THE DEVELOPMENT AND STANDARDIZATION OF A GROUP SCREENING AUDIOMETER AND A PROCEDURE FOR INDIAN CONDITION

KALAI SELVAN

A DISSERTATION SUBMITTED IN PART FULFILMENT FOR THE DEGREE OF MASTER OF SCIENCE (SPEECH & HEARING) UNIVERSITY OF MYSORE.

1979

CERTIFICATE.

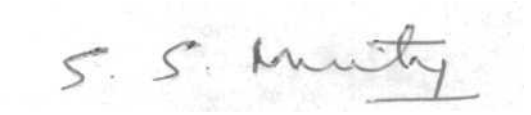
This is to certify that the dessertation " The Development and standardization of a group screening audiometer and procedure for Indian Condition" is the bonafide work in Part Fulfilment for the Degree of Master of science (Speech & Hearing) carrying 100 marks, of the student with Register No.3.

_ DIRECTOR
All India Institute of Speech
and Hearing,
MYS0RE:-570 006.

CERTIFICATE.

This is to certify that this dessertation has

been prepared under my supervision and guidance.



GUIDE
(S.S.MURTHY)
lecturer In Electronics,
All India Institute of Speech and Hearing,
MYSORE, 570 00*,

DECLARATION,

This Dessertatlon is the result of my own study under taken under the guidance of Sri.S.S. Murthy, Lecturer in Electronics, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any University for any other diploma or degree Course.

KALAI SELVAN

Register No.3

Msc. IV semester,

All India Institute of Speech and Hearing,

MYSORE: 570 006.

ACKNOWLEDGEMENT.

I express my gratitude to my guide Mr. S.S. Murthy, Lecturer In Electronics whose invaluable encouragement, guidance and assisstance helped me in bringing up this researth work.

I acknowledge Dr. N. Rathna, Director-in-charge, All India Institute of speech and Hearing, for his suggestions and encouragement in the begining phase of

I am very much thankful to Mr. Narayan Raju, Mr. srikanth and Mr. Viswanath for their needful and enthusiastic assisstance and encouragement at various stages of the study.

I thank Miss. Radha Alagar for her kind and invaluable help at every stage of this study by spending her precious time.

My Special Thanks are to Miss. Lalitha. M. Kulkarni for having shown her artistic talent in this study.

Finally, my Thanks are to Miss. Malini Devi, Mr. Kannan Mr. Basavalingappa and to all my friends & Subjects who have helped me at different phases of the research.

CONTENTS.

LIST OF TABLES

LIST OF FIGURES.

INTRODUCTION.

Auditory Screening is an attempt to indentify persons who have significant having defects from a population made up, predominantly of people with normal or adequate hearing (Hegdecock, Miller and Rose,1973). The technique of screening has as its purpose the Identification, as quickly as economically as possible of individuals In a large population who are in need of some special service (Anderson, 1978), Downs et. al believe that the primary goal of screening programme is the detection of active or past ear diseases whether accompanied by hearing loss or not. Early identification of hearing loss results, ideally, in early diagnosis, treatment, rehabilitation, and education of persons with communication disorders (Downs and sterrit,1967, Anderson,1972). In India, many Individuals are brought to the speech and hearing centre only after it becomes, too late to be able to provide any significant help to these Individuals,

Ihere are two aspects of screening 1.Estimating,2. Case finding."Identification Audiometry refers specifically to the a case finding aspects of a hearing conservation programme (Melnick, et,al,l964)

There are Two stages in an ideal hearing screening programme.

The first stage, eliminates all those persons who have normal hearing and finds thoae who may have hearing problem. The second stage eliminates whose who did not fellow the instructions of first stage or those who are poor responders for some other reasons (Darley, 1961).

Traditionally, hearing screening procedures have had as their basis, Air condition, hearing senstivity measures. Such procedures are considered fairly adequate for children with perepheral hearing impairments, serious enough to cause communication problems (Anderson, 1978).

Hearing screening tests are administered either in individual or group setting. The stimuli used in these tests range from puretone and speech to noise produced by various noise makers (Anderson, 1978, Downs & Doster, 1959, Darley, 1961, Solomon and Fletcher, 1958, Meyerson, 1956, Bennett, 1951 Watson and Tolan, 1949, and Nickm and Shyamala, 1971).

In recent widespread acceptance of acoustic impedance and reflex testing provides additional measures which if used judiciously, can Improve our ability to Identify health problems dramatically (Anderson, 1978).

In 1939, at world's fair in Newyork and sanFransisco, the Bell Telephone company carried out group puretone testing.

The purpose for administering these tests were to determine the incidence of hearing disorders and to determine age, sex place of residence and economic status on hearing (Steinberg, et. al 1940).

Although no adequate surveys have ever been done in India, it isvery roughly estimated that more than 3% of general population suffers from hearing difficulties, figures from the ministery of education government of India indicate, there are 2,23,000 deaf children in the nation(1964). But these figures are not conclusive as they are not based on any reliable survey (Kapur, 1965).

The aim of an ideal hearing screening should be to locate all the persons with impaired hearing. In order to achieve these hearing screening should be carried out at a number of places and they should be conducted in such a way that they cover the entire population.

Most of the attempts in India, madeto identify persons with hearing loan, have made use of crude tests of hearing. The procedure adopted were tuning fork testing, conversational and whispered voice testing and puretone individual tests. In many situations 500 Hz, 2kHz & 4kHz were used as test frequencies. The intensity levels were not specified in many studies and the studies were done in uncontrolled environment.

To identify individuals with hearing loss in the population group procedures of hearing screening is used more by way of economising in time expenditure and the staff needed for conducting the testing programme. In India,at present it is) very difficult to carry out hearing screening programme, because of the following problems.

1. Insufficient number of trained speech and hearing specialist.
2. Economical problems in the country.
3. The amount of time required to screen each individual separately
4. The lack of equipment needed in conducting screening programmes.

TO overcome the above mentioned problems a group hearing screening procedure is developed along with a group hearing screening audiometer.

PURPOSE OF THE STUDY.

At present in this country there is only one company manufacturing clinical Audiometers and screening audiometers. This screening audiometer is used to screen only one subject at a time. Also the cost of this audiometer is too high to have in different clinics in India to carry out auditory screening programmes.

Therefore, the purpose of this present study is to develop a group healing screening Audiometer and a procedure where many people

can be tested simultaneously.

This Audiometer should cost cheeper to suit Indian condition and the testing procedure should fairly identify an individual who is hearing impaired, in a given group.

BRIEF PLAN OF THE STUDY.

First a group screening Audiometer was developed. This audiometer gives puretones of frequencies 500Hz, 1000Hz, 2OOOHzwith a provision to perform speech Audiometry. The signals (Tone and speech) are delivered through a free field loudspeaker. The intensity range O to 10dB, is cantrolled by an attenuator in 10dB steps.

Kannada picture SRT list, (Rajashekar, 1976) was modified and used to suit in the group screening.

Seventy kannada knowing subjects are tested. Group of 14 subject are tested together. First puretones were delivered through loudspeaker starting from 60dB and decreasedup to 20dB in l0dB steps. Subjects were asked to count and math in a response sheet as many times as they hearnd. Secondly,kannada spondaic words were given at 60dB level decreasing to 20dB level in l0dB steps. The subjects are asked to tic the appropriate picture in the response she

A therapy room at All India Institute of Speech and Hearing was used as a testing room where the noise levels were found to be very

less . When At was measured using B & K sound level meter(type 2 it was found the noise level was 30dB,(A).

Conventional hearing evaluation was done in a sound treated room for all the subjects to find out the reliablity of present procedure.

CHAPTER .II.

Review of Literature.

A number of specific techniques for screening the hearing of large populations have been described in the literature ever the years. The Major classifications of these techniques are summarised below. The procedure or technique chosenfor any given group of hearing conservation programme is typically some variation of one of there basic techniques. The modifications used are often dictated by the local situation. Hearing screening procedures are administered in either individual or group settings with group being as large as 50 children for one administration of the test.

The signals are most often individual puretones or speech; However,noise makers environmental or animal sounds have been used on decasaions with varying degree of success. The obvious advantage of group hearing screening procedure is that several children can be x screened with each administration of the test procedure with the end results that morechildren can be seen in any given period of time. There are some disadvantages which must be taken into account in evaluating the overall effeciency of group as opposed to individual administered test. These are the maintenance of the equipment and caliberation. The necessity of insuring against cheating and as

typically higher rate of false positive identification obtained with group screening (Anderson, 1978).

PROCEDUREs USINGSPEECH SIGNAL.

The fading numbers test wasthe first hearing screening procedures to be used on a large scale. With is technique pairs and triplets of digits were recorded on a Phonograph disc with each set of numbers presented at a level three dB less intense than the proceeding set. These discs were played on a western electric 4—A or 4—B Phonograph speech audimoter. The output of which could be directed to 40 children through different ear phones. The children were gives blanks on which they were to write the numbers heard each time, they were alerted to listen. The answers which were disigned in each a way they could be scored easily to determine the lowest dB level at which each child was able to identify the digits correctly, A cut off level, usually, "the 9 dB level" (Newhart & Reger, 1956) was chosen and any child could hear at this level or lower level was considered to have hearing within normal limits.

One obvious disadvantage with the fading numbers test was the children have to be able to respond by writing the digits, requirement which limited its use with younger or intelluctually limited children.

Newby (1958) indicated that children with losses as high as 32 to 50d^B at lkHz and 2kHz have been able to pass the fading numbers test at 9dB level. Also a child who passed in the fading numbers test may not be able to function adaquately in the conversation situation because digits are not representative of running speech.

Many children with high frequency losses of hearing sensitivity above 1k were able to identify the digits correctly on the basis of the acoustic information contained in the lower frequencies and, therefore, their having losses were net identified with this procedure. For this reason, the procedure has fallen into disfavour and, hopefully is no longer in use (Anderson, 1978).

Several other procedures using speech signals have been developed since the fading numbers test in attempts to overcame tame of its disadvantage, Watson and Tolan (1949), Report the use of mice RS Audiometer employing equipments similar tp the western electric 4 series audiometers to play disc recording of individual mono syllables which could be represented by pictures which the child identi fied, This fading word test used the same technique as the fading numbers tests of reducing the level of each succeeding level reducing the level of each of 3 dB. Watson & Tolan felt that having the child identified the pictures representing the mono—

syllable words, overcome both the problem of a written response and lure to identify the children with high frequency losses.

Bennett (1951) reported the procedure similar to the MicoRS test which used monosyllabic words as the Auditory signal with picture as the response mode. In these test a closed response set of 4 Phonetically similar words is presented for each trial. Bennett has reported a rather strong positive relationship between his procedure and puretone screening in ldentififying 6 years old children with hearing loses.

