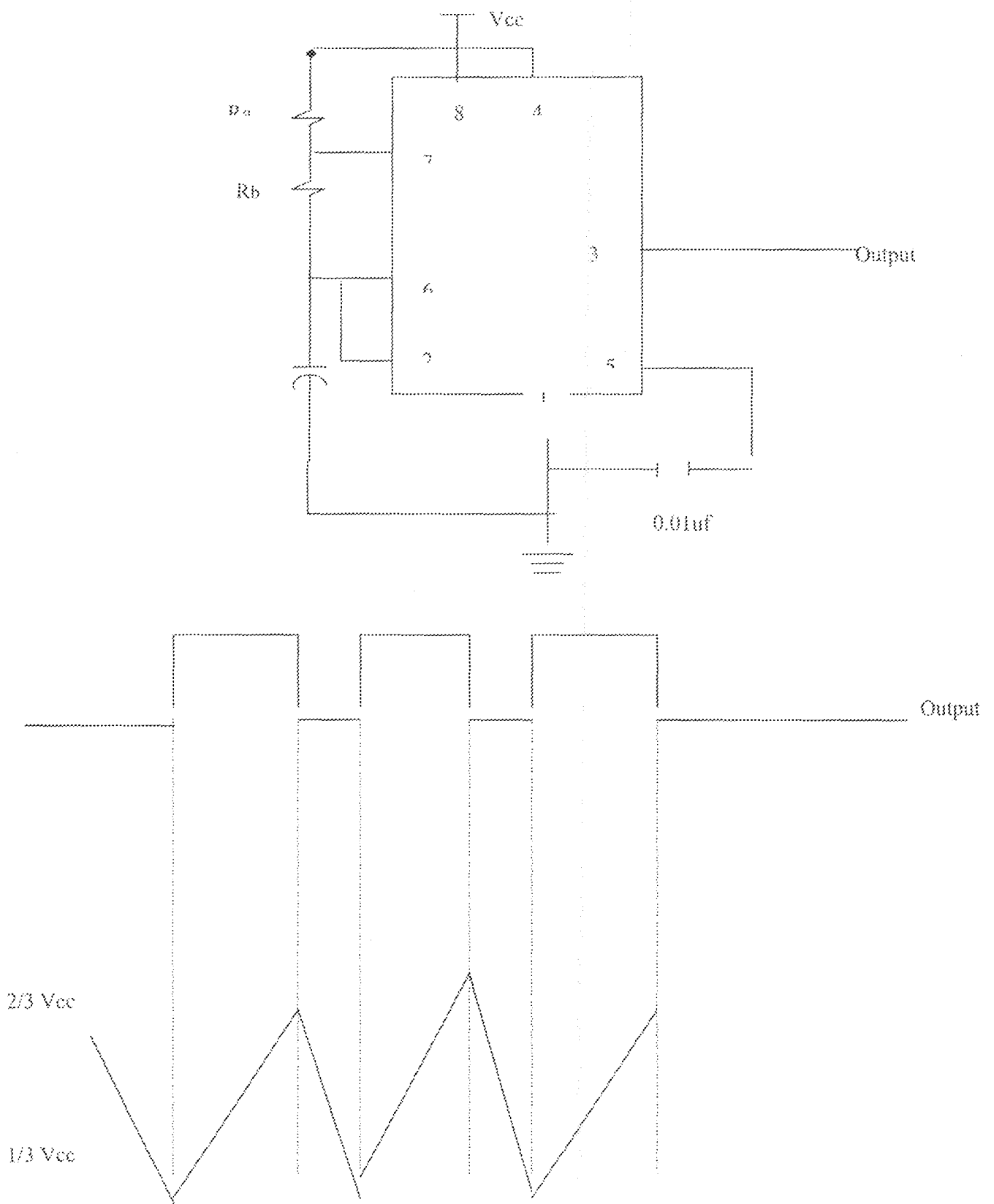


Fig 3.3 TITLE ASTABLE MULTIVIBRATOR CIRCUIT

(a) The 555 timer connected as astable multivibrator.

