ACOUSTIC CAMP FOR SCHOOL CHILDREN

REG. NO.M9614

An Independent Project submitted as part fulfilment of First Year M.Sc, (Speech and Hearing), Mysore.

All India Institute of Speech and Hearing, Mysore

May 1997

DEDICATED

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This is to certify that this Independent Project entitled ACOUSTIC CAMP FOR SCHOOL CHILDREN is the bonafide work in part fulfilment for the degree of Master of science (Speech and Hearing) of the student with Register No.M9614.

i

Mysore
May, 1997

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CERTIFICATE

This is to certify that this Independent Project entitled ACOUSTIC CAMP FOR SCHOOL CHILDREN has been prepared under my supervision and guidance.

Mysore
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DECLARATION

This Independent Project entitled ACOUSTIC CAMP FOR SCHOOL CHILDREN is the result of my own study under the guidance of Dr. (Miss) S.Nikam, Prof, and HOD-Audiology and Director, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any University for any other diploma or degree.

Mysore
May, 1997

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I am thankful Dr.(Miss) S. Nikam, Prof, and Director, All India Institute of Speech and Hearing, Mysore, for allowing me to take up this project.

I express my deep and sincere indebtedness to my guide Dr. (Miss) S.Nikam, Prof. & HOD-Audiolog, and Director, All India Institute of Speech and Hearing, Mysore, for her invaluable help, suggestion and guidance at every phase of this project.

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A friend is a person who put the drawings for my research work, without you, I could not complete this project. Thanks a lot Binu.

Finally, I'd like to thank Rajalakshmi Akka for her typing this Independent Project and giving its final shape.

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INTRODUCTION

Many events of nature, whether the meeting of two objects or the turbulent flow of air, radiate a tiny part of their energy as pressure waves in the air. A small fraction of air that is scattered, thus we know of the event. Man's links to the outside world through hearing seems to be the essential "sense", the one that makes man peculiarly human.

The first step of intellectual development are beyond the deaf child's reach. The sounds of life remain unknown. He cannot learn to imitate meaningful sounds because he cannot hear them unless heroic effects rescue him, he will never truly master his own language, with its offspring, speech, that gives man his superlative capacity to communicate.

The virtuosity of human hearing is as remarkable as its importance. A man can hear a mosquito buzzing outside his window, even though the power of the sound reaching him, may be no more than one quadrillianth of a watt. The ear is the organ of hearing, it has a remarkable ability for resolution and perception of acoustic signals. The ear, apart from being the organ of hearing, has the organ for balance. The ear consists of outer ear, middle ear and inner ear, which are sound gathering, sound conducting and sound analyzing portions. The nerve impulses from the cochlea are carried to the auditory centers of the brain, through the auditory pathway, for perception of the acoustic signals.

Life is spent in a world of competing signals, some of which are at times extremely important and at other times ignored. A sound one does not want to attend to, can be regarded as noise and sound a person is interested in as signals. noise defined as an unwanted sound has been known for a long time. In the name of technological programme, noise has been regarded as undesirable but a necessary by-product.

It was not until the technological revolution of the past century that unwanted sound crept into significant portions of the life of every resident of civilized world. The proliferation of vehicles, machines, appliances and aircraft has poured noise-producing devices into the environment in ever increasing manner. Noise has been classified as insidious in our environment, because its effects appear slowly. In fact, the effects of noise exposure may not become apparent until long after exposure has began. Noise delivered with sufficient force to the ears can cause irreversible damage to portions of hearing sensory mechanism. Concern about non-auditory effects, is increasing since the last decade.

It is highly essential to protect the ears of the industrial workers by means of control of noise levels. One of the most efficient ways of hearing protection is by the control of noise brought about by the action of engineering controls and administrative controls. If however, it is not possible to control noise in this way, the control of noise can be brought about by ear protective devices. These ear protective devices reduces the noise level at the ear to a harmless one if not a pleasant one.

Purpose of the Study

Acoustics is the branch of physics that deals with sound. The Acoustic Camp is aimed at making the concepts of sound and its characteristics easy to understand and remember. The purpose of the "Acoustic Camp" is to present in as simple and concise a form as possible, the fundamental principles underlying the generation, transmission and reception of sounds.

STALLS

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* **Stall No.l**

Sound defined :

Sound is defined as a wave motion propagated in an elastic medium, travelling in both longitudinal and transverse directions, producing an auditory sensation in the ear by the change of pressure at the ear (Audio cyclopedia).

Sound is a vibratory disturbance in a medium which is capable of eliciting an auditory sensation in the ear. The disturbance is due to a body in vibration. e.g., tuning fork vibration, stretched rubber band that can be plucked to set into vibration.

Experiment 1 :

Take a taperecorder and record signals such as sounds produced by tuning fork, audiometer (puretones, noise), speech, musical instruments, machinery etc. in the audio cassette. The recorded signals can be played back to have auditory sensation in the ear.

Experiment 2 :

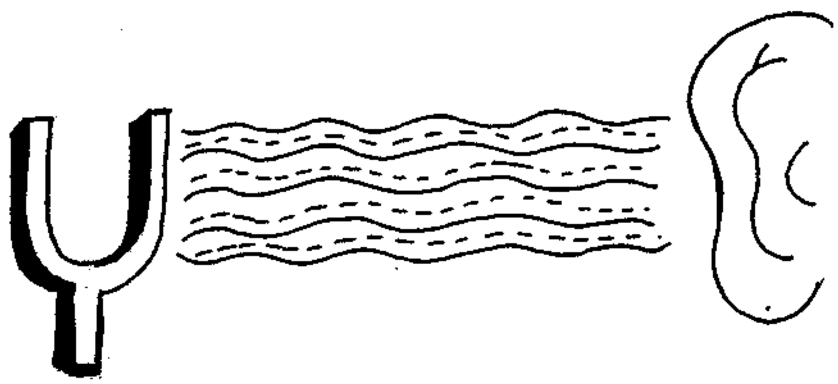


***Fig** 1.*

Take a tuning fork and struck into vibrations and the vibrating tuning fork should be kept near the external ear which results in auditory sensation in the ear.

Generation of sound

A sound producing body is always a vibrating body, in contact with some medium that is capable of passing the energy to the ear. e.g. the vibrating body may be tuning fork, strings, drum etc. and the medium may be air, water or other liquids, other gases, in addition to air even through solids.

Experiment 1

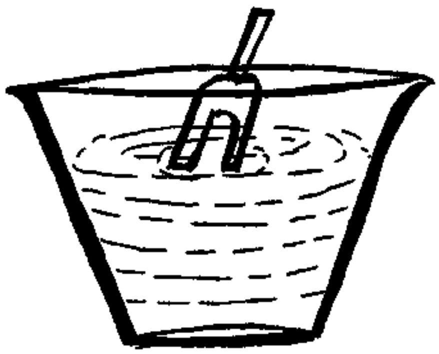


Fig 2

Take a tuning fork and struck into vibration, the vibration tuning fork should be kept in tumbler containing water. When the vibrating tuning fork is kept in the water. We can see ripples in the water indicating generation of sound.

Experiment 2 :

Take a blade and keep it at one edge of the table. One end of the blade should be supported with the finger and other end should be made free. If, the free end of the blade is made to vibrate by the finger, we can hear the sound generated by the blade.

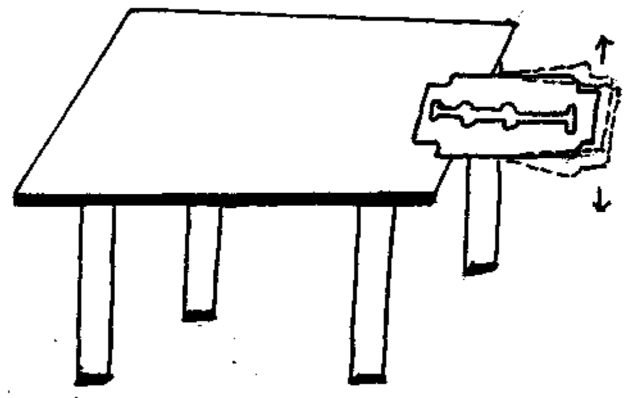


Fig.3.