Mayerson (1956) reported the use of spondaic words to screen the hearing of children. He used spondees whichcould be pictured and instructed the children to point the picture of the word each time. In addition to the standard presentation of the words, he also had high pass filter presentations. It was Mayersons impression that his verbal audiometric test was adequate for identifying children with losses of hearing sensitivity in to range of speech frequencies.

In attempt to find a more effective procedure for identifying preschool children with hearing impairments, a group in Minnesota developed a procedure called Auditory screening for children or VASC Audiometry (Griffing , simmonton and Hedgecock 1967) Twelve spondees which can be pictured are recorded on

tape as speech signals. The first word is presented at a level of 51 dB (re normal speech reception threshold (SRT) where the last 3 words are presented. The test is administered to two children at a time, while an observer records the responses of each child as he/she points to the pictures. It has been noted that children who have hearing impairments may be labelled as having hearing within normal limits when only the words are used. In an attempt to overcome this problem of false negative identification on the basis of low frequencies recognition of the words, a lions roar and a birds whistle have been added to the signals to be identified in the pictures. Mencher and Mc Culloch (1970) reported that the VASC was inadequate in identifying hearing losses in Kinder Garten children despite the fact that the childrens with hearing impairments may net be identified with the VASC, it has gained popularity since volanteers can be trained to Administer it. It is available commercially on cartridge tape and is currently being used in a number of hearing conservation in programme for preschool children.

PROCEDURES USING PURETONE SIGNALS.

Pulse tone described by Keger and Newby (1947) was one of the first group screening test to use puretone signals. In these tests, the listener records the number of bursts of tone heared

with each alert 2 descending series of of presentation of tone are givenin each ear for each frequency chesen for presentation, the frequency tested 500, 1000, 2000,4000 and 6000 Hz. The lowest level at which the listeners correctly identifies the number of puls in one of the Two series is considered to be an estimate of threshold for that frequency. The responses are recorded on answered sheets which can be checked after the test is administered. Depending upon the equipment which is available, this test can be automated and administered to as many as forty listeners at a time. A loss of 20dB at any of the test frequency in either ear is considered to be the failure of the test. Individual testing is indicated for those who failed in the test so that appropriate referral or necessaries may be made for the children. With this test procedure it is necessary to teat one ear at a time. Glorig (l965) reports a modification of this technique, whereby same of the pulsesin each group are presented to one ear and others are presented to opposite ear. In this way, it impossible to evaluate, the response in both ears at the same time by scoring the number of pulses reported as heard at each level.

Johnston (1948) developed the Massachussettc test of a group pure tone test. With this method forty children can be screened simultaneously. Three frequencies are utilised in this test,

500,4000,8000Hz. These are presented at hearing levels of 20, 25,30dB respectively. The tester calls out a aeriesof numbers ranging from 1 to 6 . The children are informed that after each number is called, they may or may not hear a faint tone. The tone is heard the 'YES' opposite to the number is dueled. If NO. tone is heard they circle 'NO'. Following a prearranged plan the audiometrician will occasionally not present atone after giving the signal, for observation. If the number of the 'NO' at any frequencies differs more than 2 from the way in which the test was presented, the subject fails in the test. Because of the difficulty in matching the tone at 8000Hz. Later instructions for these tests have specified the highest frequency tested should be 6 KHz. In an attempt to make this test applicable to younger children who are unable to read or otherwise respondin YES,NO situation, Johnston (1952). Later offered a modification which has been called the Johnston puretone Group Screening test. In this procedure, 1O children each with an earphone are seated in a semi-circle and asked to close their eyes. They had to raise the hand when the tone is presented. Johnston also suggest having a switch available to cut out certain earphones at times. In this way the person administering the teat can be reassured that the children are responding for the tones and not to other cues.

In 1939, at the worlds fair in New Yark and san Fransisco,

the Bell Telephone Company carried out tests with musical tones and speech (Steinburg et. al 1940)

Anderson (1952) constructed a group puretone test of hearing using 500,l800,& 2000 Hz tone. The tonse were given at a level of 15dB. The subjects were required to count the number of tones they heared these tones, in each ear. Anderson formed that the pulse tone test was a good screening test device. He also determined that bursts of white noise could be utilized as test stimuli.

In 1953 glorig described an instrument, he designed to test 50 persons simultaneously for screening with pure tone frequencies ranging from 500 to 8000Hz. The instrument was started by pressi a button and then continued through entire cycle automatically. The stimuli were delivered in different numbers in left aad right ears . The subjects have to listen and count, the tones they heard and then record the number in the answer sheet.

Nelson (1952) administered a pure tone group test to 2400 school children. The frequency used were 256Hz and 496Hz at intensity levels 45,35,25,15,5 & 0 dB above normal threshold. The children were instructed to make a dot when they hear a short tons and dash when they hear a long tone.

Cox et. al (1957) pointed to the utilisation of a mobile lab of a group hearing screening tests. Solomon and Fletcher

(1958) used group audiometry in conducting a survey of hearing losses among armour personal. They tested 18 persons at a time. Stinliv used were warble tones of frequency 500,l000,2000,4000 & 7000Hz.

Hedgecock et.al (1973) uaed automatic screening audiometrice technique testing 4 persons at a time. BeKesy audiometers is used to screen a group of people.

Webster in 1952 reported the development of a warble tone screening test. The test tone waa presented through a loudspeaker in a reverberant room. The tones were presented with decreasing intensity from 40dB above normal threshold. The greatest Barrier to obtain satisfactory results in such a test is the unpredictable ambient noise levels.

HEARING SCREENING IN INDIA.

Most of the attempts made to identify persons with hearing loss in India made use of crude tests for hearing . The stimuli used were arbitrary and intensity levels not specified. The studies were done in uncontrolled environment. This involved a lot of subjectivity in the criteria employed. A few examples of the studies conducted in India are: Misra (1961), in a sample survey of 50000 school children found that one in every thirty children required attention for hearing problem.

Kapur (1965) tested school children from schools in and around vello end concluded that prevalence of hearing loss in these children was 16.3 to 6 %. The test given was individual puretone. Any child who failed to respond at 25dB for any of the frequency from 500 to 6000Hz was considered to have failed in the test.

Gupta (1966) tested 3504 children using tuning fork, conversational and whisper voice test. The children with wax in the ear were also included in the test which reported 35.4% of the population as the test failures. Jain (1967) tested 5000 children using same procedure as Gupta (1966) and reported 39.13% of the population to have failed.

Other studies are reported where full details regarding the test procedure and the criteria used are not specified. Such studies are as follows.

1. Dr. Abrol et. al (1971) study on 210 subjects from rural area using group and individual procedures.
2. Study on 1886 school children done by Dr. Kameshwaran S. in 1967
3. Shah et. al (1971) conducted individual hearing test for school children at Bombay in a comparatively quiter area, of the achool. The frequencies tested were 4000, 2000 & 500Hz at 15 and 25dB levels. Any child who failed to respond at 15dB level for 2000 & 4000Hz and at 25dB for 500Hz tone was considered

to have failed in the test. The total number of subjects screened were 7100 in the age range of 5-9years.

Viswanath et. al (1971) used individual puretones screening test to screen 410 school going children in a rural area. The testing was done in a quiet area of the school. The frequencies tested were l000, 2000 & 4000Hz at 20dB & 500Hz at 30dB Hz (ISO 1964) : (in the order of presentation). The test was considered positive if the child failed to respond at two are more frequencies in one ear or at the same frequency in both the ears. However, if the subject failed only for 2000 or 4000Hz in one ear only that the test was extended to frequencies 6000 & 8000Hz at 20dB 18.9% if the subjects failed the test.

Dr. Nikam, (1970) reported a school screening programme being conducted at A.I.I.S.H., children were brought to center and were tasted in a morecontrolled environment. The frequencies tested were 500, 1000, 2000 and 4000Hz at levels 30dB, 20dB, 20dB and 20dB respectively. The levels were decided upon after a validating threshold study on 50 children with normal ear, nose & throat & Hearing findings. Al1 2048 children were given the test Out of these 247 children failed the screening test but out of these 62 were found to have hearing loss. The false positive score, as seen is quite high in this study.

Offall the studies reported only a few have reported the use of standard procedures, and defined the criteria for fall or pass in the test (shah Vijay et. al, 1971), Nikam Shailaja, 1970, and Viswanath et al, 1971).

Sathyendrakumar (1974) developed a mass screening test which could be broadcasted ortelecasted and thus administered be all the people listening to the broad cast. The intention of this test was bhat if such a test of hearing isbroadcasted, in one administration of it, it would test a very large no. of people. The test was broadcasted from All India Radio, Bangalore. 195 persons responded to the test by sending him the scoresheetsa It was found that Broadcast mass screening test is a valid and effecient test. The mass screening test can be used to test an almost an infinite number of groups of subjects at a time. It does not require any special equipment. The test environment need not be controlled for the adminstration of this test as it relies on intra group comparison of the responses for interpretation. The method consists of presentation of tones of frequencies 500Hz, 1k, 2k, & 4kHz. Each tone is presented several times and for each subsequent presentation, the intensity of the stimuli is reduced still the tone becomes too weak to be heard. The subjects sit in a group infront of the speaker of a radio receiver in the form

of a semicircle . Thus the distance of the speaker from each subject is kept same for a particular group. The subjects are asked to count and write down the number of times they hear each tone. There is no need for a trained personnel for the administation of the test.

SPEECH OR PURETONE SIGNALS.

The hearing screening procedure currently in use suggest whether or not the individual has hearing with-in normal limits inrelation to some reference group and lead to inferences about a range within which his or her hearing threshold levels fall. Signals have to be chosen to provide the most efficient in the estimate of hearing status. It is a standard procedure in the measurement of hearing to sample at-least the hearing threshold levels across a given range of frequencies. The frequency re— presented in more complex auditory signals such as speech, noisemakers and animal sounds usually cover a broad range; However, we have to recognize the detection or recognition of one of these signals, may be dependent upon a very small portion of that range, Hearing screening procedures using these signals may not sample the hearing sensitivity adequately across the freq- uency range and, therefore may result in a significant number of false negative identification.

It is common practice in hearing screening to use a simpler, more easily defined puretonea as the signal of choice. Speech noise makers and various animal and environmental sounds continued to be used when, for some reason, it appears, that it is too difficult to get children to respondto pure tone. Despite the heavy criticism which has been levelled at screening procedures relying on signals other than puretone, these procedures continued to emerge (Anderson, 1978).

Criteria for identification

It is assumed that the goal of hearing screening testing is to identify the individual with actual or potential hearing impairments of significant as communication or health problem; the criteria for identification will have to be consistent with this goal. The signals used on behavioral testing which must be correctly detected or recognized in order for the individual to demonstrate hearing within normal limits must be representative of the frequency, range considered to be important for these purposesand must be at a level at which it is responsible expect their detection. The level of the signal must not be so high nor the frequency range so restricted; however, the individual with an existing or potential hearing problem it not identified.