(b) Output voltage and capacitor voltage waveform in astable mode.



$$T_2 = 0.693 R_b C$$

$$= 0.693 (5.6 \times 10^3) \times 100 \times 10^{-9}$$

$$= 3.89 \times 10^{-4} \text{ sec}$$

$$= 0.4 \mu\text{sec}$$

The frequency,  $f$  of: oscillation of the tone generation is calculated as follows: -  $f = \frac{1}{T}$

$$T$$

$$= \frac{1}{1.48 \mu\text{s}}$$

$$1.48 \mu\text{s}$$

$$= 675.7 \text{ Hz}$$

The duty cycle from equation 3.6 is

$$DC = \frac{R_a + R_b}{(R_a + 2 R_b)}$$

$$= \frac{11}{T}$$

$$= \frac{1.08}{1.48}$$

$$= 0.73$$

For IC2, which reset, the continuous tone generated by IC1, the following values of  $R_a$  and  $R_b$  were calculated, on time of 4 second and off-time of 28cc ends with  $C=220\mu\text{F}$  from equation 3.2 and equation 3.3: -

$$T_1 = 0.693 (R_a + R_b) C.$$

$$(R_a + R_b) = \frac{4}{220 \times 10^{-6} \times 0.693}$$

$$= 26236.4 \Omega$$

$$t_2 = 0.693 (R_b) C$$

$$t_2 = 0.693 (R_b) C$$

$$R_b = \frac{t_2}{0.693 C}$$

$$= \frac{2}{0.693 \times 220 \times 10^{-6}}$$

$$R_b = 131180 \Omega$$

Hence, due to unavailability of this value of resistor, 10k $\Omega$  was chosen as  $R_a$  and 15k $\Omega$  as  $R_b$  to give on time = 3.8115sec and off time = 2.284sec which approximately equal to the required time of  $t_1 = 4$ seconds and  $t_2 = 2$  seconds.

### 3.5 THE AMPLIFIER.

The function of an amplifier in an electronic circuit is to increase the low voltage to high voltage is called a voltage amplifier while a circuit designed to low current to a higher one is called a current amplifier.

An ideal amplifier must fulfill the following conditions:-

- i. The output signal must be of exactly the same in wave form shape as the input signal
  - ii. The output signal must be greater in amplitude than the input signal
- the first condition means that the signal wave form should not suffer any distortion during the process of amplification measures of voltage gain and current gain voltage gain given by: -

$$A_v = \frac{\text{output signal voltage}}{\text{input signal voltage}} = \frac{V_o}{V_i} \text{----- Equation 3.6}$$

and the current gain is: -

$$A_i = \frac{\text{output signal current}}{\text{input signal current}} = \frac{i_o}{i_i} \text{----- Equation 3.7}$$

The power gain of the amplifier is given by :-

$A_p = \text{voltage gain} \times \text{current gain.}$

$$= A_v A_i \text{-----Equation 3.8}$$

### 3.6 OPERATIONAL AMPLIFIER.

An operational amplifier is a directly coupled, high gain voltage amplifier designed to amplify signal over a wide range. The operational amplifier consists of internal configurations in linear ICs. It is so on can be connected to its terminals like resistors its external characteristics.

The operational amplifier is represented diagrammatically with a standard triangular symbol with inlet and outlet leads. The input of the operating amplifier can be single or double depending on whether input voltage is applied to one input terminal only or to both. Figure 3.5 shows the standard symbol of an operational amplifier.

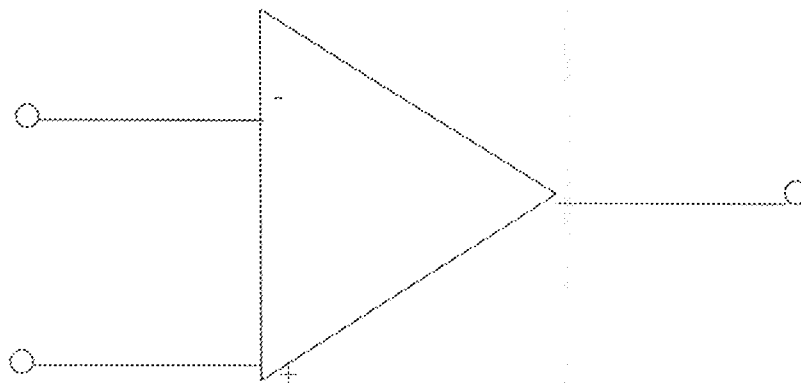


Figure 3.5 operational amplifier symbols.

### **3.7 DUAL ROLE OF SPEAKERS.**

The loud speaker converts electric impulses into audible sounds. It has a coil that moves in a magnetic field when a current is applied to it. The speakers used in this project have impedance of 30 ohms each.