This establishes the fact that the sound emitting body is a vibrating one. Is the converse also true? i.e. does a vibrating body produce sound. This is not always the case. Among several conditions required for hearing, the matter of frequency is important one.

1. The vibrations should be in the audible frequency range, i.e. 20 Hz to 20,000 Hz.

2. The medium linking the generator and the receiver of sound is another important factor for hearing.

3. The failure of a vibrating body to "sound" is that it conveys too little energy to be heard.

*** Stall No-2**

Vibration

The best way to approach the subject of vibration is in terms of a simple example. There are many to choose from, such as the vibrating prongs of a tuning fork, an oscillating piano string, a pendulum or a spring and mass.

Experiment 1 :

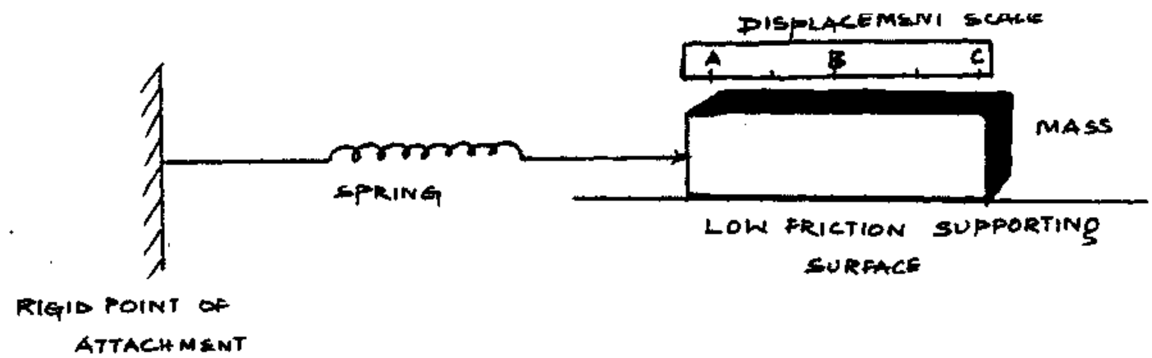


FIG **. 4**

The spring and mass arrangement.

One end of the spring is rigidly fixed and cannot move, and the other end is attached to the mass, say a metal block. The mass rests on a surface, it can easily slide along. When it is in its normal resting position, the pointer attached to the mass is at ,B' on the scale.

If the mass is moved toward point 'A', the spring will be compressed and will exert a force on the mass that tends to move it back toward its resting position. If the mass is moved in the other direction, toward 'C', the spring will be stretched, again, a force will act on the mass to move it toward rest position B. i.e. the spring excerts a "resting force" that tends to move the mass toward its rest position. Because of inertia, the mass will pass through its rest position [Inertia is the properly which causes a body in motion to remain in motion or a body at rest to remain at rest] in the absence of external forces. Again the restoring force will force the mass to the rest position.

* **Stall No.3**

Sound waves :

The vibratory motion of the sound source is conveyed to the ear by wave motion, usually in air.

The sound wave is a longitudinal wave, i.e. the particles of the medium in which it is propagated, move to and fro periodically, in the direction in which the sound is being propagated. The longitudinal wave of sound is not easily seen as the transverse waves in a pool of water.

Experiment 1 :

A pencil is attached to the tine of a tuning fork. When the tuning fork is truck into vibration, it vibrates in a particular frequency. The pencil that is attached to the tuning fork will vibrate to-and-fro. The to-and-fro motion would be drawn by the pencil as a repeating motion, so that the pencil's line would be drawn on itself over and over again.

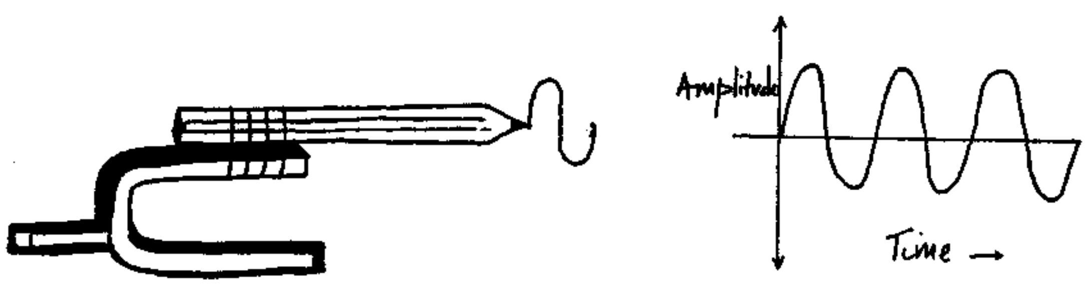


Fig 5

Illustration of longitudinal waves

Now, if the vibration fork is smoothly pulled across a sheet of paper, it results in a pattern in which the to-and-fro motions appear as a line that smoothly varies up and down; it takes the shape of a sinusoid (amplitude vs. time).

Experiment 2 :

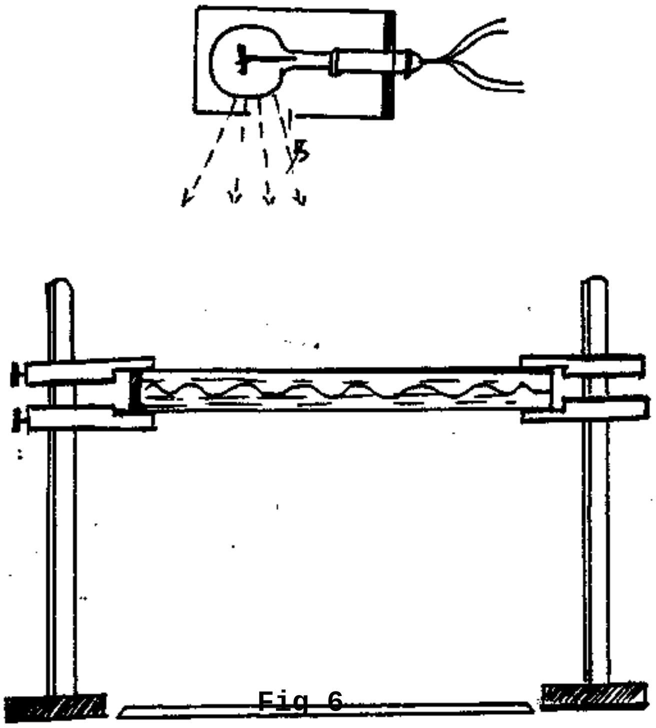


Fig 6

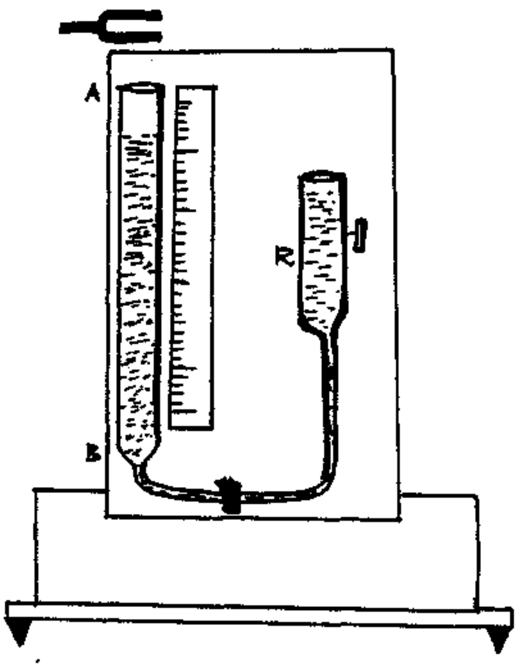
Ripple box experiment

Ripple box is a shallow box of fairly large dimensions filled with water. A strong light from above.is so directed as to throw a reflection from the surface of the water to a screen or wall. As the surface of water is disturbed, alternating patterns of light and shadow move across the screen. The shadows may be considered the phase of compression and the light the phase of rarefaction.