In 1961 the national conference on identification audiometry, (Darley, 1961,P.31) recommended that puretone can be used as the signals for the hearing screening and that ".....Only Four Frequency can he considered in the criteria for referral: 1000, 2000, 4000, 6000 CPs. It is recommended that screening be done at 10dB level with reference to the present Americian standard Audiometric Zero (ASA, 1951) for the frequency 1000, 2000, 6000 Cps and at the 20dB level tor the frequency 4000cps. A child would be judged to have failed in the screening test and to be a candidate for referral for the next step. If he failed to hear and ..... any of these signals at these levels in either ear.

Anderson, 1965 and Lloyd, 1966 have pointed out that an easy and useful conversion of these levels to the ISO, 1964 at all frequencies.

The justification of the national conference for recommending these frequencies was that children often failed to hear the frequencies below 1000 Hz simply on the basis ef inter-ference from the noise in the environment. And that the information at 8KHz was rarely used clinically. Their justification for the levels recommended was to insure the identification of the child within 25dB (ISO, 1964). Hearing threshold levels. The reasons may be adequate in many situations. Many practitioners prefer to include 500 Hz in these screening frequencies and referral criteria when

feasible .

A review of the data of Eagles wishik and Doerfler 1967 and Roberts, 1972. Does not support the impression that children with Middle Ear disorders will be identified any more readily with the inclusion of 500Hz. It is recommended whenever possible atleast 500Hz be added to the frequencies used for referral criteria.

Since many children have hearing threshold levels at 4k & 6k Hz at 30dB (ANSI, 1969) or greater and do not have a problem of medical significance (Newby, 1964) recommends that priorities for medical referrala be given to the children identified according to these criteria. The Otologist or Physician in the programme can then determine, on the basis of these priorities, which children should be given individual medical examination. He suggested that the highest priorities be given to those children falling to meet the the criteria for hearing within normal limits at 500, 1k & 2k Hz. second highest priority shouldbe given to those demonstrating reduced hearing sensitivity at any of these frequencies and lowest priority to those with a loss of hearing sensitivity at only 4k &/ or 6K Hz.

The Asha committee in Audiometric evaluatlon (1975) recommends the use of the following priorities for an audiologic referral:

e. Binaural loss in both ears at all frequenceis.

b. Binaural loss at 1000 & 2000 Hz only.

c. Binaural loss at 1000 or 2000 HZ only.

d. Monaural loss at all frequencies.

e. Monaural loss at 1000 & 2000Hz.

f. Binaural or Monaural loss at 4k only.

It appears to be generaliy accepted today that one should be use 1k, 2k,4k at levels no higher than 25dB. ANSI, 1969 in the criteria for referral.

House and Glorig 1957 once suggested the use of limited frequencies audiometry in which only 4kHz or 2KHz and lKHz

were used.

A more precise procedure, especially for identifying aedical significance might be to use 500 to 6000Hz at the level of 15dB ANSI, 1961 as suggested for all frequencies by Gloring, 1965.

TESTING ENVIRONMEMT.

The noise level with the distractions in the testing environment can be crucial in determining or undermining the effectiveness of any hearing screening programme. For this reason, specific attention needs to be given to the testing environment while choosing a place to administer a test.

Observations of the environment need to be made during acutal testing, as well asprior to the selection of the location. Especially, inbusy, croweded areas the hearing testing enviorn—ment can change dramatically without notice resulting in a high rate of mis-identification. Although moat standards for acceptable ambient noise levels in hearing testing rooms (Example ANSI, s 3.1/1960) are written in order to avoid situations where the environmental noise will mask the signals being used in the test. Examiner must also be alert for any distracting visual or acoustic signal in the environment which will take the attending individual away from the listening task at hand.

Sites for hearing screening & testing need to be selected so the individual can be placed out of visual or auditory contact other activities in the area room selection will depend upon the daily schedule in the builing, general environment availability of electrical outlets and the appropriate sit for administering the test. The test site should be chosen to avoid any major noise sources such asboiler rooms, recess areas, Physical education areas,shops or choral music and band rehercel areas during periods of use. Rooms which often make group testing sites include auditorium stages with the curtains drawn, libraries, private offices conference room, music rooms (Anderson, 1978).

Group procedures at screening offered more by way of economising in time, expenditure and the staff needed for conducting the testing room. The tests, most often were given in sound treated room, most often making use of the multiple head set Audiometers, except in one study where the test was given using Loudspeaker in a reverberant room and the other tests using broad cast. The maximum number of subjects tested at a time has been limited to 50 subjects only. In addition, there are problems of having large sound treated room, costly equipment/difficulties in caliberatlon and ensuring against cheating in group testing.

In the present study by developing a group screening audiometer were the signal, is delivered through a loudspeaker and many individuals can be tented simultaneously. The intensity of the stimuli can be controlled. A quiet room ismore than sufficient to serve as an audiometric room. Both puretone audiometry, for 500, 1000 and 2000 Hz and speech audiometry can also be performed to ensure the reliability of the test. This instrument and the screening procedure will be most economical for the Indian conditions for Identifying hearing loss canes in general population.

CHAPTER: III

METHODOLOGY.

The present study consists of three parts. The first part of the study is developing a group screening Audiometer. The second part is preparing speech material for group screening purposes. And the lest part in the study is administering group screening test and standardising it.

PART :I

An Audiometer which can deliver puretone signals of frequencies 500, 1000 and 2000Hz and speech signals which is fed from a tape recorder through a freefield loudspeaker was constructed.

PURETONE SIGNAL:

The puretones 500Hz, l000Hz and 2000Hz were obtained from a weinsbridge IC Oscillator. The weinsbridge oscillatoris capable of generating low distortion sine weavta of 500, 1k and 2KHz. An operational amplifiers type 741 C (BEL) is used along with the weinsbridge with different resister net work to obtained the above frequencies. A field effect transister (FET) is used to limit the output level of the oscillator. The values of the weinsbridge are calculater using the formula f=l/2 RC. The value of 'C' is kept constant were as value of

'R' is changed for three different frequencies in this present study. The table gives the operating condition of the oscillator The frequencies and distortion of the sine waves are measured using frequency counter type 203 (Radart) and distortion factor meter number 811 (systronics).

To caliberate frequencies the necessary presets (P1,P2,P3) are used in the arms of weinsbridge. Equaliser potentio-meters are incorporated at the output stage of the oscillator to obtain electrical output such that when the signal is applied at the amplifier, the acoustical output obtained from the loud-speaker is equal (the presets are p5, p6, p7)

TABLE I.

OPERATING CONDITIONS OF THE OSCILLATOR

Operating voltage + 10, 0 - 10 Volts

Current rating 50mA

Frequency	Output signal distraction	Output Voltage.
500Hz	3%	l.3V
1000Hz	2%	1.3V
2000Hz	2.8%	1.3V

A four pole five way band switch is employed to perform the operation of the selection of the signal in the following order.

Position	1	---	No signal
Position	2	---	Speech
Position	3	---	500Hz
Position	4	---	1000Hz
Position	5	---	2000Hz

SPEECH

An input provision is made to give recorded speech signals. In the input stage, a potentiometer is used to control the input signal strength.

VU meter:

A VU meter is incorporated at the input stage of the speech signal. A simple milli ammeter, calibrated in terms of volume units by giving a small rectified signal obtained from the speech input.

INTERRUPTER:

The puretone signals from the oscillator is made to pass through an interrupter, to the attenuator. The speech signal from the speech input stage is made to bypass the interrupter to attenuator, through the selector switch network.

ATTENUATOR:

A variable step attenuator is employed to attenuate the output signal to required level. The attenuator attenuates the level in 10dB steps. The Minimum level of the attenuator is 0dB and Maximum level is 100 dB. The circuit diagram of the attenuator network is shwon in the figure 4. Though the range 0 to l00dB is not used for group hearing screening purposes,the provision is employed to used the Audiometer for different purposes such as freefield screening of young children and to test cases in speech and hearing camps conducted by All India Institute of Speech and Hearing.

AMPLIFIER.

the Amplifier consists of a single operational amplifier (741C) which drives a complementary-Symetry output circuit. The amplifier is provided with adjustable negative, feedback to minimize the distortion and keep the gain constant. The output of the amplifier is fed to a loudspeaker of seven ohms Impedance. Table: 3 shows the operating conditions of the amplifier.

TABLE :2

OPERATING CONDITION OF THE AMPLIFIER.

Power supply	+10	0	- 10	v.

Current rating	50 mA in no signal condition.
	300mA in signal condition.
Sensitivity	2mV at 1KHz.
Power output	3 Watts peak.
Frequency response	20Hz to 8 KHz. with the deviation Of ± 3dB
Distortion	Less than 5% at 1 KHz.

LOUDSPEAKER

Philips Freefield Loudspeaker type 9710M/01 was mounted in an enclosure as recommended by the company. The Table 3 shows the specifications of the speaker.

TABLE 3

SPEAKER	**SPECIFICATION**
Diameter	217 mm.
Total depth	114 mm.
Power handling capacity	low.
Impedance	7 Ohms.
Total Flux	980 $(\mu WB)^2$
Flux density	800 $(mT)^3$
Enclosure Volume	>>30 liters.
Frequency range	45 to 19000 Hz.

A Teakwood cabinet of 35 liters with the following dimention is made to mount the loudspeaker.

Lenght 600 mm.

breadth 380 mm.

Height 160 mm.

POWER SUPPLY

The oscillator and the ampilifier are provided with the external DC power supply of 20 V. The 20V it splitted in to + 10 0 - 10 using potentional divider network as shown in the figure 6.

The potential divider network is incorporated along with the audiometer.

The Osillator, and the power amplifier are mounted on a Printed circuit board made for this purpose. The printed cicuit board ia mounted on the front panel of the audiometer. The signal selector switch, attenuator, V.U meter, on/off switch and pilot lamp are fixed on the front panel. The Interrupter switch, power input, tape input, Tape input control and output of the audiometer are fixed on the side panel. The figure 1 shows the location of the various controls of the audiometer. Figure Two shows the wiring diagram of the audiometer.

The cabinet of the audiometer is made out of copper and aluminium. This acts as a good shield for the circuit. The dimention of the cabinet is as follows.

Length	30cm.
Breadth	24cm.
Height	8cm.

CALIBRATION:

The calibration of the group screening audiometer was carried out as follows:

The frequency was calibrated using a counter type 203 (Radart). The frequencies 500Hz, 1kHz and 2kHz were adjusted sharpely by adjusting the presets(pl,p2 & p3) which are in the oscillator board. The output intensity from the speaker was calibrated using sound level meter type (2203 B & K), along with octave filter set type (1613 B & K), condenser microphone number 4145 (FREE FIELD) was used . The sound level meter was calibrated using piston phone type (4220 B & K).

The Output intensity of group screening audiometer was made 1.5 meters from the centre of the speaker box. The attenuator was set at 90dB to avoid the external noises. The output intensity was adjusted by adjusting the freesets (p5,p6,& p7) which are in the oscillator board.