The speakers are made to serve a dual purpose in this project design, that is, they serve as both loud speakers and microphone.

When speakers are connected to the input of high gain amplifiers they can act as microphone, changing sound energy into electrical energy. The audio amplifier is a high gain amplifier, hence the speakers used in this project design serve a dual role: microphone/ speakers; converting electrical energy to sound energy when the intercom is operated in the receive mode, or converting sound energy into electrical energy when the intercom system is operated in the send mode.

### **3.8 THE AMPLIFYING CIRCUIT.**

#### **AUDIO AMPLIFIER: -**

The function of the audio amplifier in this project design is to amplify the level of the alternating voltage converted from the audio frequency level to a level that can effectively drive the speaker. There is the need to match the amplifier's output impedance and the impedance of the speaker in order to ensure maximum power transfer.

The audio amplifier used in this project design is an operational amplifier (LM 386) I.C figure 3.6 shows the pin connection of the operational amplifier the incoming low-level signal from the input transducer to a high level signal.

The characteristics of the audio power amplifier used is shown in fig 3.6



The parameters of the audio power amplifier ( LM386) are input resistance

( $R_{in}$ ) = 50kohms

Operating supply voltage (min to max) = 5v to 18v.

Voltage gain ( $A_v$ ) = 46dB

Input bias current ( $I_{bias}$ ) = 250nA

input voltage =  $\pm 0.4v$ .

Minimum external parts

Storage temperature =  $-65^{\circ}c$  to  $\pm 150^{\circ}c$

Low quiescent current drain: 4mA.

Operating temperature  $0^{\circ}c$  to  $+70^{\circ}c$ .

ground referenced input

Junction temperature =  $150^{\circ}$

Output power ( $P_{out}$ ) (min) 500mw.

Low distortion: 0.2%.

The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value between 20 to 200.

1

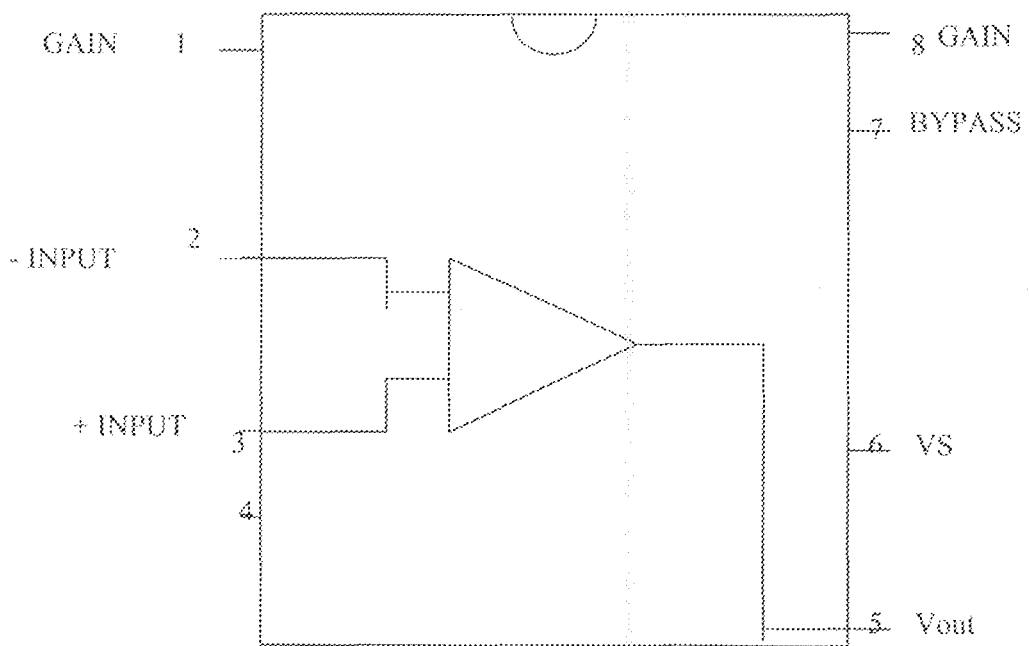


FIGURE 3 6b: - The pin connection of LM386

The circuit used in the design of the amplifier in this project is as shown in figure 3.6

