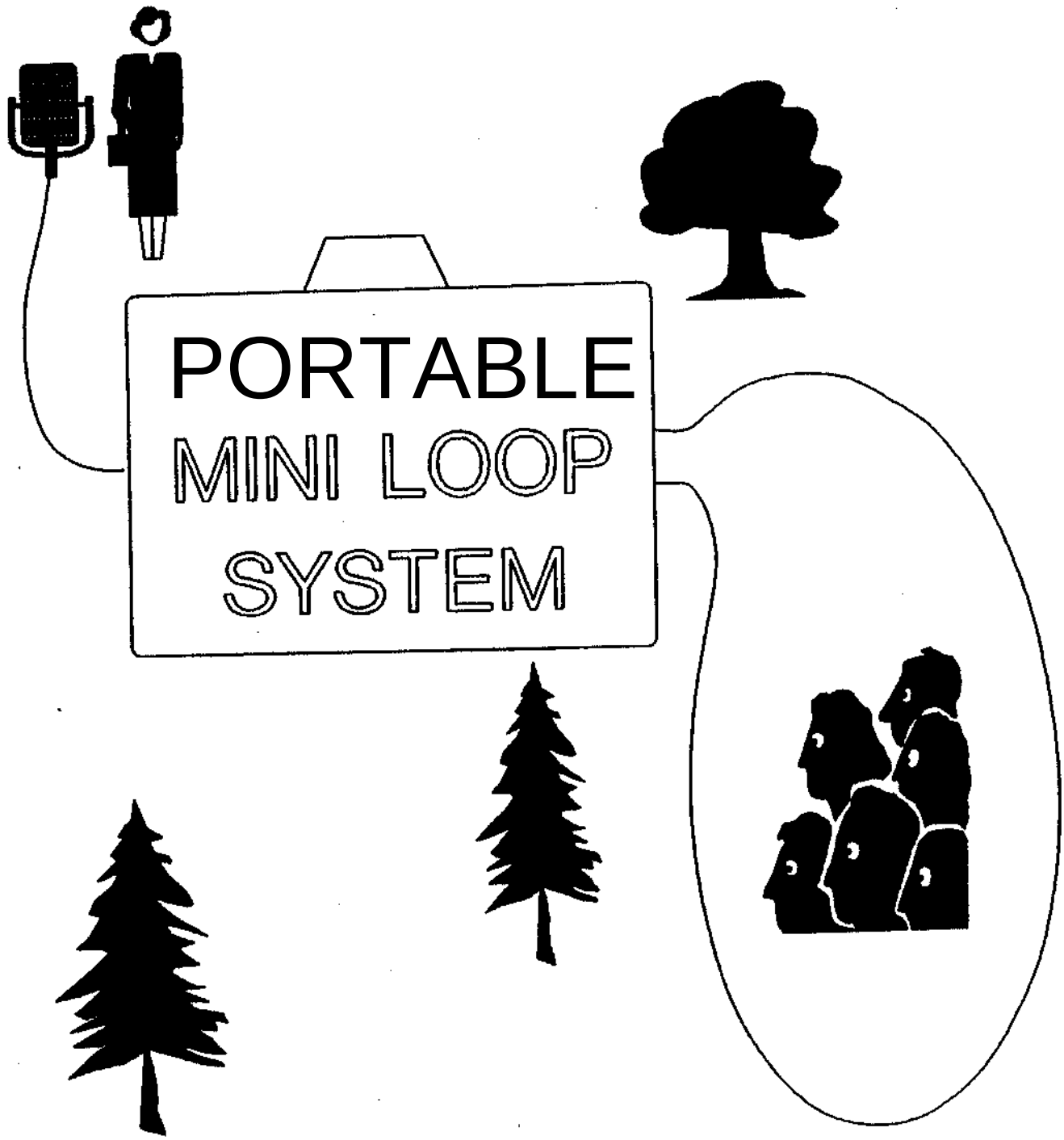
PORTABLE
MINI LOOP
SYSTEM

PORTABLE MINI LOOP SYSTEM

Reg No:M.9118

An independent project submitted as part fulfilment for the first year M.Sc(Speech & Hearing) to University of Mysore

ALL INDIA INSTITUTE OF SPEECH AND HEARING

MYSORE _ 570 006.

DEDICATED TO

My profession,My parents & dear sireesh.

CERTIFICATE

This is to certify that this independent project entitled

" **PORTABLE MINI LOOP SYSTEM** "

is a bonafide work, done in part fulfilment for the first year degree of Master of science (Speech & Hearing), of the student with Reg No: M9118.

MYSORE

Dr. (Miss). S. NIKAM

DIRECTOR

All India Institute

of Speech A Hearing

MYSORE - 6.

CERTIFICATE

This is to certify that independent project entitled

" portable mini loop system "

has been prepared under my supervision and guidance.

MYSORE.

Dr.(Miss).S.NIKAM
GUIDE
PROF. HEAD OF THE DEPT.
OF AUDIOLOGY
AIISH. MYSORE.

DECLARATION

I hereby declare that this independent project entitled

" PORTABLE MINI LOOP SYSTEM "

is *the result of my own study under the guidance of Dr.(MISS).S.NIKAM, professor and Head of the department of Audiology, All India Institute of Speech & Hearing, Mysore, has not been submitted earlier at any University for any other Diploma or Degree.*

MYSORE **Reg No:M.9118**

ACKNOWLEDGEMENT

I received great encouragement, support and guidance, from Dr.(Ms).S.Nikam. Director, AIISH Mysore, under whom I am a student of M.Sc. (Speech & Hearing). I am very greatful to her for all that has been received to prepare this project, I hope with her blessings this economical and effective device will come into existence.

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CONTENTS

INTRODUCTION

HELEN KELLER, that great deaf and blind lady was once asked, **"If you had a choice of having your eyesight** or **your hearing, which would you rather have ?"** Her answer rocked the world. For she considered hearing more important for one's happiness and social wellbeing. Modern day research has science proven Helen Keller correct. Deeply rooted in our ability to hear is our sense of security, Psychological and social wellbeing. So it is of little wonder that most people with hearing loss put off doing any thing about it, they need encouragement and support from the family and the concerned professionals.

Hearing Impairment has an devastating effect on the speech and language development of the child. The amount and the nature of deviation of the speech and language is largely dependent on the severity and age of onset of impairment. The professional help of right kind and time has always shown a constructive nature in the development of speech and language of the child towards normalcy. Hearing Impaired students deal with many different listening conditions in the educational environment. For the impaired, proper selection of the amplification is extremely important for language and speech development, because of the adverse effect of the hearing loss, it becomes most essential that the amplification system selected must provide the highest quality signals possible, so that the child is provided with the best possi-ble acoustic signals.

Properly selected amplification will have an important impact on language and speech acquisition because the development of speech and language relies heavily on the auditory modality. Properly selected amplification also enhances speech intelligibility for the child, which may be a primary factor in educational progress. Considering the crucial role of audition in early language acquisition, selection and fitting of hearing amplification systems are a shared goal of parents, educators and audiologist. The technological advances in hearing aid performance,ear mould modification's and a growing knowledge of speech sciences,child language development must be categorated into the process of selection of amplification systems,to ensure effective and appropriate amplification.The other important factor in addition to quality of amplification,is the duration of amplification a child is getting.