*** Stall No.4**

Resonance

Resonance is a particular case of forced vibration in which, the frequency of the applied force is equal to the natural frequency of the body. This is also called sympathetic vibrations. At resonance rapid transfer of energy takes place resulting in louder or booming sound.



FIG·7·

In Fig. AB is a hallow glass tube with its lower end closed with one-holed stopper. A narrow glass tube passes through the hole. The lower end of the glass tube is converted to a tank (R) of water. The tank (R) is fixed to a stand and can be raised or lowered. A meter-scale is attached to the side of the tube. The tube AB and tank (R) are partially filled with water. The level of tank (R) is raised, until the level of water in AB is near the top. A tuning fork is excited and held above the AB. The tank (R) is gradually lowered. At a particular stage a loud sound is heard because of resonance.

* **Stall No.5:**

Types of vibrations : There are basically three types of vibrations.

1. Free vibrations
2. Forced vibrations
3. Maintained vibrations

1. **Free vibrations** - results, once having set into vibration, the sounding body is released from the original force which set it into vibration. Nevertheless, the body vibrates for a considerable length of time in its natural or resonance frequency, and then stops. Usually, free vibrations do not last indefinitely, they die away. Part of their energy is carried away by sound waves; part is turned into heat by the bending of the vibrating body,

part is dissipated in other ways. The loss of mechanical energy shows itself by a decrease in the amplitude of vibration. The decrease is known as damping. When the amplitude dies rapidly, damping is large. When the amplitude dies slow, damping is small.

Experiment

When a coin is dropped on hard floor, the sound seems to "ring" for a short time. When the coin is dropped on a soft 'cushion', the sound is more like a dull that quickly does out

Following figure shows the displacement of the vibrating mass with and without damping. .

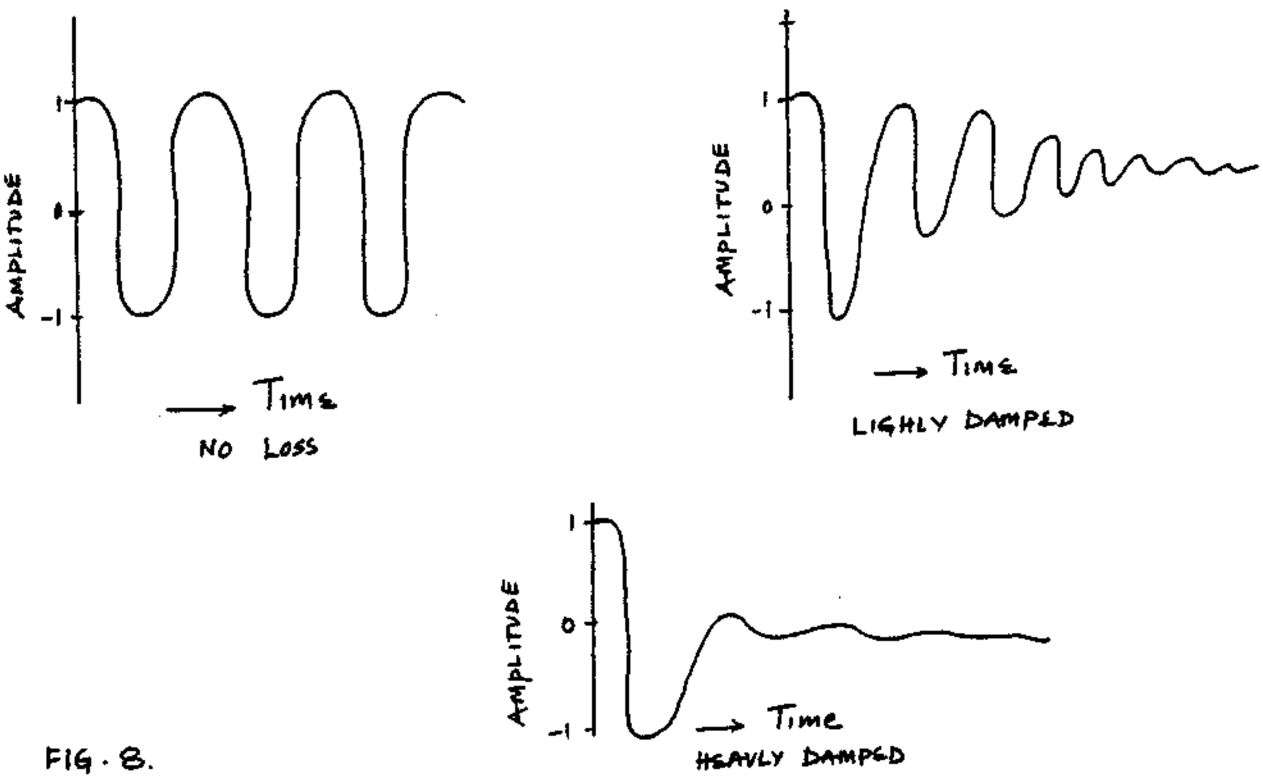


FIG. 8.

2. Forced vibrations

Forced vibrations result when the sounding body is continuously subjected to an outside force. The body vibrates only briefly, after the outside force is withdrawn. The frequency and amplitude of the sounding body is imposed by the outside force. The vibration of the mass is largest when the driving frequency equals the natural frequency of the sounding body. This phenomenon, whereby a sounding body undergoing forced vibration oscillates with greatest amplitude for applied frequencies near its own natural frequency is called resonance.

Experiment

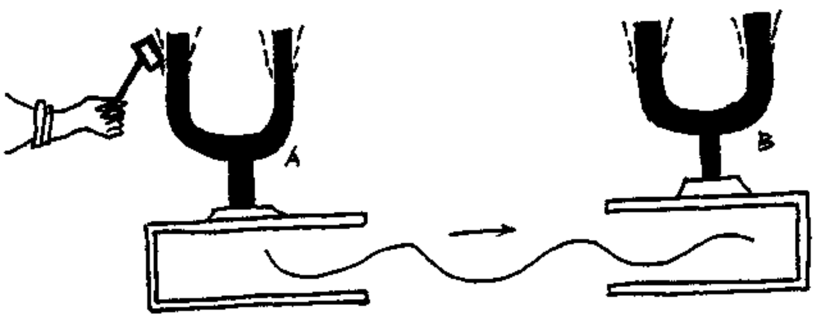


Fig. 9.

Two tuning forks coupled together.

When two tuning forks are coupled together and one tuning fork is made to vibrate, at a particular frequency of vibration the other tuning fork also vibrates.

3. **Maintained vibrations** result where an outside force keeps a body vibrating without imposing a frequency of its own, i.e. the vibrations are of **a** frequency close to or exactly that of free vibrations for the body. e.g. a violin string during bowing.