The attenuator was set at 90dB the output intensity at these speaker was adjusted for different frequencies as recommended by ANSI,(1969). The table four shows the output values for different frequencies.

TABLE : 4

OUTPUT INTENSITY FOR DIFFERENT FREQUENCIES.

Frequency in Hz.	Expected output from loudspeaker in S.P.L.	When the attenuator is at 90dB the output in S.P.L.
500	9dB	99dB
1000	3dB	93dB
2000	-3dB	87dB

Ref: ANSI, 1969 as quoted by Wilber, 1978.

The Maximum output of the Audiometer was adjusted to 100 dB HL. The whole calibration was carriedout in one of the sound treated room at All India Institute of Speech and Hearing.

The field around the Loudspeaker ata distance of 1.5 m and 2.5 m at an angle of 45^{o} from normal axis is measured. It is observed that the difference of sound level between the 2 distance is only 2 dB. Hence it is ignored.

FIGURE: I

THE LOCATION OF THE VARIOUS CONTROLS OF THE AUDIOMETER.

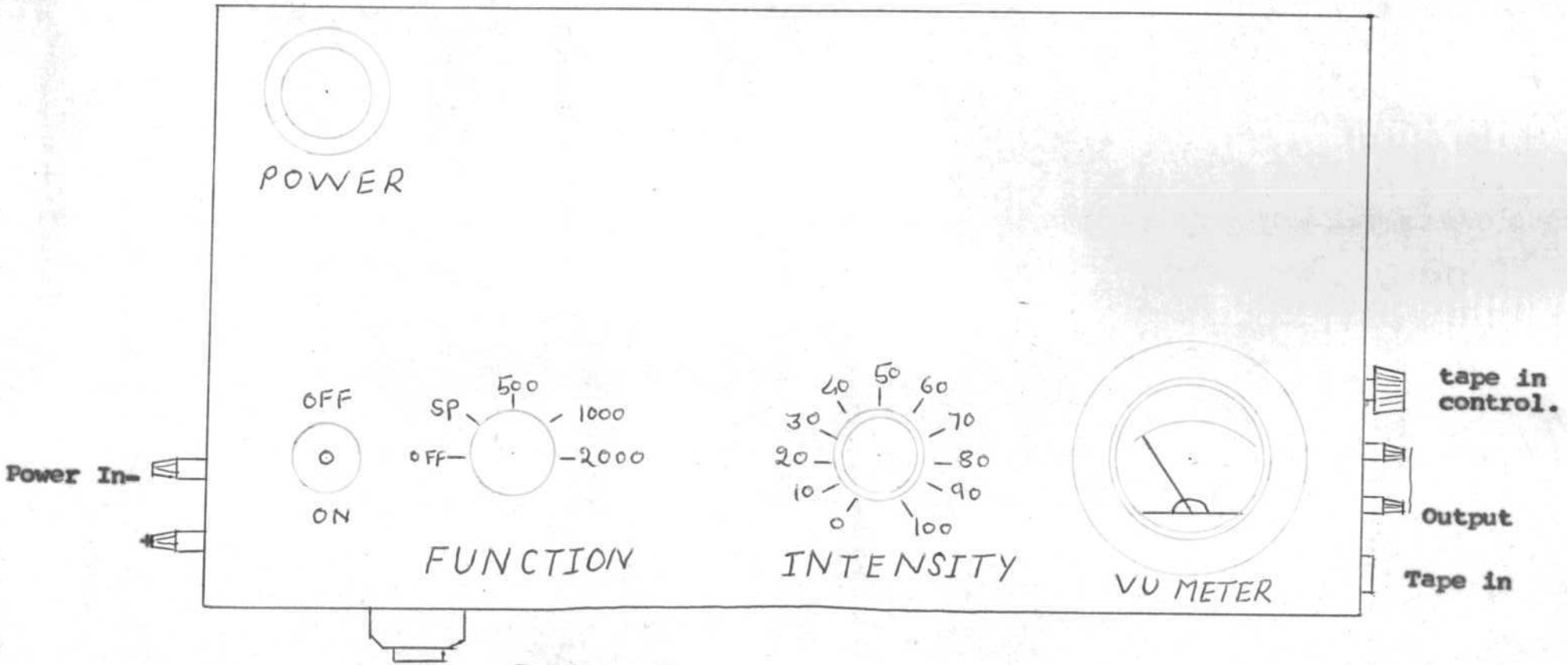


FIGURE: II

THE WIRING DIAGRAM OF THE AUDIOMETER.

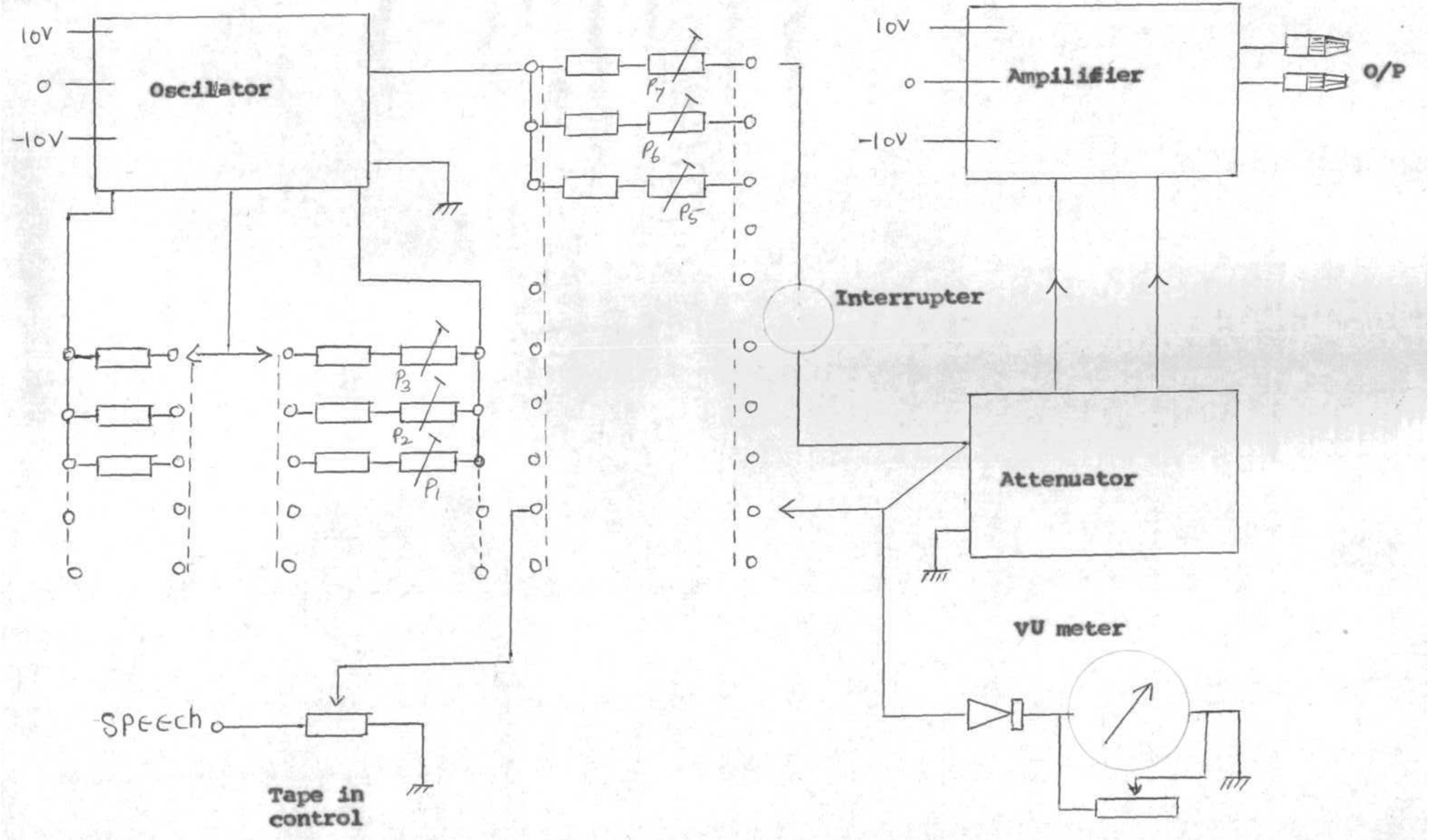


FIGURE: III

OSCILLATOR.

