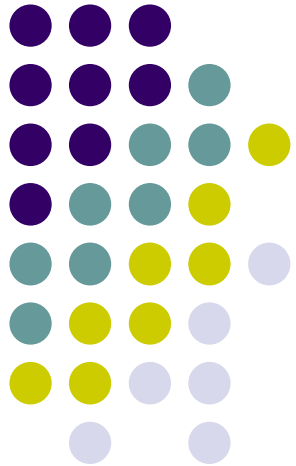
Recording of Sound



History of Recording sound

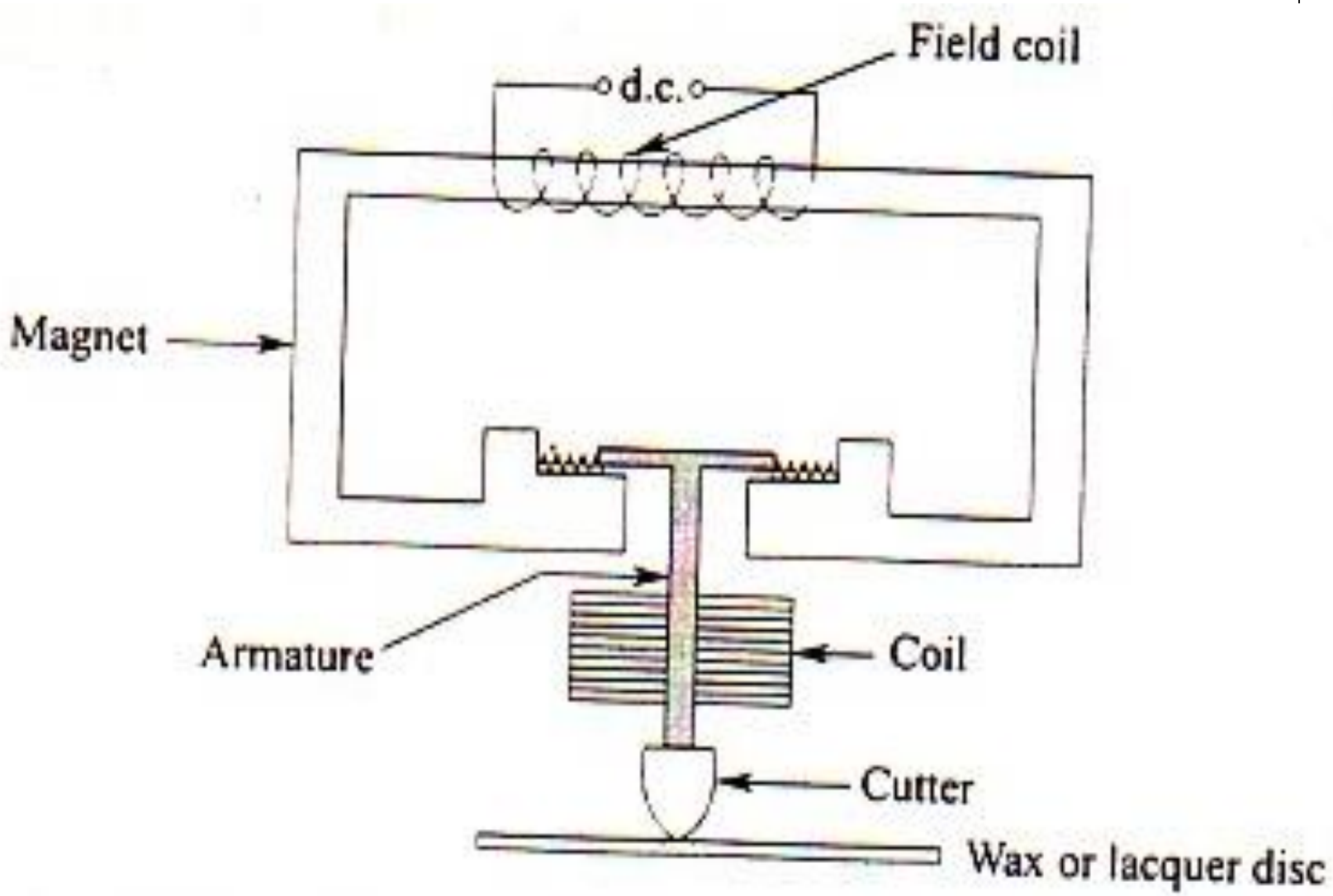
- **Thomas Edison** is credited with creating the first device for recording and playing back sounds in 1877.
- He invented Phonograph.
- In Edison's original **phonograph**, a diaphragm directly controlled a needle, and the needle scratched an analog signal onto a tinfoil cylinder.
- You spoke into Edison's Phonograph the diaphragm vibrated, so did the needle, and those vibrations impressed themselves onto the tin.
- During playback, the vibrations pressed into the tin caused the needle to vibrate, causing the diaphragm to vibrate and play the sound.