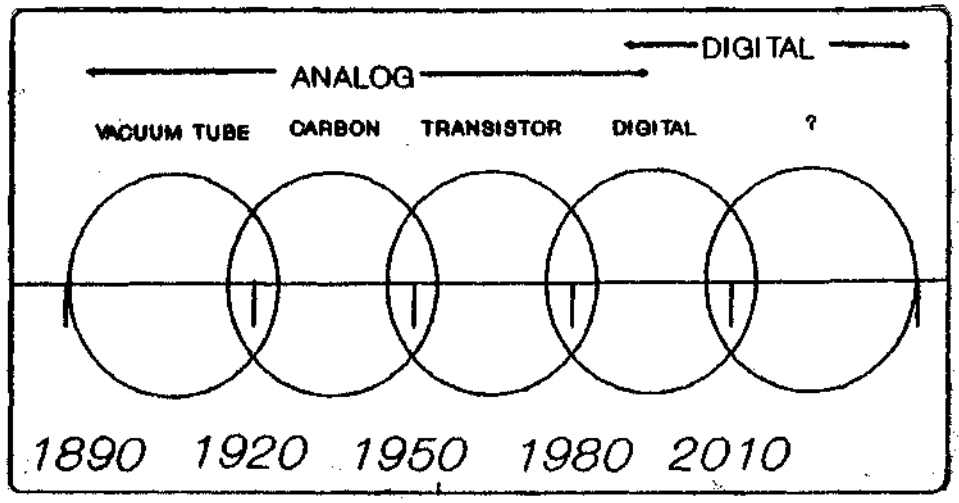
In a classroom setting, 3 options for amplification are available : personal owned hearing aid, school - owned auditory training systems and school owned system that may be used in conjunction with the personal hearing aid. From the last 5 decades electronic amplification devices have been used in schools for the deaf,group amplification being the best for the classroom teaching.

AMPLIFICATION SYSTEM FROM

VACUUM TUBES TO DIGITAL SYSTEM;

Hearing instrument that employ various forms of digital technology have been on the market for leas than 5 years, yet they are already having a significant impact on the field.

The major era's in the history of hearing instruments are given below in a schematic illustration.



Those periods have occurred about every 25 to 30 years. Each era overlaps with the preceding one, indicating that there is initially a merging of the technologies before the new technology reaches maturity and replaces its predecessor. During the period of overlap there were many high breed models, meaning that components from each technology were used in a single device.

Advances in hearing aid design generally have lagged a number of years behind the introduction of each major new technology and its application to the other areas. After a long period of acoustic hearing trumpets and horns, "ALEXANDER GRAHAM BELL'S" invention of telephone in 1876, led 20 years later to the first electronic hearing instrument i.e. the carbon transmitters. Although the triode vacuum tube was invented in 1907 by Deforest and was quickly adapted for radio and television applications, Vacuum tube (electronics) hearing instruments were not seen until the early 1920's. The present era began a few years after the invention of the transistor in 1947 by scientists at Bell laboratories.

Transistor technology made possible the development of ear level hearing instruments and the application of integrated circuit (I.C) design in the mid 1960's ultimately led to small, In The Canal Devices available today.

The offshoot of the technology of 1950's was induction loop system, the principles of induction were made use of for development of group amplification systems for schools for the deaf. Such systems still have utmost importance in the present era of digital amplification systems. Many surveys have shown that 45% of Indian School set-ups are fitted with induction loop systems, which is next to the hard wire group classroom amplification.

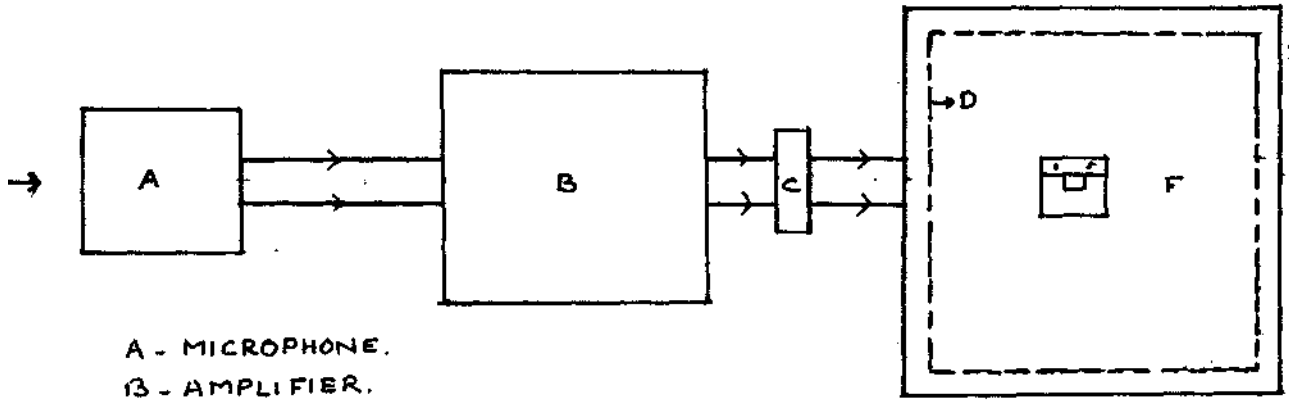
CONVENTIONAL LOOP IN USE

INTRODUCTION TO INDUCTION LOOP AMPLIFICATION:

Now for many years the two methods of amplification for the deaf and hard of hearing have been, the conventional hearing aid and the group amplifiers in the school.

Both devices inspite of the limtations, still remain as the available methods of amplification. In most programs for the deaf the group amplifier is the source of stimulation used during the classroom teaching, however the hearing aid becomes the sole means of providing amplification to each child all the time.

The induction loop amplification is one of the oldest systems next to hard wire group amplifications. The induction loop system consists of the following.



A - MICROPHONE.
B - AMPLIFIER.
C - TRANSFORMER.
D - LOOP WIRE IN CLASSROOM.
E - WALLS OF THE CLASSROOM
F - HEARING AID.

With time and experience it was found that this system was not the ultimate in group amplification. To overcome some of the problems of ILA like spill-over, null points and to have more sensitive electromagnetic signals ILA underwent few 'modifications.

WORKING OF INDUCTION LOOP SYSTEM :

The basic principle involved is that of electromagnetic induction.(Hal1iday and Resnik 1962). When a conductor (a wire) is carrying current, that current sets up a magnetic field around the wire. If another conductor is situated in the vicinity of the first then a current will be inducted into this conductor whenever a change occurs in the strength of the current through the first conductor.

Thus a loop induction system comprises of a microphone that is connected to a loop drive amplifier, the microphone may be fixed or free. The amplifier derives current (from the microphone) through a wire which is placed around the entire classroom; while the wire is placed at a convenient height. When a teacher talks into the microphone, current flows through the loop in synchrony with the speech, this current also sets up a synchronous magnetic field in the "T" coil in the child's Hearing aid which is able to sense the fluctuations of magnetic signals that is directed to the amplifier of the hearing aid and ultimately to the ear of the child. Thus use of electromagnetic induction does permit a good teacher child link.

ADVANTAGES 0F INDUCTION LOOP SYSTEM

- Improved mobility of students in the classroom as they are no longer tied to fixed system.
- Headphones, chords, control hooks could be eliminated.
- Many of the potential sources of restoration and failure can be eliminated.
- This maintains a good signal - to noise ratio for the 1istener.
- This system can cover a larger group of population at a given time.
- Easy to operate and maintain.