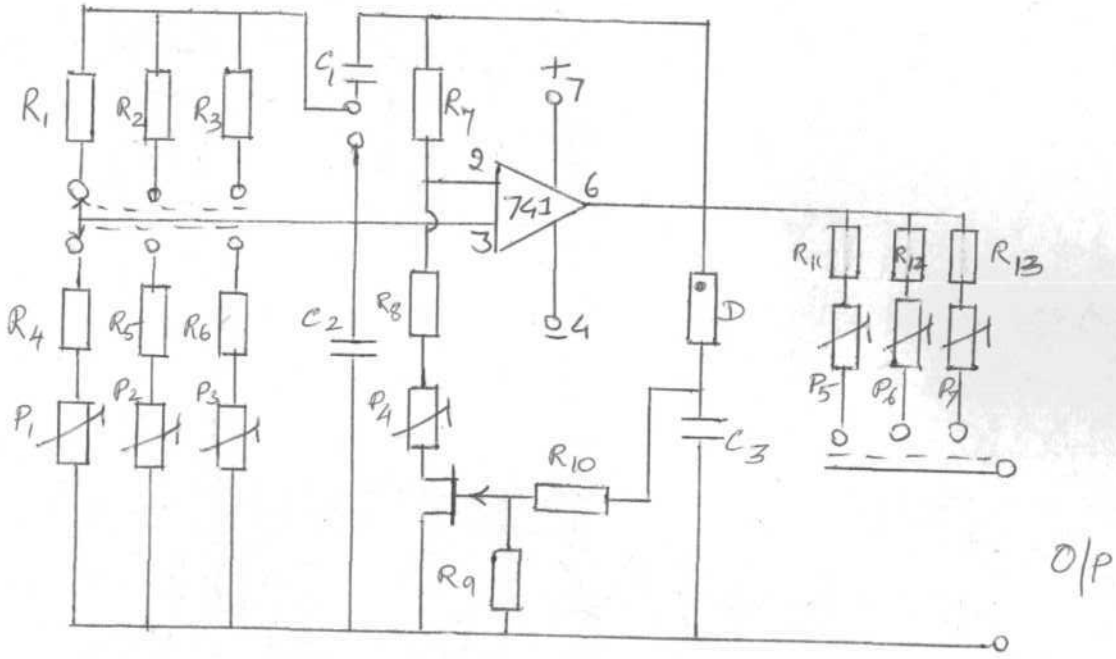


FIGURE IV

STEP ATTENUATTOR

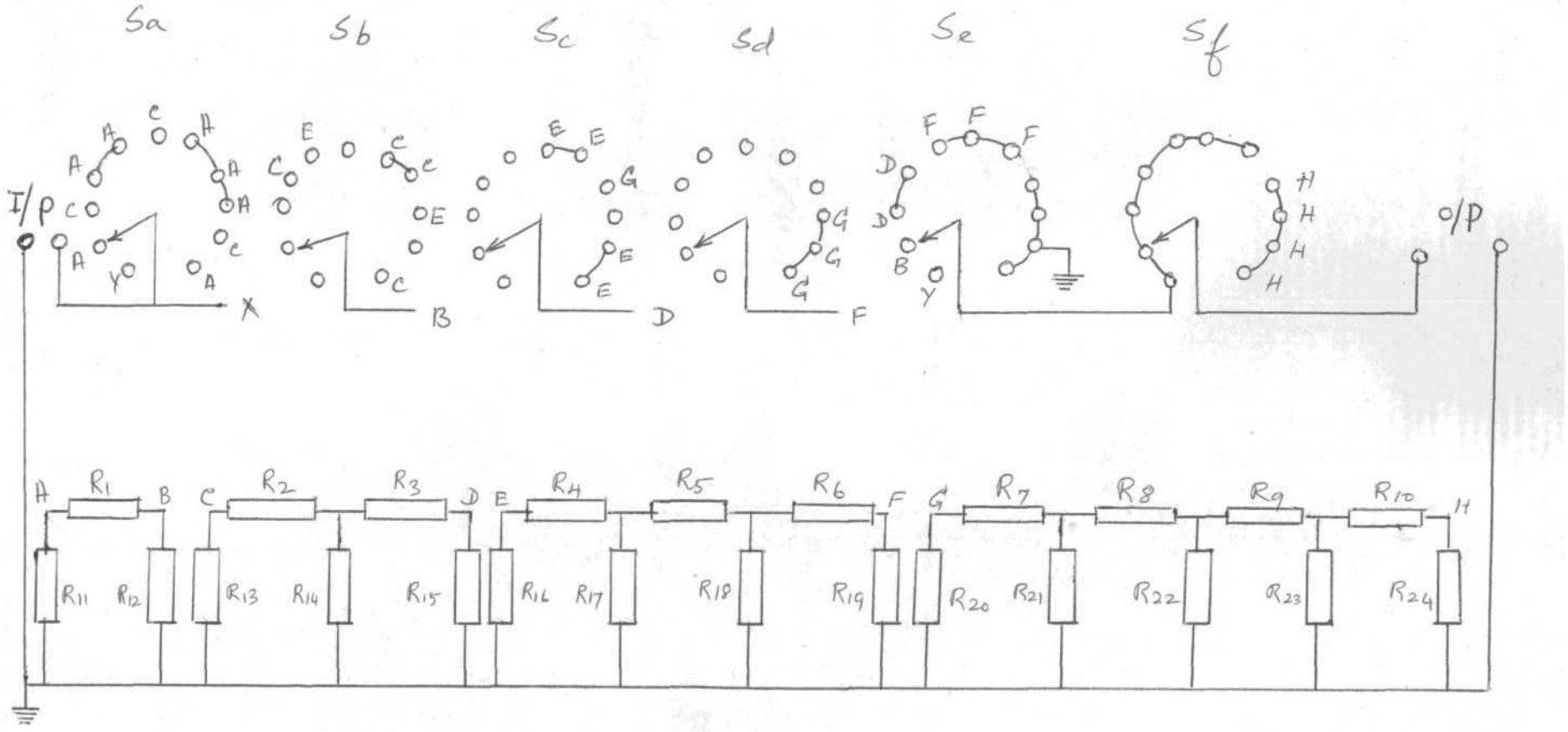


FIGURE V

AMPILIFIER.

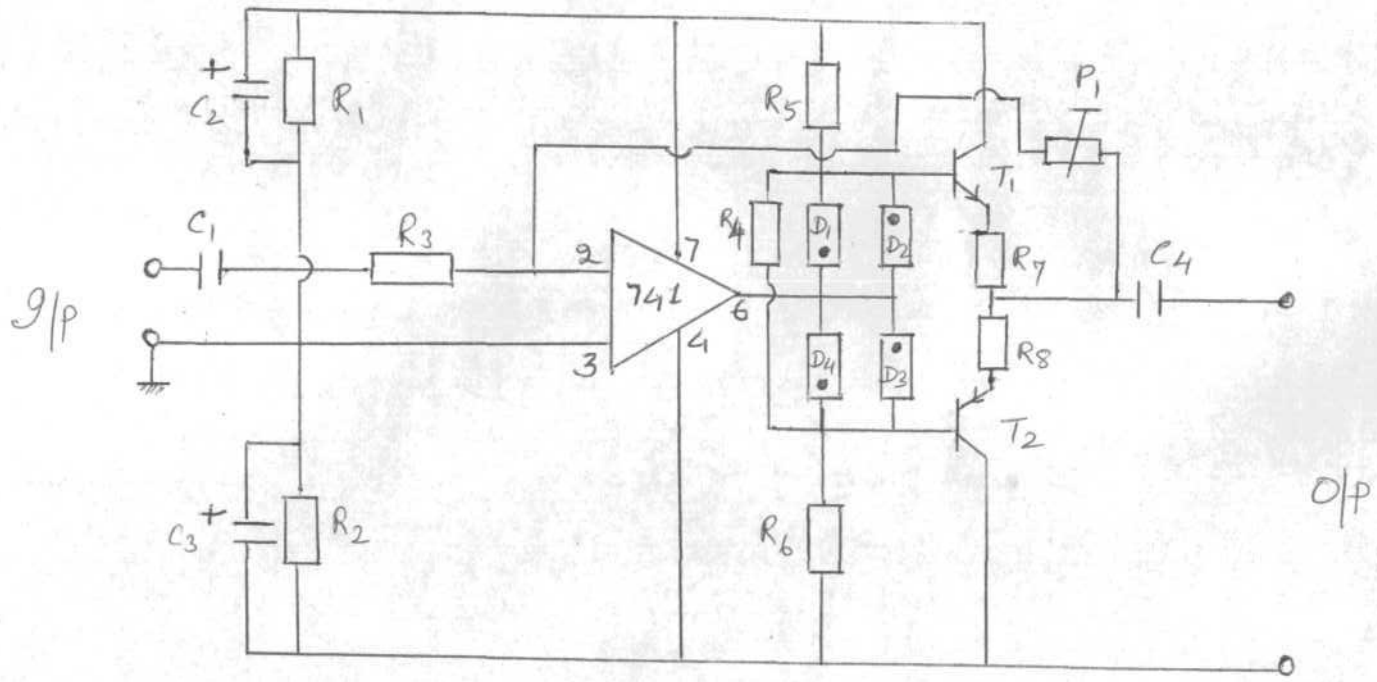
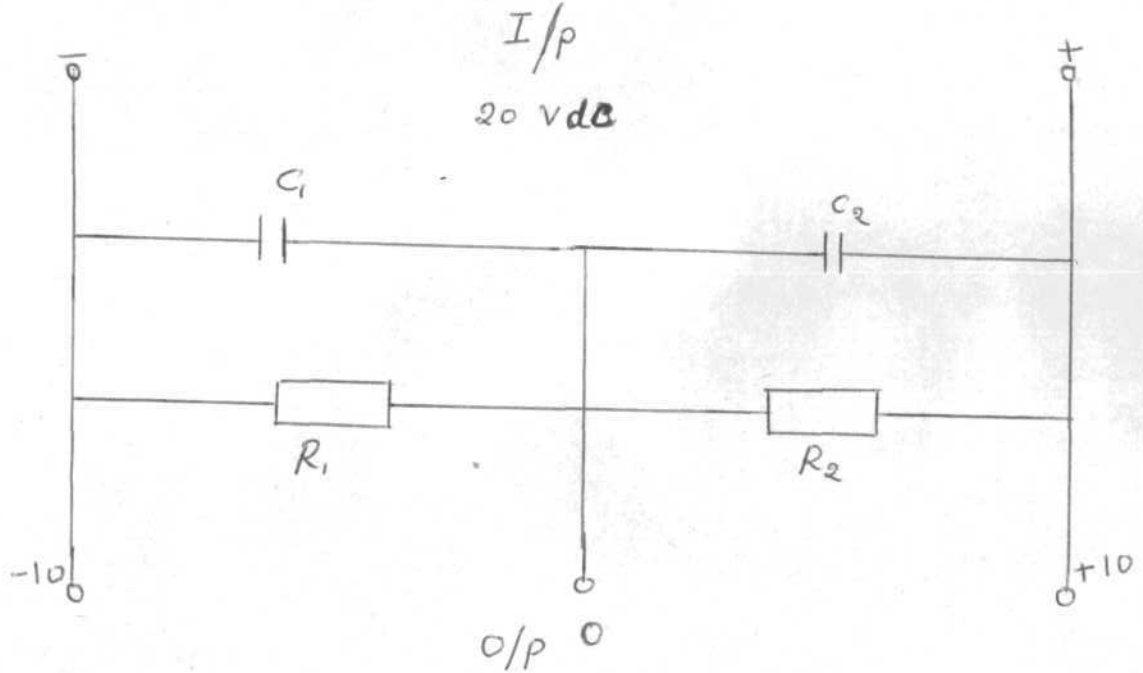


FIGURE VI

POWER SUPPLY.



PART II

PREPARING SPEECH MATERIALS

Kannada picture SRT list (Rajashekar, 1976) is used with 40 a little modification to screen kannada knowing subjects. The Kannada picture SRT list I (Adults) and SRT list II (Adults) are pooled together and the common pictures among this pooled adults lists and the children list are selected. The selected 12 pictures are found to be common in both adult and children lists. This is done to screen groups consisting of adults and children .

The pictures were drawn in a single page and cyclostyled to use as a response sheet. The pictures and the kannada words list for those given in the figur 7 and table Five respectivety.

The original picture SRT list as given by Rajashekar, 1976, is also given ia the table 6, 7,& 8. The words are recorded in a Cassette tape for the testing purpose.

TABLE : V

THE WORDS LIST USED FOR THE TEST.