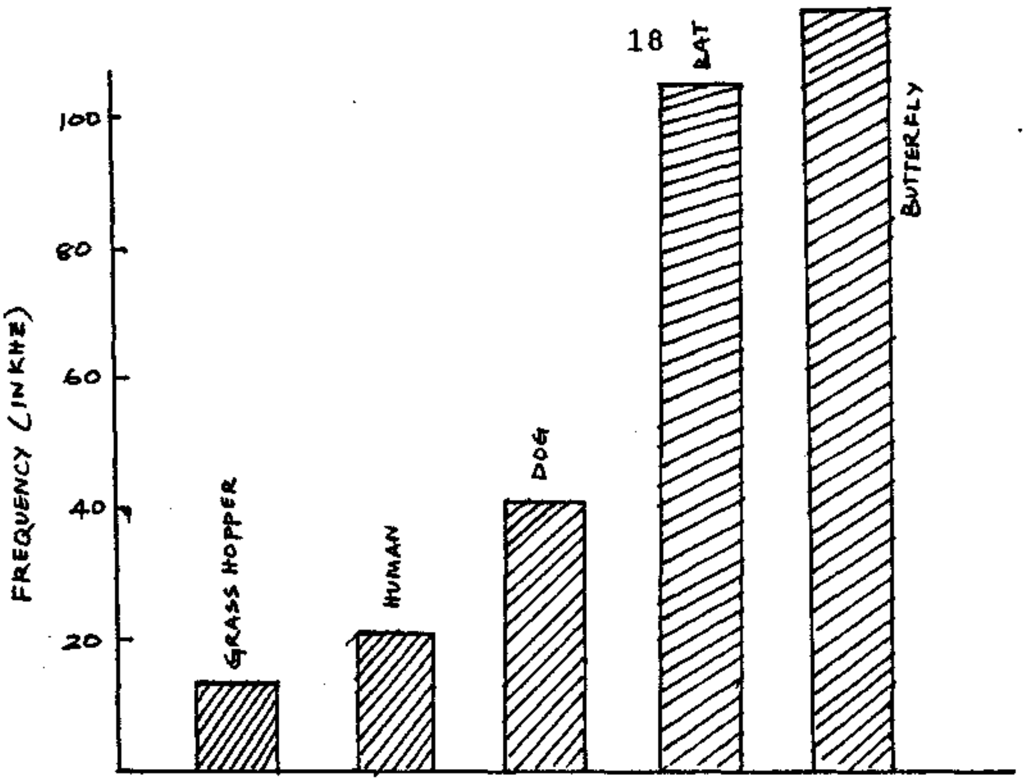
Properties of vibrating system

All types of vibrations have certain properties in common. Taking the mass and spring example again, if the mass is displaced from its rest position and allowed to vibrate, it moves back and forth between two positions that mark the extreme limits of its motion. The distance of the mass from point B at any instant is called its displacement. The maximum displacement is called the amplitude of the vibration. If there is no energy loss during vibration, due to friction for example, the maximum displacement of the mass will be the same on both sides of its rest position.

The movement of the mass from A to C and then back A is called one cycle of oscillation. The number of complete cycles in one second is called the frequency of oscillation. The unit of frequency is cycles per second (cps) or Hertz.

The time taken to complete one cycle of vibration is the reciprocal of period. A complete cycle of vibration comprises of one compression and a successive rarefaction. The distance between two successive compressions is one wavelength. A wavelength is the distance the wave travels in one cycle of vibration of air particles. If there are 'f' cycles in one second the wave will travel a distance of 'f' cycles in one second. Since the distance travelled in one second is the velocity, velocity = frequency x wavelength.

If the frequency is increased, wavelength becomes shorter. Human ear is sensitive to the vibrations from 20 Hz to 20,000 Hz. This range of frequencies is called audible range. Sounds below 20 Hz are called infrasonic and those above 20,000 Hz are called ultrasonic. However some animals (dogs) can her ultrasonic sounds.



GRAPH 1. RANGE OF FREQ. HEARD BY DIFFT. ANIMALS.

Factors affecting frequency :

1. Mass : greater the mass, lower the frequency.

2. Length : greater the length, lower the frequency.

3. Tension : greater the tension, greater the frequency.

i.e. $F = \frac{1 \quad KT}{21 \quad M}$

1 = length
M = Mass
T - Tension

i.e. to reduce a frequency by one-half, we have to double the length, or multiply the mass or device the tension by four, e.g. male and female voice.

Usually the voice of male fundamental frequency is low and the voice of female fundamental frequency is high. In males the length of vocal folds is more, mass is more and tension is less, because of this the fundamental frequency of male's voice is low. Whereas in females the length of vocal folds is small, mass in less and tension is more, because of this the fundamental frequency of female's voice is high.

* **Stall No.6**

Determination of frequency using stroboscope

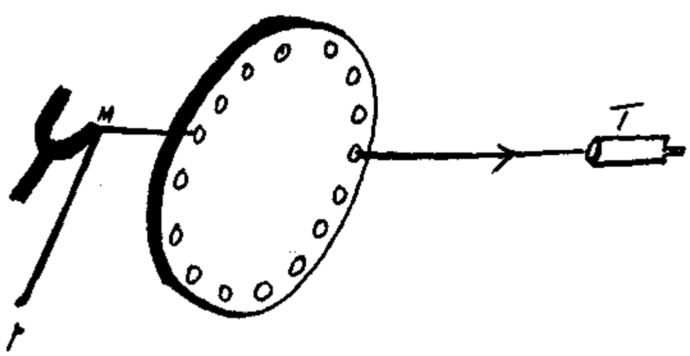


FIG. 10.

The stroboscope is a circular disk having a number of equispace circular holes near the edges. A small plane mirror strip is attached to the prong of the given tuning fork. Light from source 'P' falls on a mirror strip 'M' and gets reflected. The reflected light passes through one of the holes of the stroboscope and is finally seen through the telescope T. When the fork is excited light can pass through the hole, only for the equilibrium position of the fork.

Now, the stroboscope is slowly rotated and there will be flickering of light- The speed of rotation is slowly increased until flickering of light stops and the image is seen stationary. That is, by the time the prong makes one oscillation, next hole occupies the position of the previous hole thus allowing the continuous passage of light.

If 'n' is the speed of rotation of the disc, it will complete one rotation in 1/n seconds. If the disc contains 'N' number of hole, for one rotation of the disk, 'N' number of holes will cross the field of view.

The time taken for one hole to replace the next = 1/Nn secs. This gives the period of oscillation (T) of the fork. The frequency of the fork = 1/T = Nn Hertz.

* **Stall No.7**

Doppler's **effect**

The Doppler's effect is the apparent change in frequency of sound, light or radio waves caused by the relative motion of the source, medium or observer.

e.g. When an approaching train blows its whistle, the pitch of the whistle seems higher as the train comes toward you. The pitch seems to become lower when the train passes and goes away from you.

i.e. whenever sound source moves towards or away from the observer, the pitch of the sound as heard by the observer is slightly different than the one emitted by the sound. When the source and the observer are at rest or in motion in the same direction such that the speed of both is the same, the pitch of the sound does not change.

* **Stall No.8**

Intensity

Intensity refers to the rate at which energy is given off by the sound source, or the energy with which a sound wave strikes an object some distance away i.e. It is related to how far the particles of the medium are displaced during a cycle and unit is dB.

Experiment

Take a string which is tightly connected to two rods with its two edges and if we pull the string to a longer distance the resulting sound will be louder. If we pull the string to a shorter distance the , resulting sound will be softer.

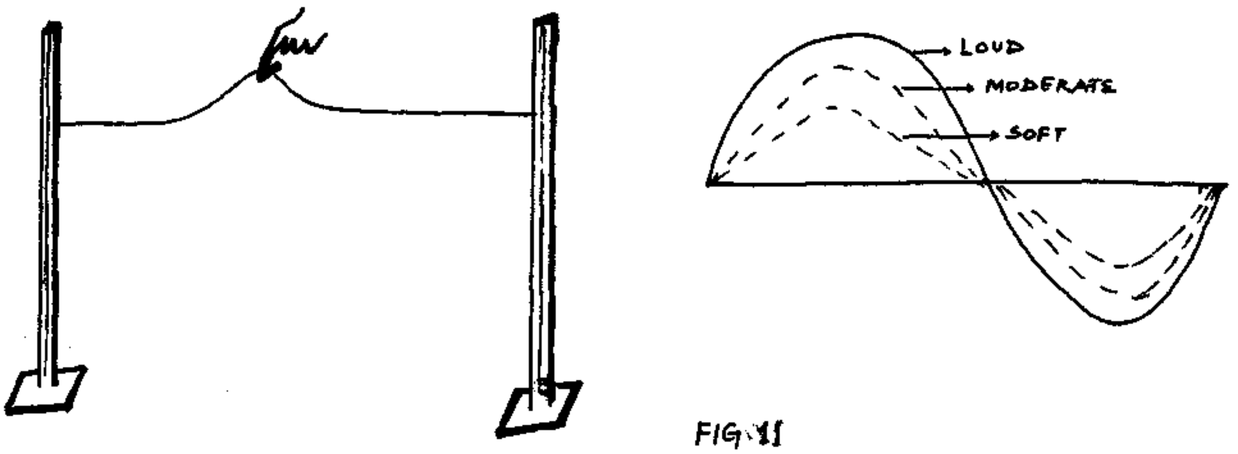


FIG. 11

As the displacement increases intensity also increases.