- This system was improved by **Emil Berliner** in 1887 to produce the **gramophone**, which is also a purely mechanical device using a needle and diaphragm.
- The gramophone's major improvement was the use of flat records with a spiral groove, making mass production of the records easy.
- The modern phonograph works the same way, but the signals read by the needle are amplified electronically rather than directly vibrating a mechanical diaphragm.

Disc Recording

- When an audio signal passes through a coil wound on an armature and placed in a magnetic field, the armature moves to and fro in accordance with the audio signal.
- A cutting needle is fixed with the armature, and it is also vibrates.
- The cutter moves from edge to center

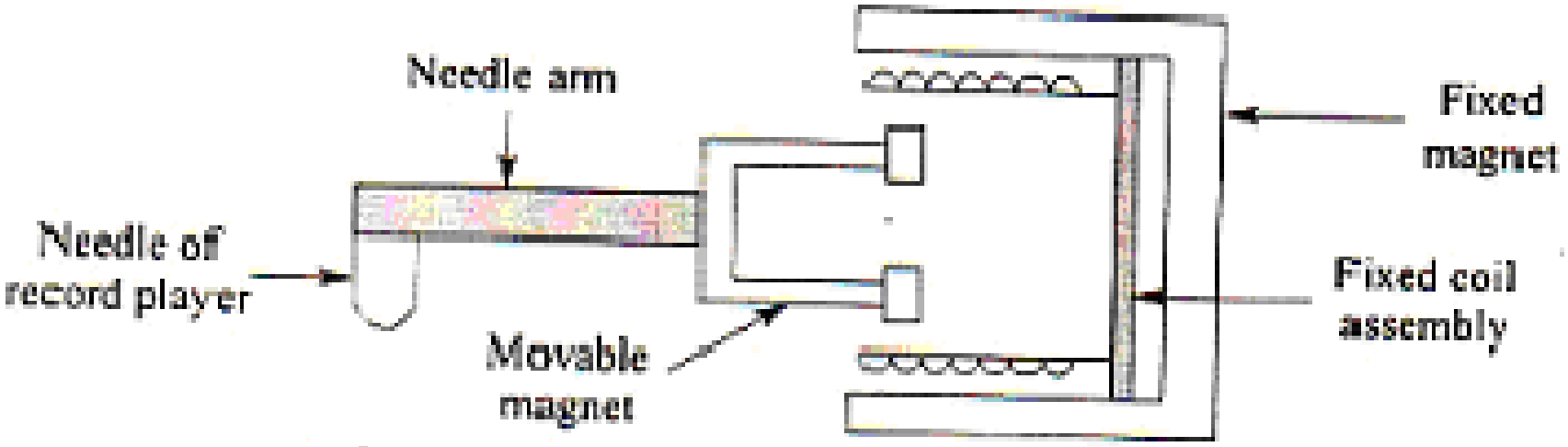
Disc Recording



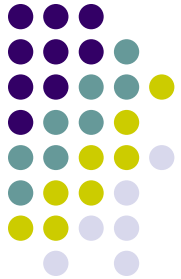
Disc reproduction

- When needle of the record player tracks the recorded grooves on the disc, it vibrates in accordance with lateral variation of groove.
- This vibration move a magnet placed in the magnetic field of a fixed permanent magnet.
- Due to vibrations of the magnet, the flux density through a coil placed in that magnetic field, changes and hence e.m.f is induced in the coil depending on the rate of change of flux

Disc Reproduction

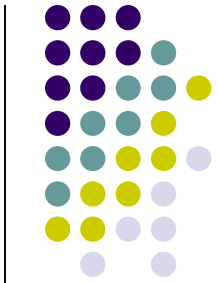


Magnetic Recording



- Magnetic recording was demonstrated in principle as early as 1898 by Valdemar Poulsen.
- There are two parts to any audio magnetic recording system: the recorder itself (which also acts as the playback device) and the tape it uses as the storage medium.
- **Magnetic tape** is a non-volatile storage medium consisting of a magnetic coating on a thin plastic strip.
- It consists of a thin plastic base material, and bonded to this base is a coating of **ferric oxide** powder.


SIDE TWO
Magnetic Tape

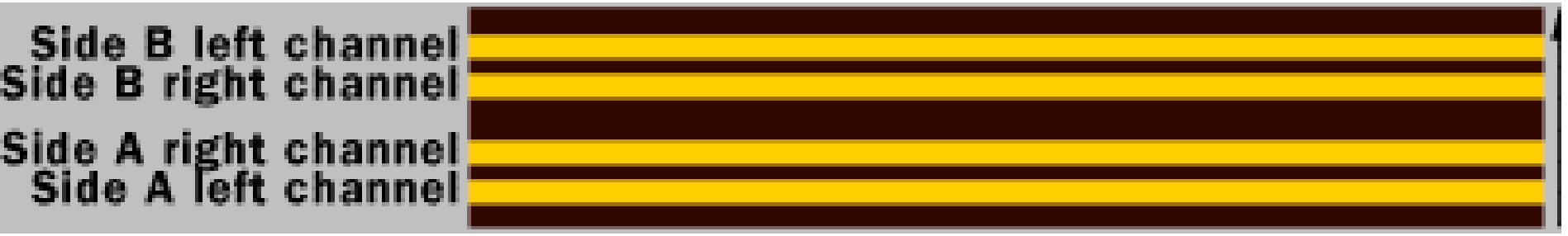


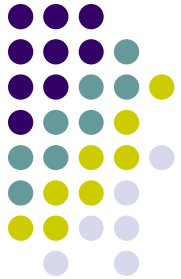
- The oxide is normally mixed with a binder to attach it to the plastic.
- This oxide is a **ferromagnetic** material, meaning that if you expose it to a magnetic field it is permanently magnetized by the field. That ability gives magnetic tape two of its most appealing features:

  -You can record anything you want instantly and the tape will remember what you recorded for playback at any time.