DISADVANTAGES OF INDUCTION LOOP SYSTEMS :

Unfortunately there are numerous disadvantages to loop system.

- Null point : Failure of the electromagnetic signal to the saturated classroom areas fully, resulting in a significant loss of hearing aid gain and different points with-in the classroom.
- Spill over effect : The magnetic field can cross walls that is from one room to another thus causing interference with amplified speech signals of the other class.
- The strength of the magnetic field varies depending upon the distance of the child from the loop.

CONSIDERATIONS FOR SELECTING GROUP AMPLIFICATION

Two fundamental criteria for successful use of classroom amplification are that the instrument operates adequately on a daily bases and they permit high fidelity reception of amplified speech in the poor acoustic condition that exist in many schools. The school factor, equipment and the listener factors are the three general areas of selection criteria utilised for choosing a classroom amplification system.

- The school factors.
- The equipment factors.
- The listener factors.

The School Factors

The following are the factors that should be considered prior to selection of any amplification system for the classroom.

- Identifying the acoustic environmental conditions of the classroom.
- Identifying the educational needs of the school program.
- Development of equipment monitoring programs.
- Identifying the personnel involved in the selection of auditory equipments.

Thus the selection of any amplification system necessitates a basic understanding of the needs and the goals of the educational setting. This includes recognition of the specific noise and reverberation conditions in the classroom and utilisation of appropriate and practical sound reduction techniques to minimise ambient noise and reverberation levels. Thus an audiologist needs to do a thorough study of the building acoustics.

The equipment factors

After the various school factors have been identified, the type of system that will be most beneficial to the educational programme should be considered. The factors include:-

- Type of system required.
- Service record of manufacturer.
- Ease of the equipment operation.
- Flexibility of the equipment.
- Budgetary considerations.

Perhaps the most important decision made by the purchaser is selecting a type of amplification equipment. A prevalent misconception is that the F.M wireless system is the only or the best classroom system under all circumstances. In fact, the educator and an audiologist may

choose among a variety of amplification systems, including hardwire arrangement, room loop system, infra-red systems or a F.M. systems. Each of these systems have applications for certain educational settings with unique advantages and limitations pertaining to different types of set-ups.

After the type of system is selected, the remaining equipment factors should be considered, for narrowing the choice to a particular manufacturer and model. Ease of operation, service requirements, including warranty and cost factors are of obvious concern. Some educational programs make the mistake of seeking amplification equipment for a particular group of children or a class without regard for the future needs of different expansion in the school programs.

The Listener factors

Another common misconception of classroom amplification system is that the selection and fitting of an individual system does not require the same basic care that is necessary when fitting the same child with a personal hearing aid. It cannot be emphasised too strongly that the list of factors that must be considered when selecting a personal hearing

aid also applies to the selection of classroom amplification units. For selection of group amplification units the factors include

- Coupling requirement of the units to the child's personal aid.
- Frequency gain and range considerations.
- Potential over amplification and trauma and residual hearing and auditory discomfort.
- Age of the listener.
- Physical and mental wellbeing of the child.

An effective amplification system for the classroom cannot be fitted unless, both the professionals i.e, Educator of the Deaf and the Audiologist follow the standards and look into the unique features and problems of the schools, which makes a particular system more suitable for that particular school.

PROBLEM

There have been many valid attempts to take care of **"Spill over", "Null points"** and "Production **of** more effective **and sensitive electromagnetic signals".** However the following are three specific problems which do not find place in the books of solutions to the problems of loop amplification.

Specific problem (a)

When using **any** type of loop system, it is important to remember that the teacher's voice is being delivered to each child in the room, no matter where the child is, no matter what the child is doing. With older children this usually presents no problems as the teacher almost always wants group communication. But with preschool children however the training situations are quite different. The group communication may comprise less than half the classroom time, the rest of the time is spent in free play or in small group activities or work. Hence when the children are separated in small groups, the teacher may intend to talk to only one group avoiding the other for separate instructions. If, however, the loop system is in operation the magnetic field permits the entire room with nearly equal strength of signals. The signal any child is receiving does not depend upon the proximity to the teacher. Every child under the loop will receive the teachers voice as loudly as those to whom the teacher intend to talk or instruct.

If for example, the teacher is communicating with an active loop in a free play activity and instructing a group of children to make **"crow sound"** and the other group in the class to **"pile up the blocks".** The later group of children here making of the crow sound to associate with activity of piling of blocks and vice versa. This situation is hardly conducive to any meaningful language development and auditory training.

Specific problem (b)

It is commonly experienced that the children are deprived of advantages of group amplification which they get in a classroom, when they arrange a picnic or a group activity in a playground, unless and until a F.M system or an infra-red system is used. However, it is very difficult to think of loop amplification in open air, because there is no such loop system developed in our country which is portable enough to be carried along with the teacher.

Specific problem (c)

Once an induction loop system is installed in a classroom of a school or in a resource room of a clinic, the teachers are bound to use only that room for group communication activity. In this way each room has to be fitted with induction loop system. Many times it is seen in the schools that all the systems are not used at the same time. However when we have a portable unit of amplifier and transducer which can be coupled with the loop system fixed in a room earlier as and when required.

WHY PORTABLE MINI LOOP SYSTEM

a) The limited / restricted range of the system will allow the use of two systems simultaneously in one classroom.

b) The portability of the system will allow the use of this system even in open places. Thus the children will be getting the advantage of the group system.

c) The limited range of the system demands sitting arrangement near to it. This reduces the distance between the teacher and the students. Hence there are better visual clues for the child.

d) The reduced size and portability of the system reduces the maintenance cost.

e) Purchase of three to four such systems will not unbalance the budget of the school.

f) In many rural schools when the loop systems go out of order, the authorities find it difficult to find servicer personnel. In a mini loop system it can be carried and be rectified.

g) Any room of the school or the clinic can be used as a group therapy room by coupling mini loop system to the already fitted loop wire in the room.

h) The last and the most important, children use their own hearing aids and are thus practising with these all the time without changing over to any other headphones or equipment.

SPEECH PATHOLOGIST WITH MINI LOOP

MINI LOOP & ITS COMPONENTS

ELECTRONICS FOR YOU:

The use of the amplifier in electronic products is very important. The main function of the amplifier is to increase signal strength. In other words, the amplifier makes the output signal larger in amplitude than the input signal. This increase in amplitude is called the gain of the amplifier.

Amplifiers are divided into two general classifications: small-signal amplifiers and large-signal amplifiers.

Generally, the small-signal amplifiers are voltage amplifiers and operate class A in common-emitter or common-base connection. Large-signal amplifiers are identified as power amplifiers. These power amplifiers are biased to operate at class B or class A, and are arranged in either a common-emitter, common collector, or common-base configuration.

A change in voltage, current, or power in a circuit can be measured in decibels. A positive decibel value means an increase, and a negative decibel value shows a decrease, in the signal between the input and the output. The most popular amplifying components in consumer products are transistors and integrated circuits. The transistor causes a change in current between the input and the output. This change is expressed as a beta value.

The transistor is designed to operate within certain limits. Having the amplifier operate outside these limits will result in distortion. To insure proper operation of the transistor, a set of characteristic curves is used. There are three different classifications of amplifiers: the common emitter, the common collector, and the common base. The common emitter is a linear amplifier, because it reproduces the full input at the output. The signal is applied to the base-emitter leads, and the output is taken from the collector-emitter leads. Simple forms of Ohm's law and Krchhoff's law can be applied to solve amplifier biasing problems.