1. bekku (cat)
2. hu:vu (Flower)
3. kivi (ear)
4. mΛrΛ(tree)
5. KΛnnu (eye)
6. ba:tu (duck)
7. sΛikΛl (cycle)
8. ko:li (cock)
9. ka:ru (car)
10. buguri (top)
11. mΛne (house)
12. a:ne (elephant)

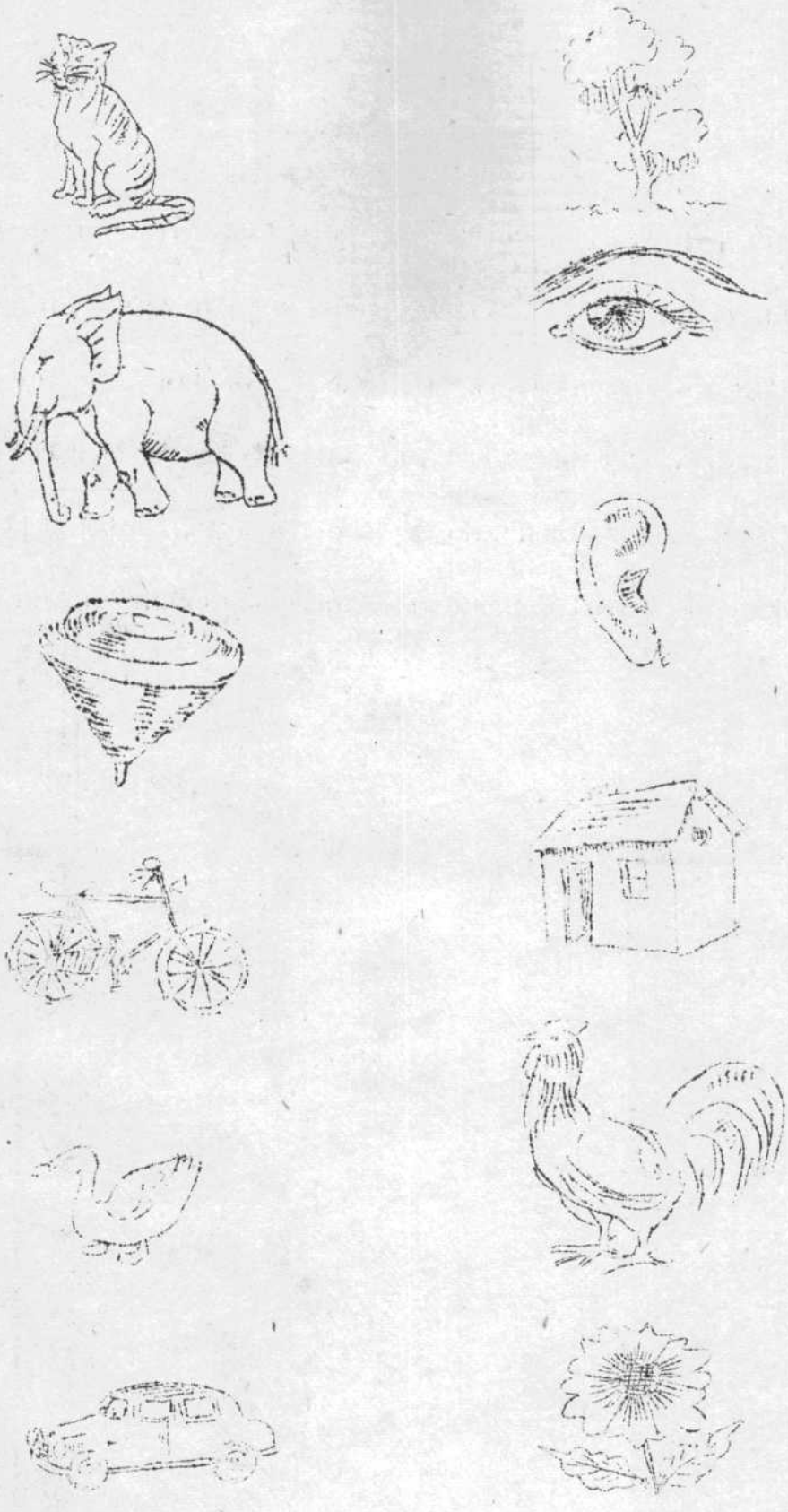


FIGURE : VII

The Pictures used for the test
(Response Sheet for Speech Audiometry).

THE ORIGIONAL PICTURE SRT LIST. (Rajashekar)

TABLE VI

WORD LIST I (ADULTS)

1. gula:bi (rose)
2. MΛdΛke (pot)
3. Ka:ru (car)
4. e:ni (ladder)
5. mΛne (house)
6. čondu (ball)
7. ČΛkrΛ (wheel)
8. jińke (deer)
9. mΛńčΛ (cot)
10. KitΛki (Window)
11. hΛllu (teeth)
12. simhΛ (lion)
13. Kuri (sheep)
14. mosΛle (crocodile)
15. bekku (cat)
16. buguri (top)
17. kod e (umbrella)
18. uyya:le (swing)
19. gu:be (owl)
20. gΛn t e (bell)

TABLE VII

WORD LIST II (ADULTS)

1. a:ne (elephant)
2. ili (rat)
3. Ko:li (cock)
4. bi:gΛ (lock)
5. kannu (eye)
6. ba:n (arrow)
7. ha :rΛ (garland)
8. kivi (ear)
9. re:dio (radio)
10. hΛggΛ (rope)
11. mΛrΛ (tree)
12. ha:vu (snake)
13. ta:vΛre (lotus)
14. mΛńgΛ (monkey)

15. čl:iʌ (bag)

16. sʌikʌl (cycle)

17. če:lu (scorpion)

18. pennu (pen)

19. ba:tu (duck)

20. kurci (chair)

TABLE VIII

WORD LIST (CHILDREN)

1. kudure (horse)

2. na:yi (dog)

3. hu:vu (flower)

4. ka:ru (car)

5. mʌne (house)

6. huli (tiger)

7. bekku(cat)

8. buguri (top)

9. a:ne (elephant)

10. ko:li (cock)

11. Kʌmnu (eye)

12. kivi (ear)

13. mʌrʌ (tree)

14. sʌikʌl (cycle)

15. ba:tu (duck)

RECORDING PROCEDURE.

Cosmic professional sterio cassette taperecorder and philips C9O cassette was used to record the words. The right channel of the tape recorder was used. While recording, the mic input gain was controlled to give the Vu meter full scale deflection. The recording was done in a sound treated room at All India Institute of speech and Hearing. The recording was made by a 22 years old male whose mother tongue is

Kannada. He was experienced in the technique of monitored live voice speech audiometry and had adequate practice with the test materials prior to the recording session.

Before starting recording the words the instruction for speech audiometry was recorded. The Instruction is as follows:

"I am going to test your hearing sensitivity. You will be given a response sheet where few pictures are printed in the first page. Now whenever you hear a word which is appropriate to one of the pictures found there, please mark a tic against the picture. If you do not understand the word it does not matter leave that word and try to concentrate on the next word."

The instruction above mentioned is rerorded in the Kannada language . The pictures recorded randomly in the tape that is the order of presentation is not same as given in the response sheet. The orde recording is given in the table.No.5. A carrier phrase " mark the picture " is used before each word. A time gap of 15 seconds between each word was given which will help the subject to mark the appropriate picture in the response sheet.

At the end of this SRT list recording, the instructions for puretone screening was also recorded. The instructions

are as follows:

"Now you turn the the page. Here you see there are 3 columns and 5 rows. How you will here tone bursts: This may vary between 2 to 4 . You count every time carefully and write down in the first column in the first row . when I say next you will hear some more number of tones, you count this and write in the 2nd row in the first column. Like this, you first complete the first column and then go to 2nd and third columns when I say. With this above instructions in Kannada forpuretone audiometry, the recording is completed.

PART III

TESTING PROCEDURE.

seventy Kannada knowing subjects were tested. The subjects age range from 6 to 73 years. Both females and males were tested. The 70 subjects include hearing loss cases of All India Institute of Speech and Hearing, cases gurdians, and students of All India Institute of Speech and hearing school going children.

EQUIPMENT USED:-

The group hearing screening audiometers which is described in the part I of the Methodology, is used for

screening purposes. A cosmic sterio casseette tape recorder is used to deliver the speech signals and the instructions which are recorded on the philips casseette. The complete testing setup is shown in the figure 8.

Fourteen subjects were tested at a time. The subjects were made to sit in an arc of a circle, in two rows. The distance between the first row and the centre of the speaker was 1.5 m and that of the second row was 2.5m . This distance and the seating arrangement were kept constant while testing all the Five groups.

One of the therapy room at All India Institute of speech and Hearing was used as a test room. The noise level in the room was very low when it was measured using B&K Sound level meter. It was found 30dB(A).

Before starting the test the subjects were given a pencil and a response sheet where pictures are printed in one side. And the othrr side tabular column is printed for the purpose of puretone responses. This is shown in the table No. 9

After keeping everything ready for testing, a tape is played and the output of the audiometer is kept at about 80dB levels. After the first Instruction part for SRT is

FIGURE VIII

THE COMPLETE TESTING SETUP.

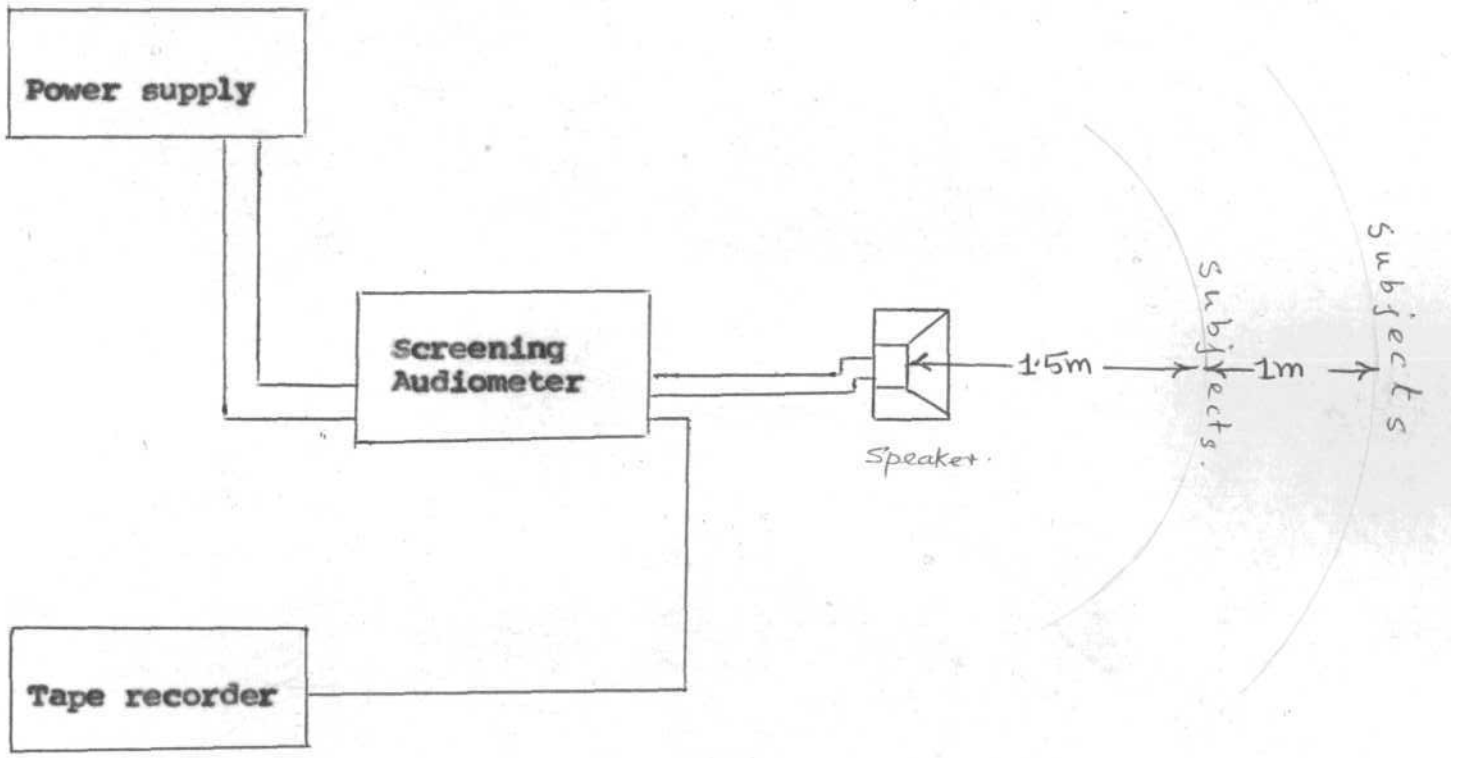


TABLE IX

PURETONE RESPONSE SHEET.