Factors affecting intensity

The intensity of a sound is inversely proportional to the square of the distance from its source. As the distance between the receiver and source increases intensity decreases and vice-versa.

e.g. soft sound	-	rustling of leaves
moderate sound	-	speech
loud sound	-	lions roar, dog barking

Sound quality

The principal determinant of sound quality is the relative amplitudes of the fundamental and the harmonics.

The quality of sound depends on the particular partials, distribution of the partials and their relation to the fundamental and to each other, intensity - absolute and relative to each other and to the fundamental, phase relationships of partial and the fundamental.

* **Stall No.9**

Velocity of sound :

Sound is not transmitted instantaneously, it takes time for a sound wave to travel from its source to the listener. The speed at which sound is propagated is known as velocity. Velocity is the distance which a sound wave travels through a given medium in a single unit of time (i.e. Mt/sec.).

Different media (gas, liquid, solid) transmit sounds at different velocities, depending on the density and volume velocity of the given medium, velocity of very loud sound decreases at great distances. Sound travels faster in solids than in liquids than in gases. All the sounds regardless of pitch, travel through the air at the same velocity.

e.g. we can hear the sound of the approaching trains _ through the tracks even when the train is at a longer distance and the train is not visible. This is not possible through air i.e. we cannot hear the sound through air when the train is coming from a longer distance.

For each degree centigrade rise in temperature, the velocity increases by about 0.6 mt/sec. (For each degree Fahrenheit rise, the velocity increases by about 1.09 ft/sec).

Velocity of sound in mts/sec.

1. In air at 0 degree centigrade 331.5
2. In air at 22.2 degree centigrade is 344.65
3. In distilled water at 31 degree centigrade is 1500.
4. In sea water at 13 degree centigrade is 1492.3
5. In copper at 20 degree centigrade is 3560.
6. In cast steal at 20 degree centigrade is 4990.
7. In lead (high density, low elasticity) is 1229.

An insufficiently elastic and excessively dense material cannot transmit sound at high speed for it does not passes sufficient elastic recovery; and, is too massive to take part in rapidly alternating to-and-fro manner.

$$\text{Velocity} = \frac{\text{Elasticity}}{\text{Density}}$$

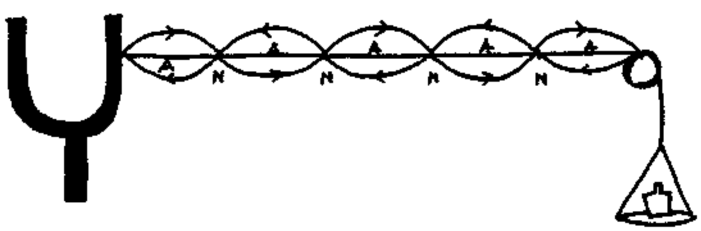
Rising temperature of air decreases the density without affecting its elasticity, hence speed of sound in warm air is higher than in cold air [2 ft/sec for each centigrade rise (0.6 mt/sec/degree centigrade]

In a gas, speed of sound is independent of its pressure, since a change in pressure affects both elasticity and density in the same. The drop in the speed of sound at high elevations is due to only low temperature, not to low pressure.

* **Stall No.10**

Standing waves

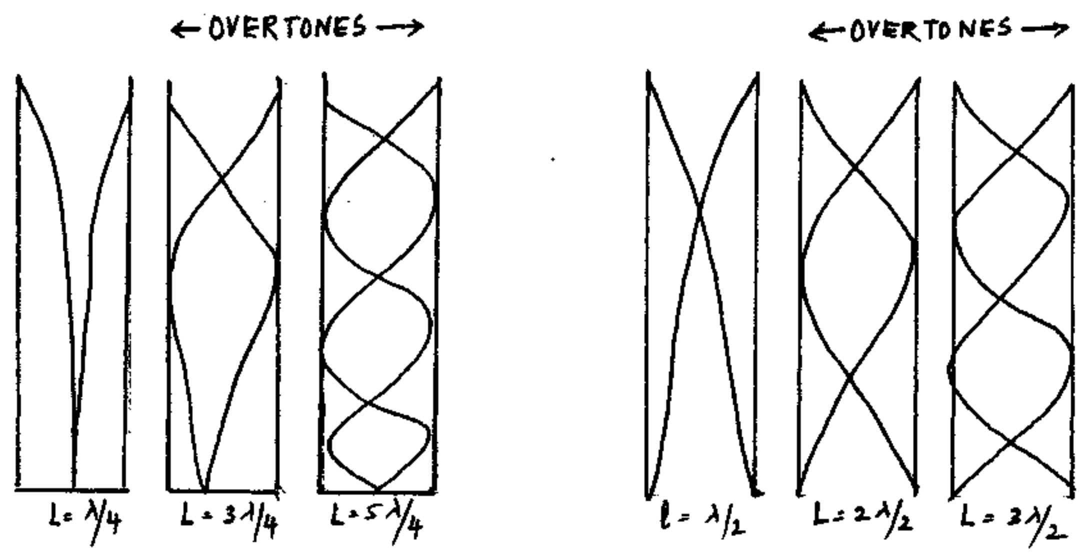
When two waves of the same frequency and amplitude travelling in opposite directions are superimposed on each other, the resulting wave so formed is a standing wave. This wave does not appear to be moving. In a standing wave, the particles of the medium at different places vibrate in the same manner, i.e. particles of the medium at certain points remain stationary - nodes. On the other hand, the particles of the medium at some other points of the medium vibrate with maximum displacement - antinodes. The distance between the two adjacent nodes and antinodes is equal to the half of the wavelength.



FIG, 12

Vibrations in pipes :

A pipe of uniform cross-section encloses a column of air, when longitudinal sound wave is set up at its open end, it travels in the air inside the tube and gets reflected at the other end. At the open end, as the particles of air are free to move, an antinode will be formed. At the closed end, as the particles of air are not free to move, a node will be formed. As a result, longitudinal stationary waves are set up in the medium with a mode at the closed end and an antinode at the open end.



Simplest mode of vibration

Frequency of Fundamental
and overtone
(1:3:5 (odd multiples)

Fundamental frequency

Frequency of Fundamental
and overtone
1:2:3 (integral multiples)

Fig -13.

*** Stall No.11**

Absorption and reflection of sound

When sound waves travel outwards from a sound source, the waves encounter all kinds of obstacles and in certain conditions, they may be reflected from those obstacles.