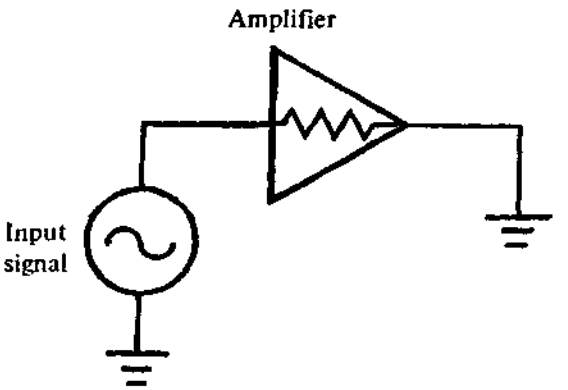
Common-collector amplifiers are designed so that the signal input is found on the base and collector and the output is taken for the collector emitter. Because output is taken from the emitter, there is no phase shift between input and output. This amplifier is sometimes called the emitter follower. It is commonly used as an isolation amplifier, and is often followed by a common emitter. The common base amplifier is the third type of amplifier found in consumer products. The input of this amplifier is between the base and the emitter, the output is taken from the base and collector. This amplifier is generally used in high-frequency areas such as RF amplifiers.

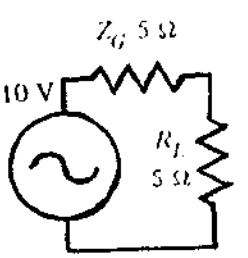
Each amplifier has a set of impedance characteristics. To achieve maximum power transfer from the signal source to the amplifier, the impedances of the generator and load must be matched. If these impedances are not matched, the signal will be distorted. Each of the three configurations of amplifiers has specific input impedance characteristics important to the service technicians.

Amplifiers can be biased to generate different degrees of wave-form at the output. Class-A amplifiers generate a full 360 degree waveform at the output. Class B amplifiers generate 180 degree of waveform at the output, and class C amplifiers generate less than 180 degree waveform.

Comparison of Class A. B. and C Operation

Class of Amplifier	Advantages	Disadvantages	Applications
A	Lowest waveform distortion	Lowest efficiency used only for small-signal app-1icat ion.	Preamplifier low-power stages
B	Fairly good effi-ciency, since no power used unless signal is present.	On1y half of waveform present Used mostly with pair of transis-tors to reproduce both halves.	Power amplifiers, audio outputs.
C	Highest efficiency because current flows in bursts during part of waveform.	Several distor-tions. Only 30-50% of each wave-form amplified.	Used in trans-mitters.





$$I = \frac{E}{Z_G + R_L}$$
$$= \frac{10\ \text{V}}{5\ \Omega + 5\ \Omega}$$
$$= \frac{10\ \text{V}}{10\ \Omega}$$
$$= 1\ \text{Amp}$$

$$P = I^2 \times R_L$$
$$= (1)^2 \times 5\ \Omega$$
$$= 5\ \text{W}$$

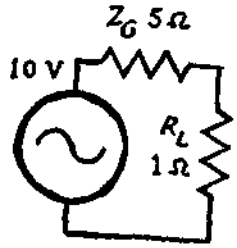
(a)

AMPLIFIER IMPEDANCE CHARACTERISTICS.

Amplifiers have an important characteristic: "impedance". Impedance is defined as the total resistance offered to an AC signal. Input impedance is the loading effect the amplifier will present to a signal source. Figure .1. is an example of a signal connected to an amplifier. When the input signal source is connected to the amplifier, the signal source sees the amplifier as a load, not as an amplifier. The load seen by the signal source is the input impedance of the amplifier.

As was mentioned earlier, different amplifier designs will offer different impedances to the signal source. Therefore, just as amplifiers offer different input impedances, so also do signal sources. For example, a microphone might have an impedance of 100 k, whereas an antenna might offer an impedance of only 50, hence the resistances of the signal source and the amplifier must be made equal. This process of making the two impedances equal is called impedance matching.

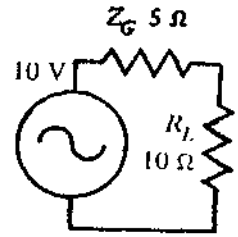
The importance of having equal impedances for the load and the signal source is illustrated in the three parts of Figure. In Figure 2a, Zg is identified as the imped-anceoffered by the signal source, and R1 represents the resistance offered by the amplifier circuit. Also, note the



$$I = \frac{E}{Z_G + R_L}$$
$$= \frac{10\ V}{5\Omega + 5\Omega}$$
$$= \frac{10\ V}{6\Omega}$$
$$= 1.6\ A$$

$$P = I^2 \times R_L$$
$$= (1.6)^2 \times 1$$
$$= 2.6\ W$$

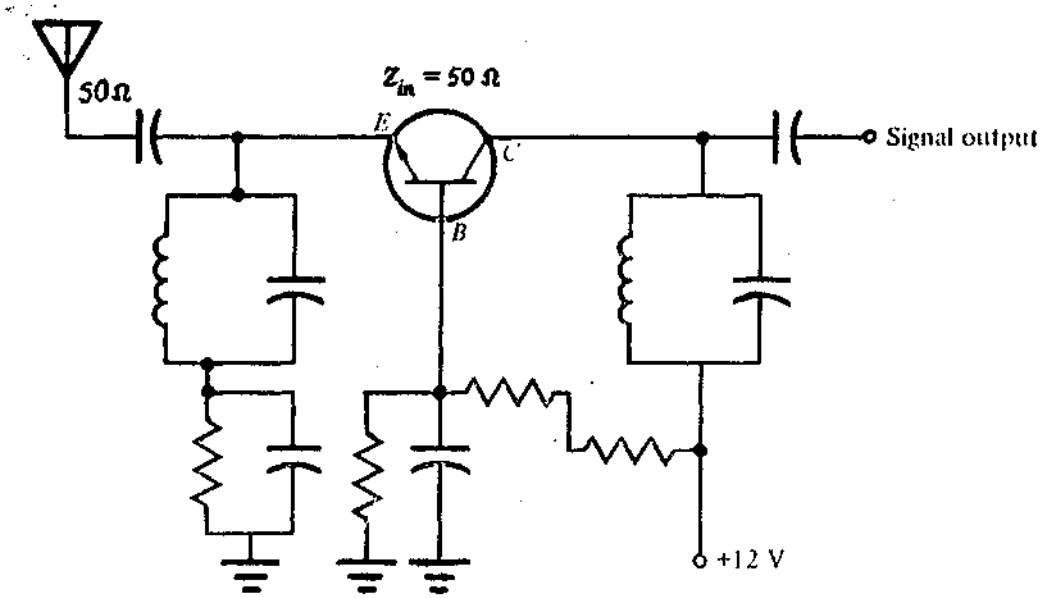
(b)



$$I = \frac{E}{Z_G + R_L}$$
$$= \frac{10\ V}{5\Omega + 5\Omega}$$
$$= \frac{10\ V}{5\Omega}$$
$$= 0.666\ A$$

$$P = I^2 \times R_L$$
$$= (0.666)^2 \times 10$$
$$= 4.4\ W$$

(c)



signal source produces an output signal equal to 10 V. The two resistance are connected in series and therefore can be added. This will result in a total resistance of 10 for the circuit. The simple Ohm's law calculation shows that a total current of 1 A is developed in this circuit. Power developed in the load can now be calculated, using the equation $P = I^2 X R_1$. Solving this equation, the load power is found to be 5 W. In figure 2b, note that the load resistance has decreased to 1.6 A The power for the load, 2.56 W, has decreased. In figure 2c, note that the load resistance has increased. This results in a decrease in current, as shown. The power for the load has increased.