1.	2.	3.
500Hz	l000Hz	2000HZ.

over the tape is stopped for 30 Seconds. And the subjects were asked whether they have got any doubt in the instruction. Ensuring every subject has understood the instruction the testing is started.

To find out Speech Reception Threshold, the presentation level was started at 60dB and decreased by l0dB steps till 20dB . The number of pictures presented at each presentation level is given in the table number 10.

TABLE X

PICTURES PRESENTED AT DIFFERENT INTENSITIY LEVELS

Intensity level dB HL	Number of Pictures presented at each level	Name of Pictures
60	1	Cat
50	1	Flower
40	1	Car
30	3	Tree, eye & duck
20	3	Cycle, sock, car.

PURETONE TESTING:

The puretone testing also started at 60dB level for each test frequency 500Hz,1000Hz and 2000Hz. The number of present-ation at each intensity level was varied Between 2 to 4. The number of presentations at each intensity level for each frequency are prearranged before starting the test, and was used with all the groups similarly. The mode of present-ation is shown in the table No.11. Between each tone burst approximately three seconds time were given. Between each level of presentation 15 eeconds time was given to make the subjects mark on the response sheet.

TABLE XI

THE MODE OP PRESENTATION FOR PURETONE TESTING.

Intensity level dB HL	Number of tone bursts presented 500 Hz	1kHz	2kHz
60	3	4	2
50	3	3	8
40	4	2	3
30	2	4	4
20	4	3	3

CONVENTIONAL AUDIOLOGICAL EVALUATION:

All the subjects were tested individually for puretones and speech in the sound treated roooms at All India Instittute of Speech and Hearing to find out the reliability of group screening audiometers and the procedures. The frequencies tested are 500Hz, 1k, 2k,4k,6k and 8kHz. Both Air Conduction and Bone Conduction thresholds were taken for puretones.

The obtained results are discused and proper recommendation for group screening are made.

CHAPTER IV

RESULTS AND DISCUSSION.

In this present study a group hearing screening audiometer is developed, as described in the methodology. The complete technical data regarding the group screening audiometer is as follows:

1. Test frequencies 500Hz,l000 Hz & 2000 Hz.
2. Speech signal Via tape.
3. Intensity 0 to 100dB HL in 10dB steps
4. Distortion of the Puretoce signal is less than 5%.
5. Operating voltage 20V . DC. 500mA
6. Power consumption 4w peak.
7. provision is provided with Vu meter to control the speech input.

Usting tne Kannada picture SRT list (which has been modified for group screening purpose), seventy Kannada knowing subjects are tested. All the subjects were also tested using conventional testing procedure to ensure the reliability of the group screening procedure. In conventional testing procedure 500Hz, 1kHz, 2kHz, 4kHz, 6KHz and 8kHz were tested for both Air conduction and Bone conduction. SRT test was also performed. The subjects were diagnosed by the conventional audiometry using the following criteria.

Table: XII

CRITERIA USED FOR THE DIAGNOSIS.

HL in dB	Discribtive term
-10 to 26	Normal limits
27 to 40	Mild Hearing loss.
41 to 55	Moderate Hearing loss.
55 to 90	Severe Hearing loss.
91 +	Profound Hearing loss.

Ref: ANSI, 1969.

Sensori neural loss, conductive loss, Mixed loss, High frequency loss, were classified using air conduction, Bone conduction thresholds and speech audiometr.

The obtained results in group screening procedure and the diagnosis made using conventional testing procedure are posted in the table number 13.

Out of seventy subjects, tested Forty-one were males and Twenty-nine females and including both children and adults.

Twentyseven males and Twentythree females were found to have normal hearing in both conventional and screening audiometry. The subjects who were diagnosed as to have normal hearing in conventional audiometry that is within Twenty dB HL were responded at 20dB and 30dB HL in the

screening audiometry. Therefore the Threshold greater than 3OdB in any frequency tested or in SRT can be considered to be having hearing loss.

In 13 cases the screening audiometry results and the conventional audiometry results coincides. In these cases with case history presented by the case, the type of hearing loss could be diagnosed as conductive loss, sensorineural loss, (serial Nos. in the Table 34,35,37,42,45,47,50,51,52,57,63, 64,70) include these above cases.)

Case No. 44 was diagnosed to have normal hearing in screening audiometry, where as the conventional audiometry and other E.N.T., findings show ASOM in the left year and Right ear normal. Here the screening audiometry failed to identify the case since the case had normal hearing in one ear.

(Case No.48 who was diagnosed as having normal hearing in the screening audiometry were as he had Bilateral High frequency loss in the conventional audiometry. This is because the ease could respond normally in the low frequencies.

Case No. 55 was diagnosed as to have Hightone hearing loss An right ear and normal hearing in left ear in the conventional audiometry where as in the screening audiometry the case was found to have normal hearing. Here also the test failed to identify the hearing loss.

Case No. 29,33 and 59 have been missed to diagnosed accurately in the screening Audiometry. By screening audiometer hearing loss in the better ear was detected which coincided with conventional audiometric results. Here the hearing loss in the poorer ear ismissed by the screening procedure.

Case No. 68 was diagnosed as to have normal hearing in screening audiometry but the case showed moderate senserineural loss in conventional audlometry. Here it was found that the case had copied the other persona response.

From the above findings we can conclude that a subjects response at 30dB or less for both puretone and SRT in the screening audiometry can be considered as normal hearing, atleast in one ear, and response at 40 dB is mild hearing Loss , and up to 60dB response can be considered as moderate hearing loss, Above 60dB , the response would indicate severe heating loss. This procudre will fail to identify the unilateral hearing loss cases, High frequency hearing loss cases above 2kHz. In this screeinging procedure only the better ear thresholds are obtained and not the poorer ear thresholds. Becuase loudspeaker used to deliver the signal.

RESULTS BY GROUP SCREENING PROCEDURE AND DIAGNOSIS

BY CONVENTIONAL AUDIOMETRY.

Serial No.	Age in Years.	Sex	Screening Audiometric Results						Conventional Audiometery Diagnosis
			Case History	SRT in dB	Puretone TH. in dB 500	1000	2000	Diagnosis	
1.	19	F	Normal	20	20	20	20	Normal	Normal
2.	23	F	Normal	20	20	20	20	Normal	Normal
3.	19	F	Normal	20	20	20	20	Normal	Normal
4.	23	M	Normal	20	20	20	20	Normal	Normal
5.	25	M	Normal	20	20	30	30	Normal	Normal
6.	20	M	Normal	20	20	20	20	Normal	Normal
7.	18	F	Normal	20	20	20	20	Normal	Normal
8.	28	M	Normal	20	20	20	20	Normal	Normal
9.	31	M	Normal	20	20	30	20	Normal	Normal
10.	27	F	Normal	20	20	20	20	Normal	Normal
11.	20	F	Normal	30	20	20	00	Normal	Normal
12.	21	F	Normal	30	20	20	20	Normal	Normal
13.	17	F	Normal	30	20	30	20	Normal	Normal

(Continued)

14.		M	Normal	20	20	20	20	Normal	Normal
15.		F	Normal	20	20	20	20	Normal	Normal
16.	7 6	M	Normal	20	20	30	20	Normal	Normal
17.	7	M	Normal	30	20	20	30	Normal	Normal
18.	9	M	Normal	20	26	20	20	Normal	Normal
19.	8	F	Normal	20	20	20	20	Normal	Normal
20.	7	F	Normal	20	30	20	20	Normal	Normal
21.	9	M	Normal	20	20	20	20	Normal	Normal
22.	10	M	Normal	20	30	30	30	Normal	Normal
23.	13	F	Normal	20	20	20	20	Normal	Normal
24.	8	F	Normal	30	20	30	20	Normal	Normal
25.	8	F	Normal	20	30	20	30	Normal	Normal
26.	15	M	Normal	20	20	20	20	Normal	Normal
27.	14	M	Normal	20	20	20	20	Normal	Normal
28.	11	F	Normal	30	20	30	20	Normal	Normal
29.	73	M	Ng. loss	40	30	40	40	Mild loss?	L-mild S.N. Lo PTA-30dB R-mixed loss PTA-60dB
30.	17	F	Normal	20	20	30	20	Normal	Normal

(Continued)

				20					Normal
31	16	M	Normal	20		20	20	Normal	
32	13	M	Normal	20	20	20	30	Normal	Normal
33	28	M	Hg.loss	30	40	40	50	Mildloss	R-mild S.N.loss L-profound loss
34	16	M	Ear discharge	40	50	50	50	Cond.loss	Bil.Con. loss
35	30	F	Hg. loss onset 23 yrs	60	60	60	60	Cond.loss Otosclerosis Otosclerosis?	
36	40	M	Normal	20	20	20	20	Normal	Normal
37	60	M	Hg.loss since 5yrs.	40	50	40	50	S.N. Loss	Pressbycusis
38	27	F	Normal	20	20	20	30	Normal	Normal
39	30	F	Stuttering	20	20	20	20	Normal	Normal
40	15	M	Normal	30	20	20	30	Normal	Normal
41	18	F	Normal	20	20	20	20	Normal	Normal
42	20	F	Ear dis.	40	50	40	30	Cond.loss	Cond.loss
43	19	M	Normal	30	20	30	20	Normal	Normal
44	12	M	Ear pain	20	30	30	30	Normal	L-Asom. R-Normal
45	27	F	Hg.loss	M. R.	M.R.	N.R.	N.R.	Severe Hg.loss	Bil. Severe S.N. Loss.
46	9	M	Stuttering	20	20	20	20	Normal	Normal
47	32	M	Hg.loss	60	50	50	50	Moderate loss	Bil. cond. loss.