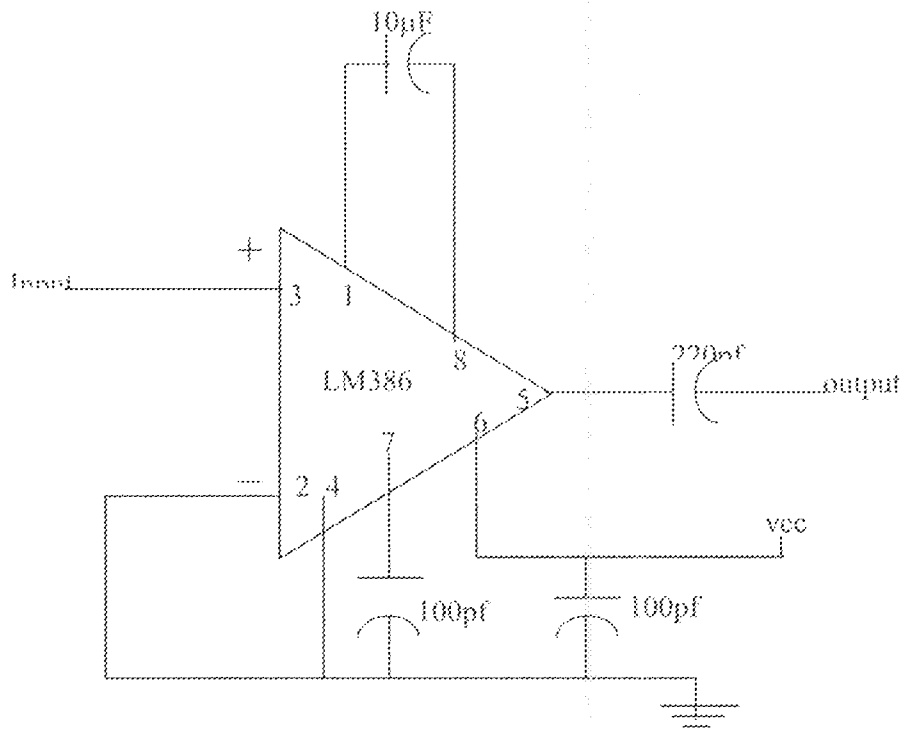


Figure 3.7: - The Audio amplifying circuit.

### 3.9. THE SWITCHING CIRCUIT

The switching used in this project design is based on transistor switching couple with and-gate with a monostable delay circuit.

#### 3.9.0 THE TRANSISTOR SWITCH.

When a transistor is used as a switch, it is either biased to be non-conducting or off, or it is biased to conduct the maximum possible current, or be on, when the base current is zero the transistor is held in its off condition. When the transistor is off it only conducts the very small collector leakage current and the voltage drop across the load is negligible and hence, voltage across the transistor in the off state, equal to the collector supply voltage. When the transistor is driven into saturation it is in its On-state. The voltage across the transistor is now its saturation voltage,  $V_{ce(sat)}$ . The figure 3.8 shows the entire switching circuit used in the design of this project. The maximum rating of the transistor used is as shown below.

The collector to Base voltage,  $V_{CB}$ , 45V.

Collector to Emitter voltage,  $V_{CE}$ , 45V

Base to Emitter voltage,  $V_{BE}$ , 5V

Collector current,  $I_C$ , 1.0A.

Power dissipation,  $P_0$  0.8mw.

Current gain,  $h_{FE}$  100.

#### 3.9.1 THE ANDGATE

The AND-gate is sometime called the all or nothing due to the form of its output, which is only high when the whole input are high. Figure 3.8 shows the pin-connection of the AND-gate used in the project design.