The only part of this example where the power is equally divided between the load and the signal source resistance is the point where the signal source resistance and the amplifier's resistance is equal. At this point, the maximum power is developed at the amplifier.

To accommodate the maximum power developed between the signal source and the load, the proper input impedance should be used. These proper impedances can be obtained by using one of the three types of amplifier designs. For example, Figure 3 shows a common-base amplifier connected to the antenna of an audio. Because the antenna develops 50 and the input impedance of the common base matches that resistance, this amplifier configuration is a good selection.

INTEGRATED CIRCUITS:

AND OP_ AMPLIFIER

Integrated circuits are classified as linear amplifier or digital. The most common linear circuit is the operational amplifier, or op amp. The op amp has several characteristics that make it ideal for consumer products. These qualities are as follows:

1. High open-loop gain
2. High input impedance
3. Low output impedance
4. Rejection of unwanted signals.

The foundation of the op amp is the differential amplifier. This amplifier will provide an inverting input and a non inverting input.

The op amp is built on a single silicon chip. This type of construction is called **monolithic construction.** The chip is housed in one of many plastic packages, the most common being the DIP style. Biasing of the op amp is established to provide the proper gain for the amplifier. To ensure proper amplification, the input terminals of the op amp must be balanced. To develop this balance, an offset resistor is used to connect the unused terminal to ground. Amplification is affected by the frequency applied to the amplifier. The rate at which the out put voltage changes is called the slew rate.

The gain of the op amp can be calculated as the ratio of the feedback resistor to the input resistor. To control the amount of gain, the op amp uses negative feedback.

In the closed-loop operation, the gain of the op amp is limited by the frequency. Generally, op amps are designed to operate within the audio range. Op amps have a wide variety of applications used in consumer products. Op amps are most commonly found in amplifier circuits, but are also used in filtering networks. One of the most popular uses of the op amp is as a voltage regulator.

Integrated circuits are also assembled by the monolithic process. An integrated circuit is the combination of various circuits into a single package. Sometimes it may become necessary to combine digital and linear functions into one circuit. An example is the PLL system. This system is used to reduce the number of components, along with providing the necessary circuit application.

CHARACTERISTICS OF *OP* AMPLIFIER

The most common of the integrated circuit (IC> amplifier is the operational amplifier, or OP amp. This circuit will give good linear amplification to input wave forms. The gain

of this amplifier ranges from a low of 1 to several thousand. This wide range of operation makes the OP amp an attractive component for use in consumer products. External feedback is the means by which this wide range in gain is accomplished. The OP amp without feedback is described as being in an open mode loop. The characteristics of the ideal OP amp are as follows:

1. **Open loop gain-The** OP amp can deliver high amount of gain. Using feedback will control the gain of the OP amp.
2. **High, input impedance** - OP amp will not load the input signal source.
3. **Low output impedance** - The OP amp can deliver an amplified signal to low impedance sources without signal distortions.
4. **Common mode** rejection - The OP amp has the ability to reject noise and hum present in the signal.

These qualities describe the OP amp as an ideal amplifier.

BASIC OP **AMP** OPERATION

The fundamental operation of the OP amp can be illustrated by a circuit called the differential amplifier. The schematic symbol for this amplifier is shown in fig. no 1. The differential amplifier is designed to respond to the difference between two input signals. An amplifier that

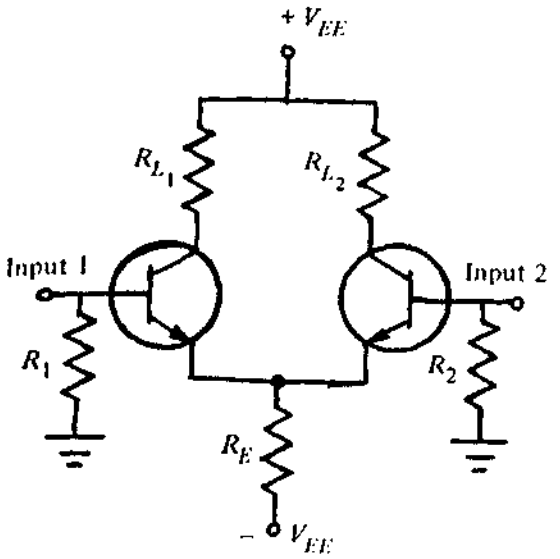


Figure ■–1. ***Schematic diagram of a differential amplifier***

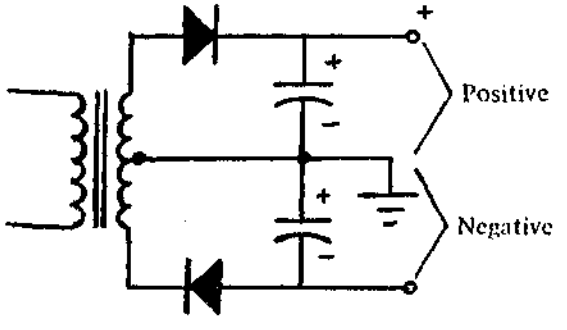


Figure ■–2. ***Schematic diagram for a dual-polarity power supply***

has two input signals and gives an output by comparing the difference between the two signals is a differential amplifier. We can see in fig. 1. that the differential amplifier requires two power supplies for operation, one output of the power supply being +ve, and the other output being -ve. Fig. 2. shows the schematic diagram for this dual low voltage power supply.

Although the differential amplifiers has two inputs, it can be driven with only one input. With only one input wave-form, an output will be developed for Ql and Q2.

In operation, an input signal appears at the base of Ql. This signal is going in the +ve direction, because this signal is increasing, forward bias on Ql conduction through the transistor is also increasing. With an increase in the conduction, the resistance of Ql must be decreasing between the collector and emitter terminals. Therefore, more current will develop through the transistor, and a large voltage drop will occur at the load resistor. Because the resistance across the collector emitter junction is decreas-ing, the voltage drop is also decreasing. The voltage is said to be going in -ve direction. This -ve going voltage causes an inverted signal at the output. Fig. 3. shows an example of the output developed at Q1.