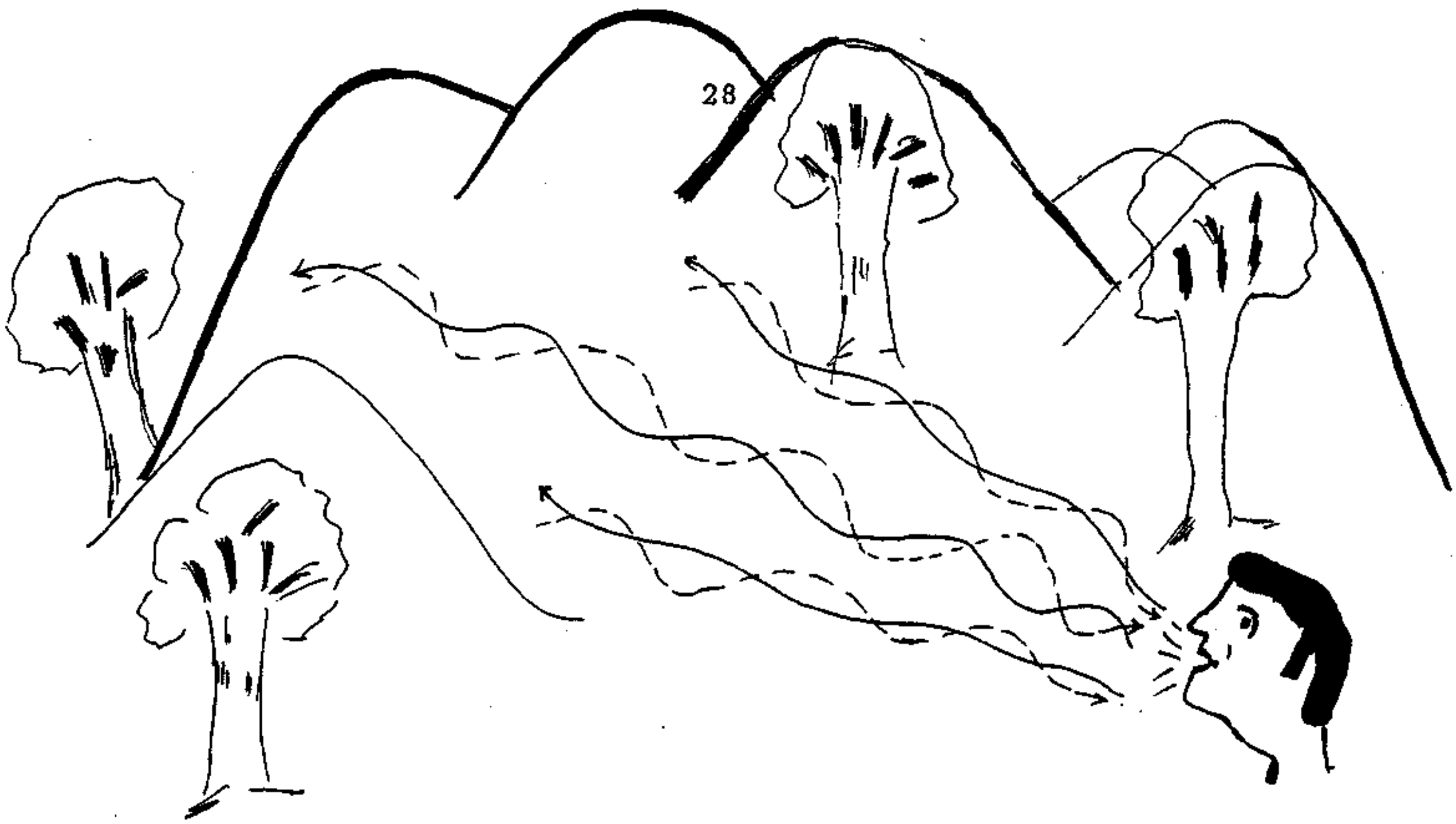


FIG.

e.g. Echoes coming back from a hillside or a building. The shouted word or a handclap will travel outwards from the source and each perhaps, a distant hillside, there the sound waves will be reflected and after an interval arrive back at our ears. If there are several such obstacles in the path of the sound. We may hear two or three echoes, which will arrive back at different times because the obstacles are at different distances and the sounds have to travel these and back at the speed of 340 mt/sec. The echo is much fainter than the original sound as the energy is being used up in moving air particles between the source and the hill.

Properties of sound waves

The properties of sound waves are reflection, refraction, interference, diffraction, scattering.

(1) **Reflection** :

When sound waves travel outwards from a sound source, the waves encounter all kinds of obstacles and in certain conditions, they may be reflected from these obstracles. These reflected sounds after an interval arrive back our ear. These are known as echoes or reflections.

(2) **Refraction** :

When a sound travelling in one medium falls on another **medium,** it gets refracted.

(3) **Diffraction** :

Bending of sound over the edges of obstacles is diffraction. The region behind the obstacle when sound is absent is called "acoustic shadow".

(4) **Interference** :

When two or more waves of same frequency and amplitude travelling in the same direction are superposed on each other the phenomenon of interference takes place. When, in same phase, the two sound waves meet each other, they reinforce. When two waves of opposite phase meet each other they cancel each other.

* **Stall No.12**

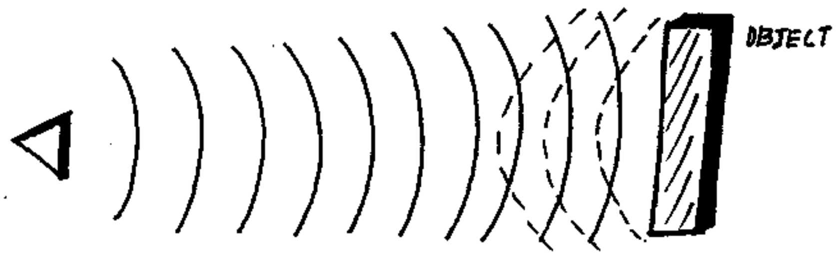
Reverberation

'Echo' is used where there is a time interval between the outgoing and the returning sound. The same phenomenon of reflection occurs in ordinary rooms and in concert halls where distances are comparatively short and there is usually overlap between the outgoing and the reflected sound, this is referred to as "reverberation". The amount of reverberation can be modified. An empty room is much more reverberant than a furnished room i.e. the furnition must be taking up or absorbing sound energy, leaving much less to be reflected.

A sound wave is reflected if the obstacle is larger than the wave length and will tend to be absorbed if it is small.

This accounts in part for the materials used in acoustic treatment of rooms, the object of which is generally sound absorption; perforated panels, rough textured and porous surfaces present effectively many small obstacles to sound waves and also increase the actual area interposed in their path and thus providing sound absorption over a wide range of frequencies.

Simplified diagram of sound waves passing objects :



Fig, 15

a) Object larger than the wavelength; most of the wave is reflected.

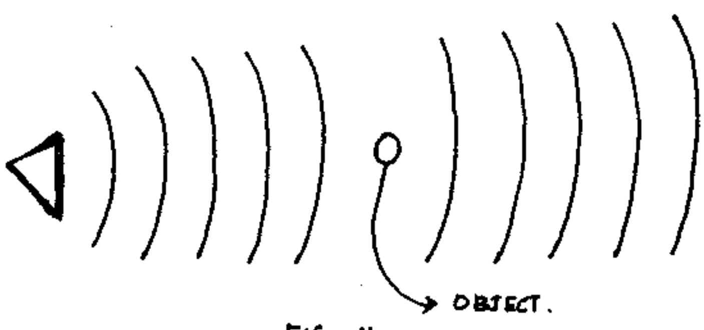


FIG. 16

b) Object much smaller than the wavelength; most of the wave passes the object.

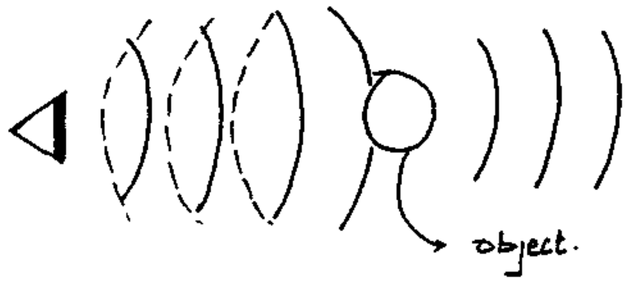


FIG: 17

c) Object close in size to the wavelength; sound shadow is produced beyond the object.

The sound persists on eardrum for a period of l/10th of a second. Any sound which comes as reflection to ears after l/10th of a second travels a distance of about 34 mts. Therefore to hear echo, the barrier should be at least a distance of 17 mts.

The open space can be considered to be an infinite medium and hence no reflection of sound takes place in it. In a closed hall, a sound produced at one place gets reflected at different places in the hall. There will be effects of reverberation, echoes, focussing of sound, unwanted resonance, unwanted interference and unwanted noise. These defects must be avoided for good acoustics. Good acoustics aid in enjoying music and construction of lecture hall or auditorium, hence requires more than just a ceiling and four walls.

* **Stall No.13**

Lombard effect

The lombard effect is based on the fact that we monitor the loudness of our own voice through the sense of hearing. If we are speaking in a noisy environment, unconsciously increase the intensity of our voice to compensate for the masking effect of the noise. Thus we observe fluctuations in the intensity of voice as the level of the masking noise is increased or decreased. This is called lombard effect.