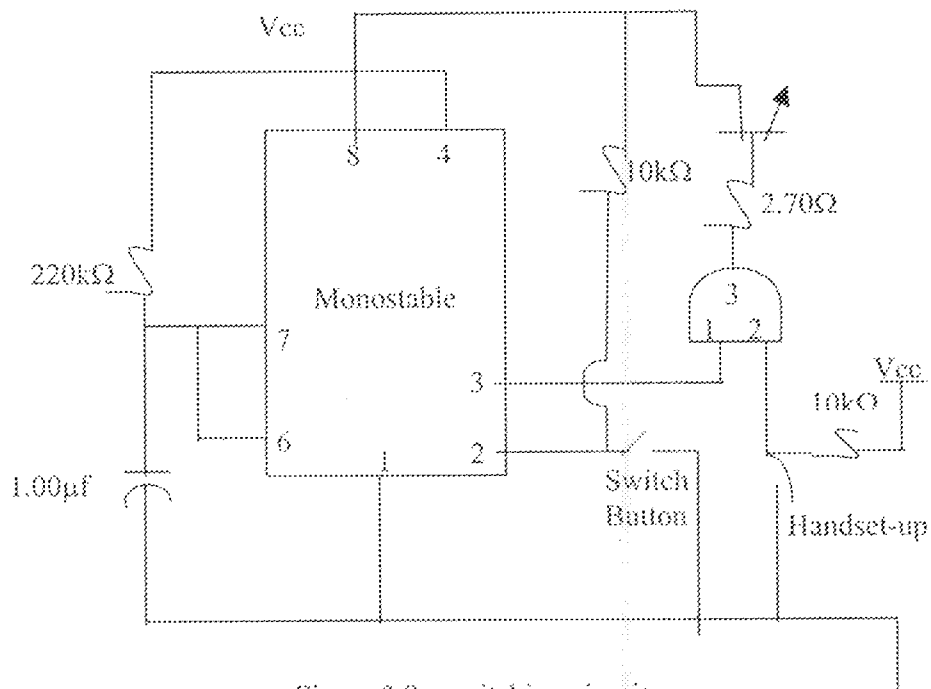


Figure 3.8:- switching circuitry

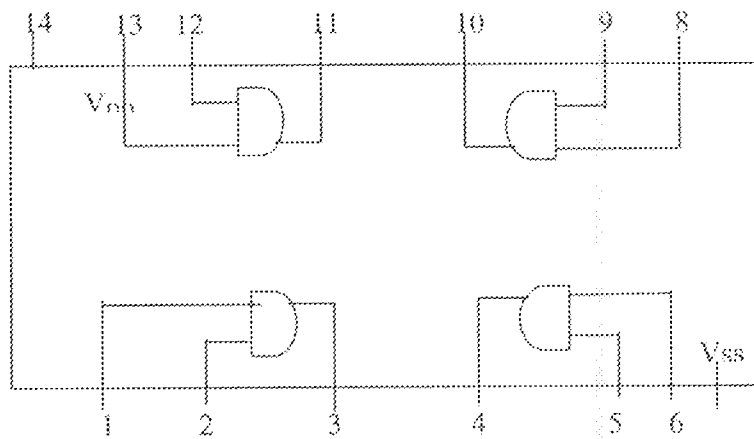


Fig 3.9: - Shows the pin-connection of Quad 2-input and -gate

### 3.9.2 THE OPERATING OF SWITCH CIRCUIT.

When a caller wants to make a call he lift his handset off the cradle of the telephone set, then press the switch button. Once the handset is off the

cradle, the state of pin 2 of and gate become high and the output of the monostable, send a signal to pin 1 and become high.

The output of the AND-gate then sends signal to the base of the transistor. The transistor then activating the remote ringing circuit. Once the called party picks his handset. The ringing tone is then cut off. But, in a situation whereby called party refuse to pick his handset. The monostable then cut off the ringing after about 24 seconds of ringing. The truth table for the state of the AND-gate is shown in table 3.2.

TABLE 3.2: -The truth table for the state of the AND-gate.

INPUT (Pin 1)	INPUT (Pin 2)	OUTPUT (Pin 3)
0	0	0
0	1	0
1	0	0
1	1	1

#### DESIGN CALCULATION.

The Delay circuit calculation.

$$T = 1.1 RC.$$

$$= 1.1 \times 220 \times 10^3 \times 100 \times 10^{-6}.$$

$$= 24.2 \text{ seconds.}$$

## CHAPTER FOUR

### 4.0 LAYOUTS AND CONSTRUCTION.

This chapter is actually on binging together various parts in the preceding chapters. The construction is divided into two main stages.

The first stage is experimental. This was done on the breadboard after the design of the circuits. Then necessary adjustments specifications: -

The second stage is the actual construction. This was done on the Vero board. This is after adjustments were made during the first stage.

#### 4.1 THE CONSTRUCTION THE CIRCUIT: -

The Amplifying circuit was first constructed on the Vero board. IC-holder was used for the LM386 which is the audio amplifier used. The IC-holder was used in order to ease fault being in the circuit and avoid damage to the IC due to overheating during soldering. The other passive components were then soldered following the design on the circuit diagram. Pins 2 and 4 were soldered to the ground, pin 3 to the voltage input, pin 6 to the Vcc and pin 5 as the output. Uniformity of the arrangement of components with the tested design was ensured which eliminates the removal of components for the purpose of correction.