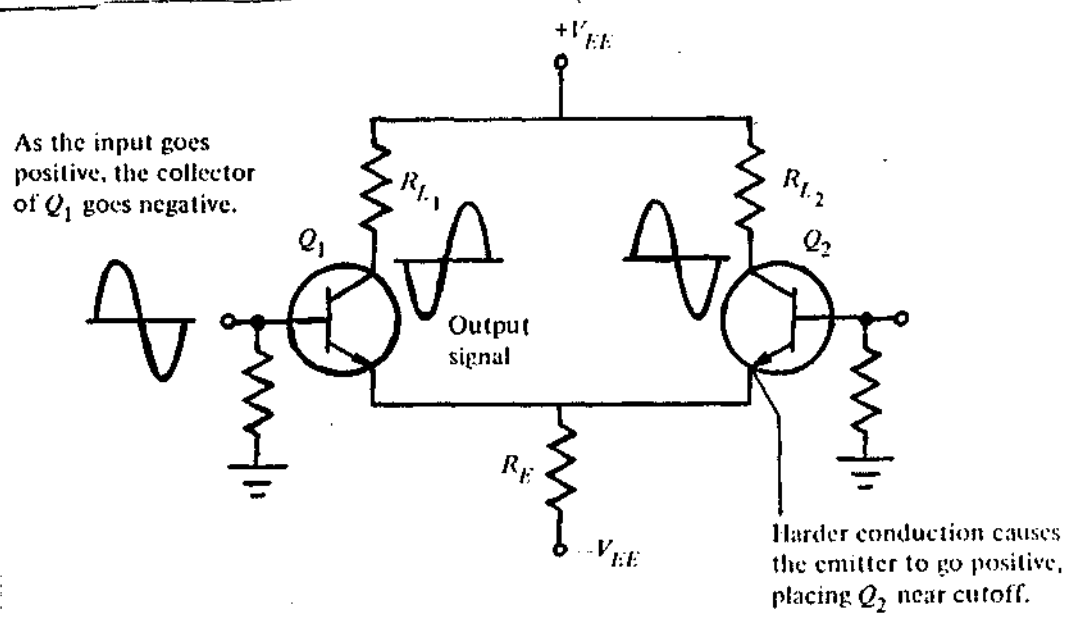


Figure 3–3. ***Waveforms for*** $\mathbf{Q_1}$ ***and*** $\mathbf{Q_2}$

The conduction through Ql has an effect on the conduction through Q2. As Ql is turned on by the +ve going input signal, the current through the emitter resistor is also on the rise. This increase in the current flow is causing an increased voltage drop across the emitter resistor Re. Thus, the voltage at the emitters of Ql and Q2 will be going in the +ve direction. This increase in the emitter voltage has the same effect as lowering the base voltage to the cut off region. This results in less conduction through Q2. A lower conduction means less current through the load, and therefore a greater voltage drop at the load. The collector voltage of Q2 then is being made more +ve. Fig. 3. shows this action.

With the input on the base of Ql an inverted signal (180 degrees phase shifted signal) and in non inverted signal are available at the differential amplifier output. In addition, this amplifier circuit is very selective in the signals it will amplify. Unwanted signals from the filtering circuit in the power supply, or a line hum developed in the circuit, are rejected. This ability to reject unwanted signals is one of the most important characteristic of the differential amplifier and is also an one of the unique qualities of the general OP amps.

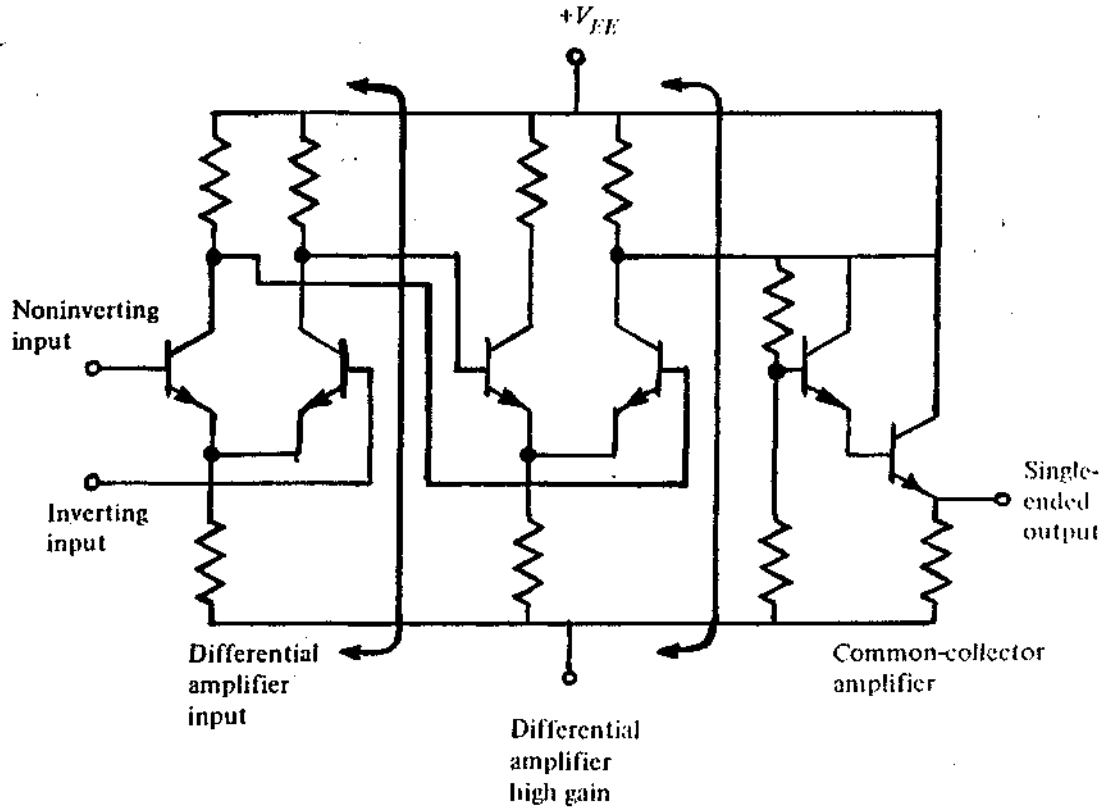


Figure ■-4. ***Three sections of op amp***

The gain of the differential amplifier can be found from the formula for basic gain of an amplifier. The formula is **Av (diff) = signal output / signal input** . The fig. 4. shows the general circuit diagram of the OP amp. Notice that the differential amplifier is the first block in the OP amp circuit. The differential amplifier is placed first because it develops high input impedance, and good gain. Also notice that there are two inputs to the differential amplifier, the inverting input and the non inverting input. The next block in th OP amp circuit is a high gain amplifier. This high gain amplifier develops additional gain to the input signal.

The final block in the OP amp is a signal ended amplifier. Generally, a common collector amplifier is placed in this section. Because of the low output impedance of the common collector amplifier, the OP amp can be a good impedance match to input of any amplifier. Notice that the output to the load is only one terminal. This is why this circuit is described as single ended. A single ended output will develop only one output phase in the signal as it relates to ground. This is the reason there are two terminals at the input of the OP amp. The OP amp can develop either an inverted or a non inverted signal depending on the terminal connection at the input. The fig. 5. shows the standard schematic-symbol for the OP amp. One terminal is marked +ve, and the other is marked -ve. When the input signal is connected to the +ve

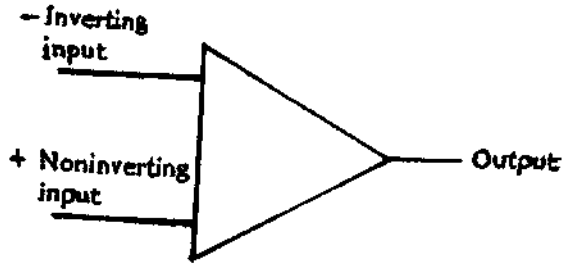


Figure ■–5. *Schematic symbol of op amp*

terminal, the signal is not inverted. When the input signal is connected to the -ve terminal the signal is inverted between the input and output. This schematic symbol is the standard symbol used in linear circuit application.