Experiment

When the noise is presented through the earphones of the audiometer and asking the person to read passage or a text by monitoring the VU meter. We can identify the increasing in intensity of voice when the noise level is high and no change in intensity of voice in the absence of noise.

*** Stall No.14**

Occlusion effect

We can hear sounds through two modes of conduction

(1) Air-conduction (sound waves - eardrum-middle ear -inner ear -auditory pathway - auditory centers in brain).

(2) Bone-conduction (sound waves - mastoid bone - inner ear -auditory pathway - auditory centers in the brain).

When the ears (the cartilaginous part of ear canal) are covered or occluded during bone conduction of sound, there is an increase in intensity of sound delivered by bone conduction to the inner ear. This phenomenon of increased loudness of a bone-conducted tone when the outer ear is tightly covered or occluded is known as occlusion effect.

Experiment

Place a vibrating tuning fork on the mastoid, close the ear canal, you can perceive the increase in loudness of the vibrating tuning fork (unless you have a conductive hearing loss). The occlusion effect is more in low frequencies and reduces at higher frequencies.

Another example:

When the subject's ear is occluded and asking him to say a vowel (with more energy in low frequency) and in the same way a sibilant /s/ (with more energy in high frequency). We can identify change in quality for vowel than the sibilant.

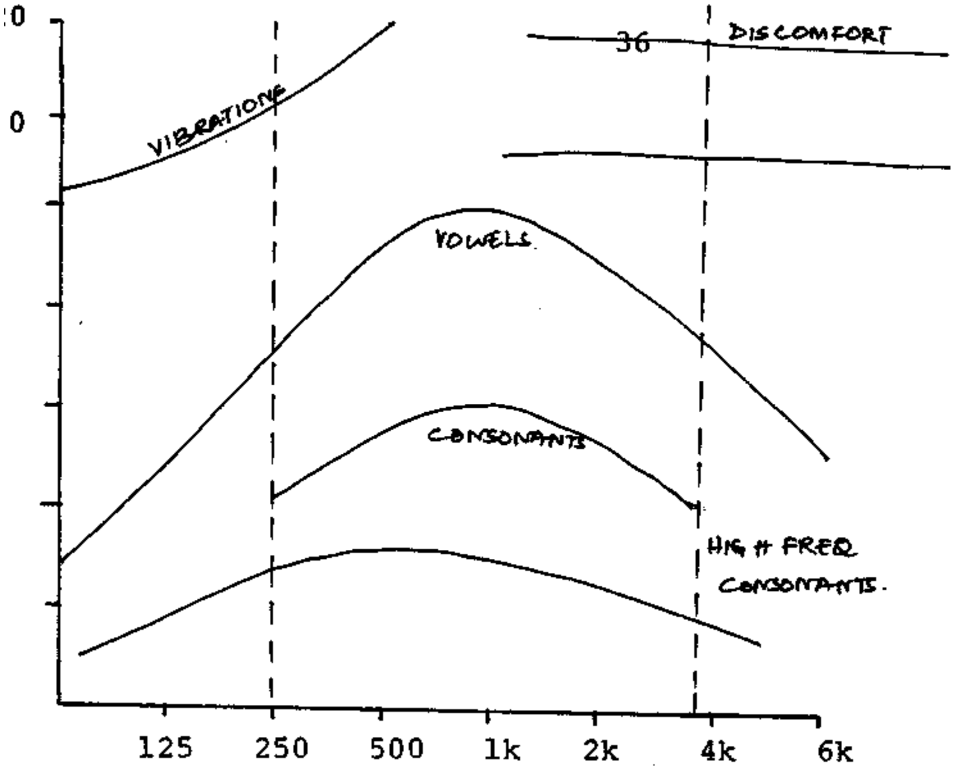
Obturation effect

The bone conduction hearing is enhanced if the ear canal is occluded at the cartilaginous portion. However, there is no enhancement of bone conducted hearing if the occlusion is at the bony portion of the ear canal. This is called as obturation effect.

* **Stall No.15**

Speech Banana

Speech is an acoustic signal. In being so, it has certain characteristics. This can be understood by studying the speech banana. The vowels are lower in frequency and higher in intensity (vowels are more intense but carry less information). Whereas the low intense consonants are more information hearing elements.



FREQ. →

GRAPH. 2.

* Stall No.16

Tones and noise

Tones are made up of sounds which have periodic vibrations. Musical sound is one which produces pleasing sensation on the ears.

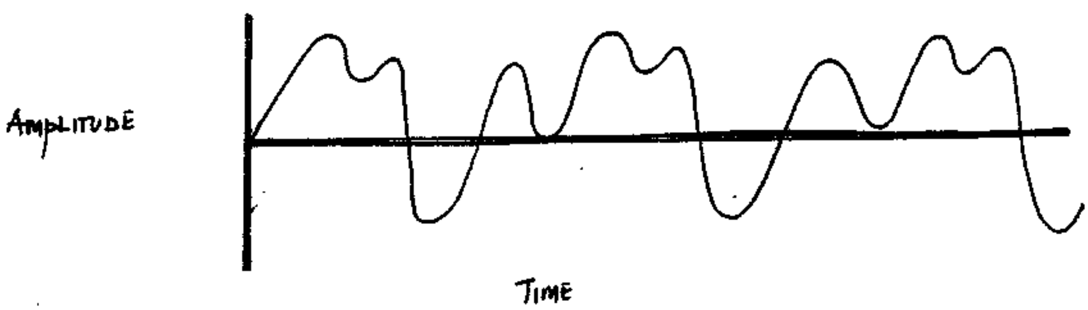


FIG. 18.

Sounds which do not have regularity of vibration, which have no periodicity and no identifiable pitch are classified as noises or complex sounds. Noise gives an unpleasant sensation to the ears.

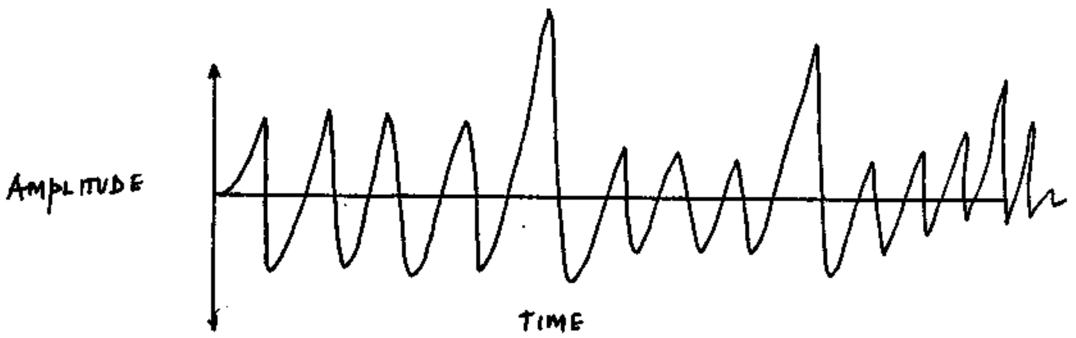


Fig 19

Noise has harmful effects not only on the ear but on physiology and psychology of the person. Hence the effect of noise should be controlled by use of ear protective devices. The available ear protective devices are ear plugs, semiinserts, ear muffs, helmets.

*** Stall No.17**

Beats

When two waves of slightly differing frequencies travelling in the same direction are superimposed on each other the intensity of the resultant sound at any point, alternately rises and falls many times in one second. This regular waxing and wanning of the intensity of sound is beats. The number of beats is equal to the frequency difference of the two waves. This phenomenon is made use of in tuning musical instruments.