(Continued)

48	29	M	Hg. loss	30	30	30	30	Normal	Bil.High freq. loss
49	45	M	Normal	30	30	30	30	Normal	Normal
50	13	F	Misartn.	40	40	40	40	Mild.loss	Mild S.N.loss
51	20	F	Hg.loss since birth	N.R.	N.R.	N.R.	N.R.	Bil.severe S.N. Loss	Bill.profound loss
52	59	M	Hg. loss	N.R.	N.R.	N.R.	N.R.	Bil. S.N. loss	Presbycusis
53	19	M	Normal	20	20	20	20	Nbrmal	Normal
54	21	M	Normal	20	20	30	20	Normal	Normal
55	45	M	Normal	30	20	20	30	Normal	R-High tone 1oss L-Normal
56	19	F	Normal	20	20	20	20	Normal	Normal
57	17	M	Hg.loss	30	40	40	40	Mild hg. loss	R—cond. loss L-Low freq.loss
58	18	M	Voice Problem	20	20	20	20	Normal	Normal
59	26	M	Hg. loss	50	40	40	40	moderate hg.loss	L-profound loss R-cond. 1oss.
60	13	M	Normal	30	20	20	20	Normal	Normal
61	14	M	Stuttering	20	20	20	20	Normal	Normal
62	20	F	Normal	20	20	20	20	Normal	Normal
63	60	M	Hg. loss	N.R.	N.R.	N.R.	N.R.	Bil.severe S.N. loss	Bil.severe S.N. loss.

(continued)

64	50	F	Hg. loss	60	50	60	50	Bil. Moderate S.N. loss	Bill. Moderate S.N. loss
65	35	M	Normal	20	20	20	20	Normal	Normal
66	28	F	Normal	20	20	20	30	Normal	Normal
67	30	F	Normal	20	20	30	30	Normal	Normal
68	37	M	Hg.loss	20	30	30	30	Normal	Bil. Moderate S.N. Loss
69	15	M	Normal	20	29	20	20	Normal	Normal
70	12	M	Ear dis.	40	40	40	40	Bil.cond. loss	Bil. Cond. loss.

ABRIVIATIONS USED IN THE TABLE .

M - Male

F - Female

Hg. loss- Hearing loss

Bil. - Bilateral

S.N. 1oss- Sensorineural loss

Con.loss - Conductive loss

Ear dis.- Ear Discharge

Misartn.-Misarticulation.

LIMITATIONS OF THE PRESENT STUDY.

1. The present test procedure fails to identify the unilateral hearing loss cases .

2. The poorer ear thresholds can not be measured.

3. Case history is essential to diagnose the case as sensorinural hearing loss or conductive hearing loss.

4. The ease should have little knowledge to understand end perform the test.

5. The case should not have motor problem and visual problem.

6. This present test is administrated to Kannada knowing population of 70 subjects only.

RECOMMENDATIONS.

1. Using this Kannada picture SRT list to test more number of subjects in different age levels with various types of hearing problems, to standardize this test procedure andthetestmaterial.

2. To davelop speech material for group screening. purposes in different languages to test different language speaking population.

3. More cases can be tested at a time, by using a bigger room. Sound field distribution is to be carried out for this Purpose.

4. To incorporate built in power supply such that it reduces the problem of carrying the bulkier additional power supply.

5. Built in battery compartment to operate the audio-meter in the absence of mains supply.

6. A Photo interrupt of switch may be provided for better perforamnce.

7. The Speaker may be counted on a tripod stand, such that it delivers a spherical were front, with Minimum ground reflections. This arrangement gives a uniform sound field.

IMPLICATIONS OF THE STUDY.

1. School screening purpose.
2. To test cases in the Speech and Hearing Camp.
3. To test children in single room situation.
4. To carryout Hearing Aid Trial in Semi freefield Condition.

SUMMARY AND CONCLUSION.

In this present study a group screening audiometers and a group screening procedure have been developed. The audiometer gives 500Hz,1kHz and 2kHz puretones and speech from 0dB to 100dB. The speech signal can be fed from a tape recorder. The output level can be increased or decreased in l0dB steps using a step attenuator.

Kannanda picture SRT list was modified and used for speech audiometry for group screening purposes. The subjects' responses were recorded in a response sheet for both speech and puretone signals.

Seventy cases have been tested using this screening audiometer and it is observed that this procedure will idenify almost all the cases who have got hearing loss in the given group. This procedure fails to identify cases with normal hearing at one ear and cases with normal hearing below 2000Hz. Using the threshold level in the screening procedure, thirty dB HL is considered to be normal hearing at least in one ear, and 40dB is mild loss, up to sixty dB is Moderate hearing loss And above sixty dB would indicate severe hearing loss.

BIBILIOGRAPHY.

Abrol. B.M. et. al. Rural survey for speech and hearing defects at village Bijwesan, the Silent world, 6,1971,11-20.

American speech and hearing Association (ASHA) Oommittee on Audio-metric evaluation guidelines Audio—metry ASHA, 7, 94-99,1975.

Anderson, C.V. Screening the hearing of preschool and school age children, Hand book of Clinical Audiology, edited by Katz, Baltimore, Williams A Wilkin, Co. 1972.

Anderson, C.V. The New International audiometric Zero-ISHA, 24,1-9, 1965.

Anderson C.V. Hearing Screening for children. Handbook of Clinical Audiology, edited, Katz, Baltimore, the William and wilkins, Co.,1978.

B & K Instructions and Applications : Condenser Micro-phones Type, 4144,4145,4146.

B & K Instruction and Applications : precision sound level meter type 2203, octave filter set type 1613.

B & K Instructions and Applications : Piston phone type, 4220.

Bennett, S.M.A group test of hearing for 6 year old children, B:J of.Educational Psychology. 21, 1951, 45-52.

Cox. J.B.et.al. A mobile laboratory for group hearing teats, Noise Control, 3, 1957, 44-48.

Darley P.S. (ed), Committee of Identification Audiometry, J.S.H.D., Mon. Sup. No.9,1961,26-34.

Downs, M.P, and MB. Doster. A hearing testing programme for preschool children, (as quoted by shepherd, 1971)

Downs, M.P. and G.M. Sterrit. A guide to the newborn and infant hearing screeing programmes. Arch Otolar. 85 1967, 15-22.

Eagles E.L., wishik, S.M. and Doerflor C.G., Hearing sensitivity and Ear disease in children. A Prospective study Williams and wilkins co., 1965

Glorig, A (Edr) Audiometry:principles and practicals. Baltimore The Williams and Wilkins Co.. 1965

Griffing, T.S. et al. Verbal Auditory screening for preschool Children (as Quoted by Anderson,1972)

Gupta, O.P. Hearing studies in Varanasi procedings of the Second All India workshop on speech and hearing problems in India ed. Y.P. Kapur, 1967, 74-79.

Megdecoch, L.D.et.al. A Clinical evaluation of group audiometry conducted with patient controlled Audiometers J.S.H.D. 38, 1973,316-322.

Hall, M.D. and K.R. devries Building Hi-Fi Speaker system, Philips Application Book.

House, M.P.and A. Glorig. new concept of Auditory Screening. Laryngoscope 67, 1957, 661-668.

Jain s.M. Hearing Studies in Kakinada Procedings of the second All India Workshop on Speech and Hearing problems in India ed. Y.P.Kapur, 1967,59-64.

Johnston, P.W. The Massachussette Hearing test JASA,20, 1948, 697 to 703.

Johnston P.W. Aneffecient group screening test J.S.H.D. 17. 1952,8-12.

Kapur Y.P.(ed) A study of hearing lossin school children in India J.S.H.D. 30, 1965, 225-233.

Kameshwaran, S. Hearing Studies in Madurai proceedings of of the second All India workshop on speech and hearing problems in India, ed. Y.P.Kapur, 1967, 70-73.

Lloyd, LC., Comments on "dilemmas in identification Audiometry" J.S.H.D. 31, 1966, 161-165.

Madson Electronic. Operator Mannual and service Mannual model 'OB 70' Two channel clinical audiometer

Melnick. W. et. a. Evaluation of recommended programme of identification Audiometry with school children. JSHD. 29, 1964. 3-13

Mencher, G.T and M.C.,Culloch, B.F. Audotory Screening of kinder garden children using the VASC. J.S.H.D. 35- 241 - 247, 1970.

Meyerson, L. Hearing for speech in children A verbal Audiometric test. Acta Otolar. suppl. 126, 1956

Misra, et, al Indian J. of cotd. 13, 1961, 107 (as quoted by Sathiandra kumar)

Kelson S.F. Group testing of school children by puretone audiometry. J.S.H.D. 17, 1952, 4-7.

Newby, H.A. Audiology . New Yark: Appleton-century crofte,1964.

Newhart, H.,. and S. N. Regar. Mannual for a school hearing conservation programme . (As Quoted by Anderson, 1972)

Nickam, S. School screening Programme in Mysore City.JAISH. 1970.26-32.

Nickam, S. and S.Dharmaraj. Infant Screening - report on a preliminary study. J.AIISH., l971 65-68

Radart: Easter Electronics Instruction Mannual: Timer/counter type - 203

Rajashekar. The development and standardization of a picture SRT Tests for Adults and Children in Kannada. A dessertation submittedto university of Mysore for master's degree. 1976.

Reger, S.M., and H.A. Mewby, A group puretone hearing test. J.S.D. 12, 1947, 61-66.

Roberts, J. Hearing sensitivity and related medical indings among children in united states. (As Quoted By Anderson, 1978.)

Sathyendrakumar: The development of a Broad cast Mass screening test of hearing - Adessertation submitted to university of Mysore— for Master's degree, 1974.

Shah, V et.al. Hearing survey of school going children in Bombay City. The silent World. 6, 1971.

Shepherd, D.C. "Pediatric Audiology" Audilogical Assessment ed. Daniel E. Rose, New Jersey, Prentice Hali-Inc, 1971.

Smith, C.A. and J.A. Vernow : hand Book of Auditory and vestibular research methods . Charles C Thomas, publisher, Springfield Ilines, USA., 1976.

Solomon, C.H. and J.C. Fletcher, Survey of hearing loss among Armour personnel J.S.H.D.1, 1958 350-358.

Steinburg, J.C., et. al. Results of the World's fair hearing tests JASA 12, 1940, 291-301

Systromics: Instruction Mannual Distartion factor meter Type 811.

Viswanath, N.S. et. al. Naguvanahalli screening- A pilot project: J AIISH 2, 1971, 136-139.

Wester, L and T. Tolan Hearing tests and hearing instruments Baltimore: The williams and Wilkins Co., 19 49.

Wester, J.C. A procedure warble tone Audiometer test for group administration over Loudspeaker JSHD.17, 1952, 213 -223.

Wilber L.A. - Caliberation, puretone, Speech and noise signals. (ed) Katz Handbook of Clinical Audilogy