OP AMP **CONSTRUCTION**

Several different transistors and resistors can be used to built an OP amp. See the fig. 4. for an example of building this circuit with discrete components. Constructing the cir cuit in this fashion is time consuming, and the circuit itself is relatively large in size. One way to reduce both the size and the cost of the OP amp is to use **Integrated Circuits.** The process of placing the three different amplifier circuits of the OP amp into one package is called **integration.** These circuits are placed on a thin layer of silicon, and then housed in a plastic package. The integrated circuit chip is made by the **monolithic process.** In the monolithic process the transistor, the resistor, diodes, and other circuit components are placed on a single thin layer of silicon material. The placement on the wafer is done photographically. Integrated circuits are not only smaller and cheaper than discretely big circuits, they are more efficient. The technology of I.C, has lead to the lowering cost of the electronic products.

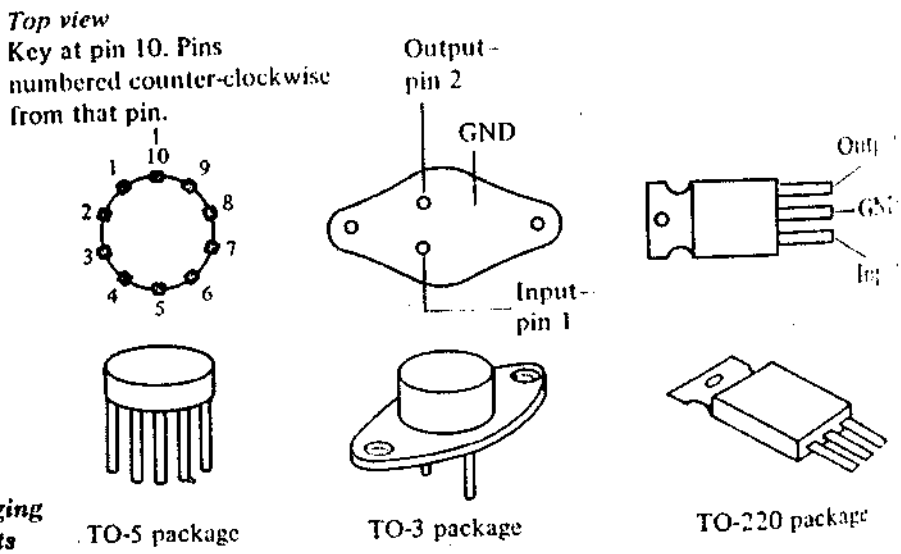


Figure 12–6. ***TO packaging styles of integrated circuits***

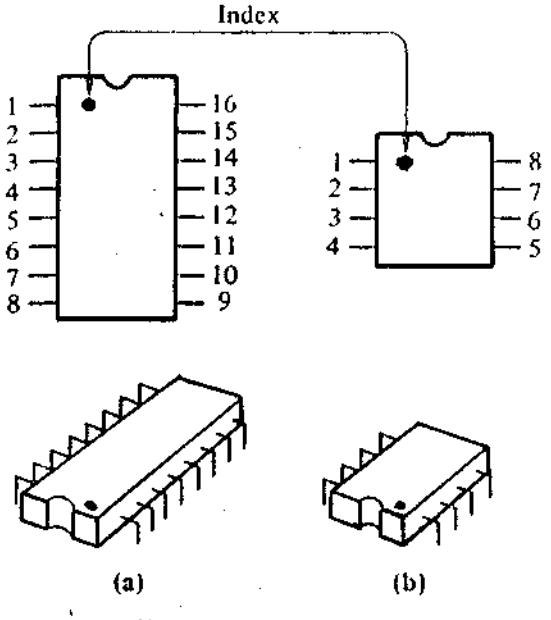


Figure 12–7. ***Dual in-line packaging (DIP) styles*** (a) ***16-pin DIP*** (b) ***8-pin DIP (mini DIP)***

Once the small silicon chip is manufactured, it must be placed into a housing. The integrated circuit come in a wide variety of packaging styles. Some of these packages look like transistor housing. The fig. 6. shows examples of the TO style of packing I.C, chips. Another type of packing used with I.C is shown in fig. 7. This style is called the **dual in-line package,** or **dip.** The packages in fig. 7A, has 16 pins connected externally. These 16 pins are connected to the internal circuit on the silicon wafer. Generally, a DIP will have 24, 16, or 14 pins connected to the external shell. The fig. 7B, shows the mini DIP. This package style has only 8 pins connected to the external shell.

An individual working with I.C should understand the pin numbering system on the I.C use on the OP amp. In th DIP series of packaging, the numbering of the pins is always the same. There is a notch at the top of the chip. To the left of this notch is a circle. This circle is in line with pin 1. The pins are numbered counter clockwise around the chip. The fig. 7. shows the numbering system. If a pin identification is not clear, an I.C manual should be consulted. In the present project, the I.C used for developing portable mini loop amplification system is **IC.LM.741C and LM.709.**

INTRODUCTION TO PORTABLE MINI LOOP SYSTEM:

Portable mini loop system is an indigenious equipment, constructed, aiming to break the four walls of the conventional loop induction amplification system. The size and the antenna of this system provides it with mobility and portabi1i ty.

The wooden box of the system is 15 X 12 X 3 inches. The total weight inclusive of the microphone, antenna and power supply is only 1.2 Kg. Its not only the weight and size, but also the ease of the operation which will bring popularity to this economical system among the professionals.

The following are the different sub units of Portable mini loop system:

a) Microphone with external wire (dynamic),
b) The wooden box (circuit),
c) The antenna.

a) MICROPHONE: The microphone used with the unit is a dynamic microphone, highly sensitive and bring a wide range of frequency response.

MINI LOOP AT A CLOSER LOOK

b) THE WOODEN BOX: The wooden box is the brain and heart of the system. It is loaded with two important circuits i.e. a pre-amplified and a power amplifier. The circuit is IC. based. The pre-amplifier has LM-709 IC, and power amplifier with IC LM-741-C, are highly chips circuit for speech sounds amplification. The other important input is power supply-unit.

The system runs on 15V D.C. current, two 9 volt batteries are used as power supply for this unit.

c) THE ANTENNA: Copper wire of guage 20 and of length 25 meters is used as an antenna. When not in use. this antenna wire can be rolled in the wooden box. The total weight is 230 gms.

This equipment is one of its own kind which can be used by professional in any class room or even can be installed in a therapy park. With such an equipment a fixed room for group therapy is not required and the benefit of group amplification will be enjoyed by the hearing impaired children in open places like parks too. The integrated schools will find this unit very economical and effective as it can be shifted to any class room as and when required.