Experiment

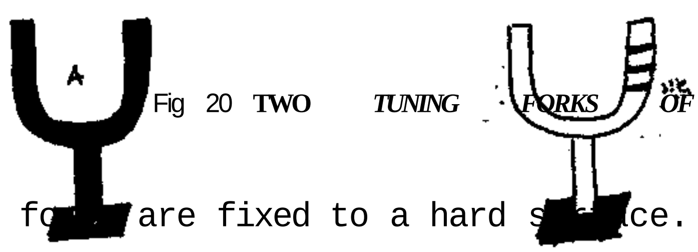


Fig 20 **TWO *TUNING FORKS OF* SAME FREQ..**

Two tuning fo[illegible] are fixed to a hard s[illegible]ce. To one of the tuning fork, a rubber band is wound. When the forks are set to vibrations, because of change in mass of the. fork A beats can be heard.

* Stall No.18

Stereophonic sound

The sounds we normally hear are stereophonic. This because we have two ears. The sound signals reaching one ear are normally slightly different from those reaching the other. These differences are discernable by the brain. Stereophonic sound gives a more natural effect on account of the ear's ability to detect the direction as well as the intensity of sounds. The listener feels as if he is actually present at the performance.

* Stall No.19

Signal to noise ratio

Signal is the sound which is of interest to a person. Noise is an unwanted sound. A schematic representation of signal-to-noise ratio.

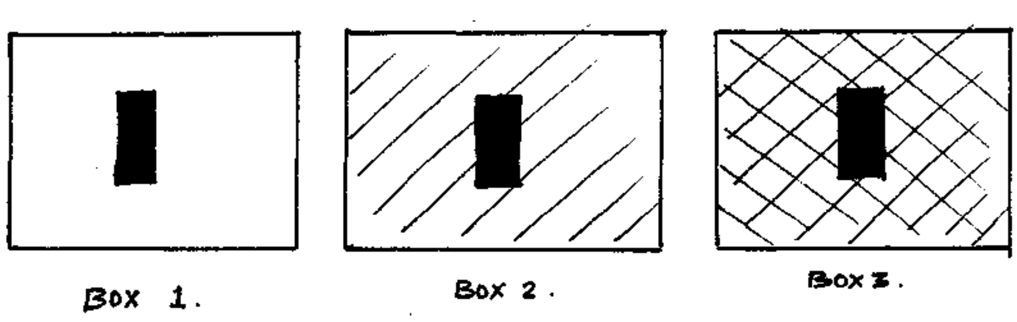


Fig 21

All three boxes carry a signal. 1st box carries only the signal; 2nd one contains noise along with the signal. Since the noise is not too great, the signal is still quite easily discernible. The 3rd box contains more noise and nearly obliterater the signal (masking).

Experiment

Take a taperecorder and record speech in the absence of any noise, in the presence of less noise level and in the presence of more noise. So we can easily understand the speech which was recorded in the absence of noise. When there is less noise we can understand to some extent and in the final condition we cannot understand the speech at all because of masking.

* **Stall No.20**

Physiology of hearing

The ear is the organ of hearing, it has a remarkable ability for resolution and perception of acoustic signals. The ear, apart from being the organ of hearing, has the organ for balance. The ear consists of outer ear, middle ear and inner ear, which are sound gathering, sound conducting and sound analyzing portions. The nerve impulses from the cochlea are carried to the auditory, centers of the brain, through the auditory pathway, for perception of the acoustic signals.

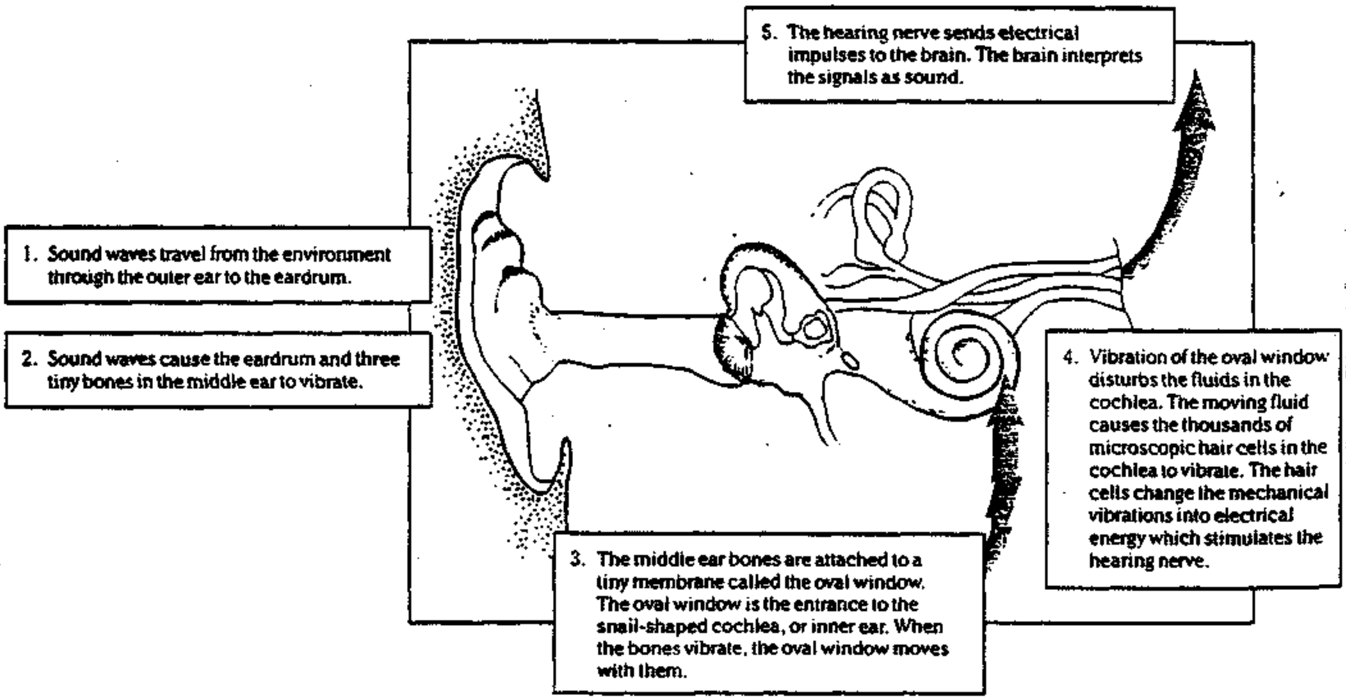


FIG. 22

STEPS IN HEARING.

Steps in hearing

1. Sound waves travel from the environment through the outer ear to the drum.
2. Sound waves causes the ear drum and three tiny bones in the middle ear to vibrate.
3. The middle ear bones are attached to a tiny membrane called the oval window. The oval window is the entrance to the snail shaped cochlea, or inner ear. When the bones vibrate, the oval window moves with them.
4. Vibration of the oval window disturbs the fluids in the cochlea. The moving fluid causes the thousands of microscopic hair cells in the cochlea to vibrate. The hair cells change the mechanical energy which stimulates the hearing nerve.
5. The hearing nerve sends electrical impulses if the brain. The brain interprets the signals as sound.

CONCLUSION

Acoustics is the branch of physics that deals with sound. The acoustic camp is aimed at making the concepts of sound and its characteristics easy to understand and remember.

Purpose :

The purpose of the **"Acoustic Camp"** is to present in a simple and concise a form as possible, the fundamental principles underlying the generation, transmission and reception of sounds.

Hope this will be an effective aid for the beginners to have knowledge regarding the fundamental principles underlying the generation, transmission and reception of sound.

Future directions :

* The teaching aid can be utilized by mass media services eg. Television networks.
* The teaching aid can be recorded in slide cum tape method and employed in school education programs.
* The teaching aid can be translated into many Indian languages.

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APPENDIX

List of materials

1. Audio cassette
2. Taperecorder with two speakers
3. Tuning fork
4. Coupled tuning forks
5- Audiometer with speech audiometry provision
6. Audiometer with bone conduction provision
7. Pitch pipes
8. Open pipe
9. Closed pipe
10. Sonometer
11. Telescope with battery
12. Bell
13. Hallow metal rods
14. Violin
15. Pendulum
16. Lamp
17. Glass tray
18. Glass tank
19. Blade
20. Ear protective devices
21. Ping Pong ball