The switching circuit was then constructed after the amplifying circuit. IC holders were also used for 555timer IC used for the constable. 14-pin IC holder was used for CD4081B and gate for the purpose earlier mentioned. The pin 14 was connected to the Vcc.

Pin 7 to the ground, pin 1 and 2 the inputs pin 3 to the output. The other passive components were then connected in accordance to design circuitry of the switching.

The tone generation circuit was lastly soldered following the design circuitry, using IC holder for the 555 timers used in the as table made to generate tone for the signaling.

#### **4.2 CONSTRUCTION OF CASING.**

The casing is the same with that of a conventional telephone the casing of an old telephone set was used. Although, the box has its own circuit, but it was removed and the constructed circuit place on the base. At each box, only one button was needed. So the others were removed and the only one needed was left for switching button. The Vero board was screwed approximately on the internal section of the box. The Vero board was first drilled at appropriate points before the screwing was done.

#### **4.2 PRECAUTIONS: -**

Several precautions were taken in putting this project. This was done to ensure the system works well with components not damaged in the process of construction so as to maintain a low cost of construction.



#### 4.4 SOME OF THE PRECAUTIONS FOLLOWED ARE: -

1. The circuit diagram was following during the breadboard and Vero board stages of the construction.
2. The values of the circuit components were ensured to be very close to their calculated values.
3. The correct polarity of the components used were correctly ascertained before soldering so as to prevent internal damages that may be caused to them.
4. Care was taken when soldering to avoid cold joint, which will then cause poor conductivity. The wire conductors used for interconnection are well insulated and flexible enough to avoid breakages.
5. IC holders were used to hold the ICs. this is to prevent the IC from being damaged by heat as a result of direct soldering onto the Vero board.

#### 4.5 CABLING.

0.5mm<sup>2</sup>, two pairs of telephone cable was used throughout the construction and realisation of this project.

#### 4.6 TESTING: -

Tests were carried out at different stages of the connection to ensure that the connections were done properly. The output of the tone generator and the delay circuit were tested in the laboratory using the oscilloscope. Continuity tests between interconnected points were carried out using AVDS30BUZ, digital multimeter.

## CHAPTER FIVE.

### 5.0 CONCLUSION.

This project gives an insight to the operation of telephone system especially as intercom system. It gives an adequate explanation of a 2-station intercom telephone system. The intercom was tested and worked well as a prototype design. The objective and aim of this project were fully achieved and the design and construction were realized.

### 5.1 PROBLEMS ENCOUNTERED AND LIMITATIONS: -

1. The hum noise from the signal circuit, in the generation of the ring tone. This was due to power from the rectified D.C. This was limited when higher value of capacitor was used to filter the rectifier. But, at the end 9-volt battery had to be used to obtain a good tone from the signaling circuit.
2. I had problem in deciding what to be used as my gravity-switch. I tried many switches but never worked as required, until when I used an old one on the telephone set used as the casing.
3. Coupling and bypass capacitors constituted their own problems too most of the time, the problem was due to wrong connection of the capacitor and improper soldering. This problem was rectified by giving consideration to the polarity of the capacitors during soldering.

## **5.2 ACHIEVEMENT:-**

The construction of the 2-station intercom system was fully achieved with the use of the simple switching, which made it possible for one to Call the remote station by simply pressing on the switch button on your set after removing the handset from the cradle. I was able to incorporate tone generator, which varied at certain interval of time of on time of seconds and off time of 2 seconds. The out put from the sample low voltage power amplifier was perfect, having a good quality, low noise output and audible.

## **5.3 RECOMMENDATION: -**

The work that has been done here can still be worked upon and improved on so as to make the system more efficient and compatible in line with modern trends. The following improvements could be made: -

1. Expanding the number of station, so that it could be used in a larger environment not limiting the numbers to only two persons alone
2. Reducing the number of pairs of cables used in the construction.
3. Making extra effort toward the construction of power supply that well filter to reduce the hum noise from the tone generator. This, I believe, could be achieved by using a very high capacitive value for filtering.

#### 5.4 SUMMARY: -

The intercom system worked as expected. However, the performance can be improved upon as earlier suggested in the recommendation.

The construction was done to make maintenance, and repair easy it is worth mentioning that the design and construction stages of this project exposed me to the techniques realizing circuit designs on paper in their hardware firms.

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