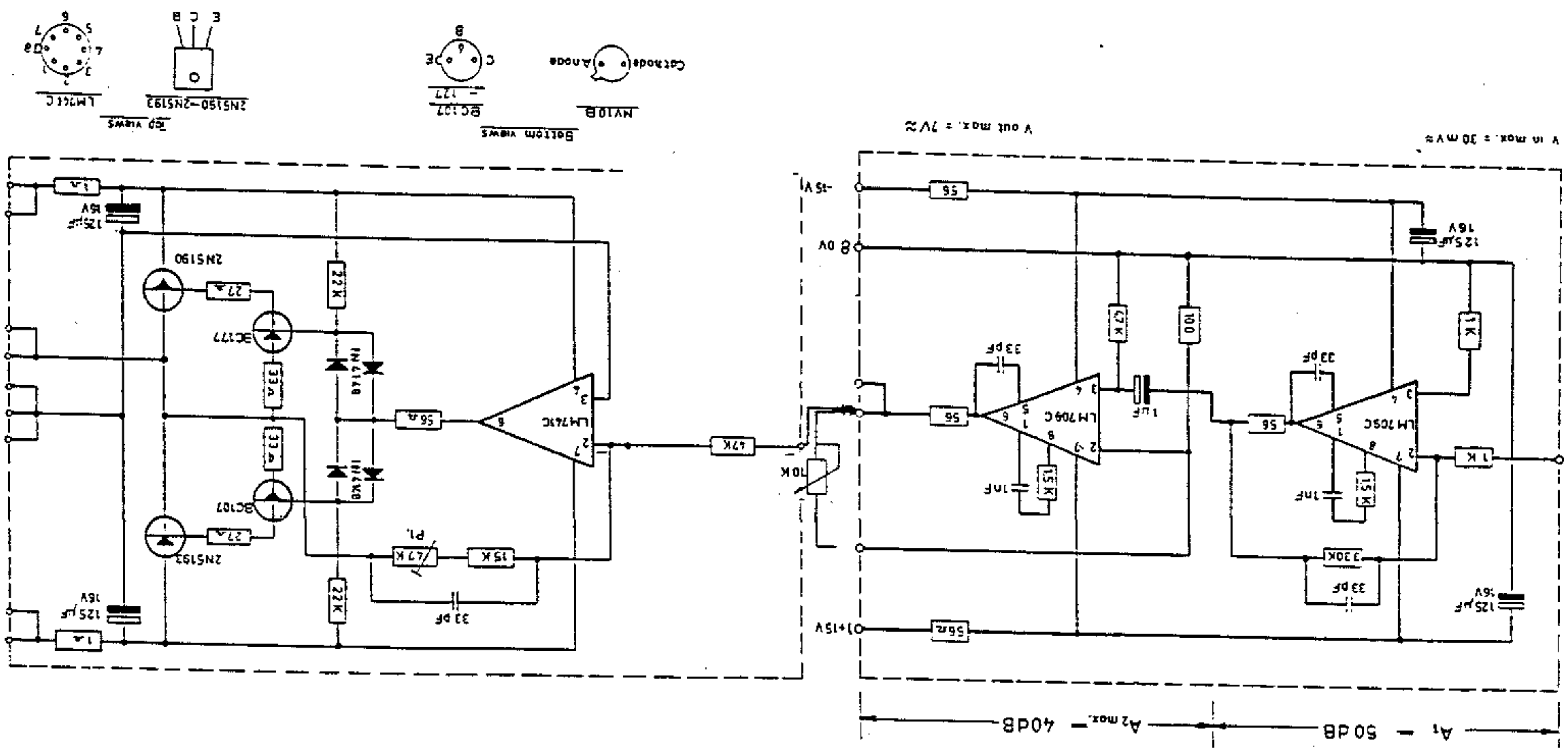
MINI LOOP IN USE IN GROUP
. THERAPY SESSION

SETTING UP OF THE UNIT FOR USE:

This D.C. driven unit can be installed at desired place. Before switching on the unit for use, the operator of the system need to roll out the antenna wire form the box. this antenna wire should be spread carefully on the ground. The total area covered is around 15X12 feet.

Following this, the ends of the antenna need to be plugged into the output socket of the power amplifier. Once the antenna is arranged and microphone taken out from the box, the system is ready to be switched on to make in use.

Following the use of the system, the antenna wire can be carefully rolled back in the box after plugging it off from the output of the power amplifier. The microphone is also placed back into the wooden box. Thus, it becomes a compact unit which can be stretched at any place and time to bring in use.



CIRCUIT DIAGRAM

THE CIRCUIT OF THE UNIT:

The total circuit of the system consists of a pre-amplifier and power amplifier. The pre-amplification stage which makes use of LM.709 IC. operational amplifier. This pre-amplifier is a two stage amplification system. The first stage of this amplifier gives a gain of 50 dB and the second stage of pre-amplifier provides with maximum of 40 dB gain. Acoustic input to this is given through a dynamic microphone connected between the inverting terminals of the IC. and the ground. The overall output of the pre-amplifier can be adjusted by the help of potentiometer or preset connected in the feedback network. The overall gain of the pre-araplifier can be adjusted by changing the setting of the value of preset or the potentiometer connected in feedback network.

The output of the pre-amplifier is then fed to power amplifier. The input stage of which consists of IC LM.741C (operational amplifier). The output of this is fed to class B pushpull output stage for further power amplification. The final stage of this power amplifier consists of power transistors to boost the power to a higher values at a very low voltage. The power supply to this unit is dual *±15* volts at the pre-amplifier unit which drives the total system.

The output of the power amplifier is then given to the antenna which radiates the induction through the total length of the loop.

FIELD REPORT:

AIM: This report aims to project the efficacy of the portable mini loop system (T-position of the hearing aid) in comparison with the body-level hearing aid at M-position.

SUBJECTS: Group of 10 subjects was taken.

GROUP-I consisted of five hearing impaired subjects with age range between 8 to 13 years. These subjects had severe to profound hearing loss and were using a body-level hearing aid at M-position.

Hearing aid used were Arphi, Elkon, Novax-strong class.

All the subjects had equal number of hours of exposure to group therapy sessions and were attending in addition to speech therapy at AIISH, special school too.

GROUP-II consisted of five normal hearing adult subjects.

METHODOLOGY: For field trial, the hearing aid was set at T-positicn and mini portable loop system was introduced for therapy.

All the five subjects of group-I were compared for the following skills between M-position and T-position (with new portable mini loop system).

The skills taken up were:

1. Auditory skills
2. Speech comprehension skills
3. Group communication skills

1. AUDITORY SKILLS: A group auditory training programme was introduced in which the child was expected to point out to the picture of

* Drum
* Kanjeera
* Table tap, whenever child heard them.

All the five subjects were tested individually.

2. SPEECH COMPREHENSION SKILLS: Child was expected to point to the picture which was called out by the therapist. The following ten cards were taken:-

Cat, Dog, Goat, Elephant, Table, Car, Camel, Ball, Bat and Mango.

3. COMMUNICATION SKILLS: While testing, two children were expected to exchange block, on deamnd with each other.

RESULTS: GROUP I, No significant difference has been found out in the performance level of children between the M-position of the hearing aid and the T-position used in conjunction with portable mini loop system.

GROUP-II: 5 normal hearing adult subjects were tested in order to account for the fidelity of the system in a two room situation. All the 5 subjects were wearing mild class body level hearing aid with the volume setting at 1.5.

10 spondees and a PB word list was used to check the speech reception and discrimination of each subject.

RESULTS Out of 5 subjects, 4 subjects got 100% scores on both the tasks and one subject got a score of 98%.

DISCUSSION: the field study using portable mini loop syBtem gives a clear indication that its efficacy is not different from that of hearing aid when used at microphone setting to that of T-position with mini loop system.

The use of the system with normal hearing subjects revealed that the induction generated by the mini loop is of high fidelity.

The battery consumption and drain by the system has not been studied in the field trial.

The frequent rolling and unrolling of antenna wire from the box may subject it to break down.

The induction generated by the system is limited to the area covered by the antenna on the ground. The best reception by the hearing aid is within the area of the antenna (25 feet). However, the induction at the outer circumference of the antenna is limited to only 3 feet.

The single microphone used in the system might not provide same strength of the signal as the subjects move away from it.

Hence, care should be taken to over come this problem by using an additional microphone.

The total cost of the system is around Rs.550/- which makes it highly economical. However, the durability of the system is still a test of time.

SUGGESTION: With further modifications this unit can be propagated into the professional field of speech and hearing.

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