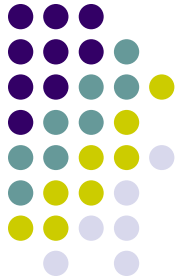
  -You can erase the tape and record something else on it any time you like

Recording tape



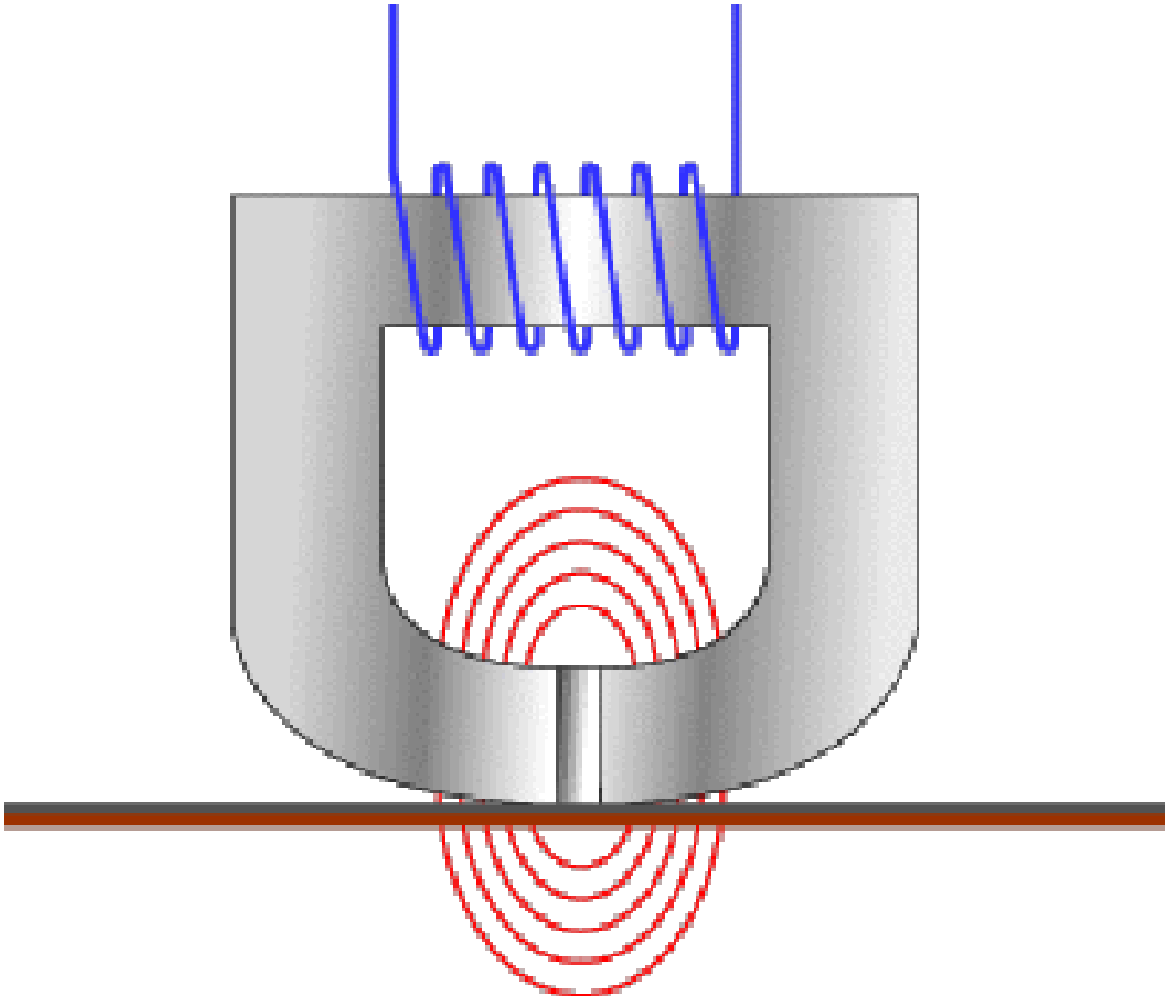


- The audio output of the microphone is amplified and fed to the coil of an electromagnet.
- The tape recorder head consists of an iron core wrapped with wire.
- During recording, the audio signal is sent through the coil of wire to create a **magnetic field** in the core.
- This magnetic field is what magnetizes the oxide on the tape.

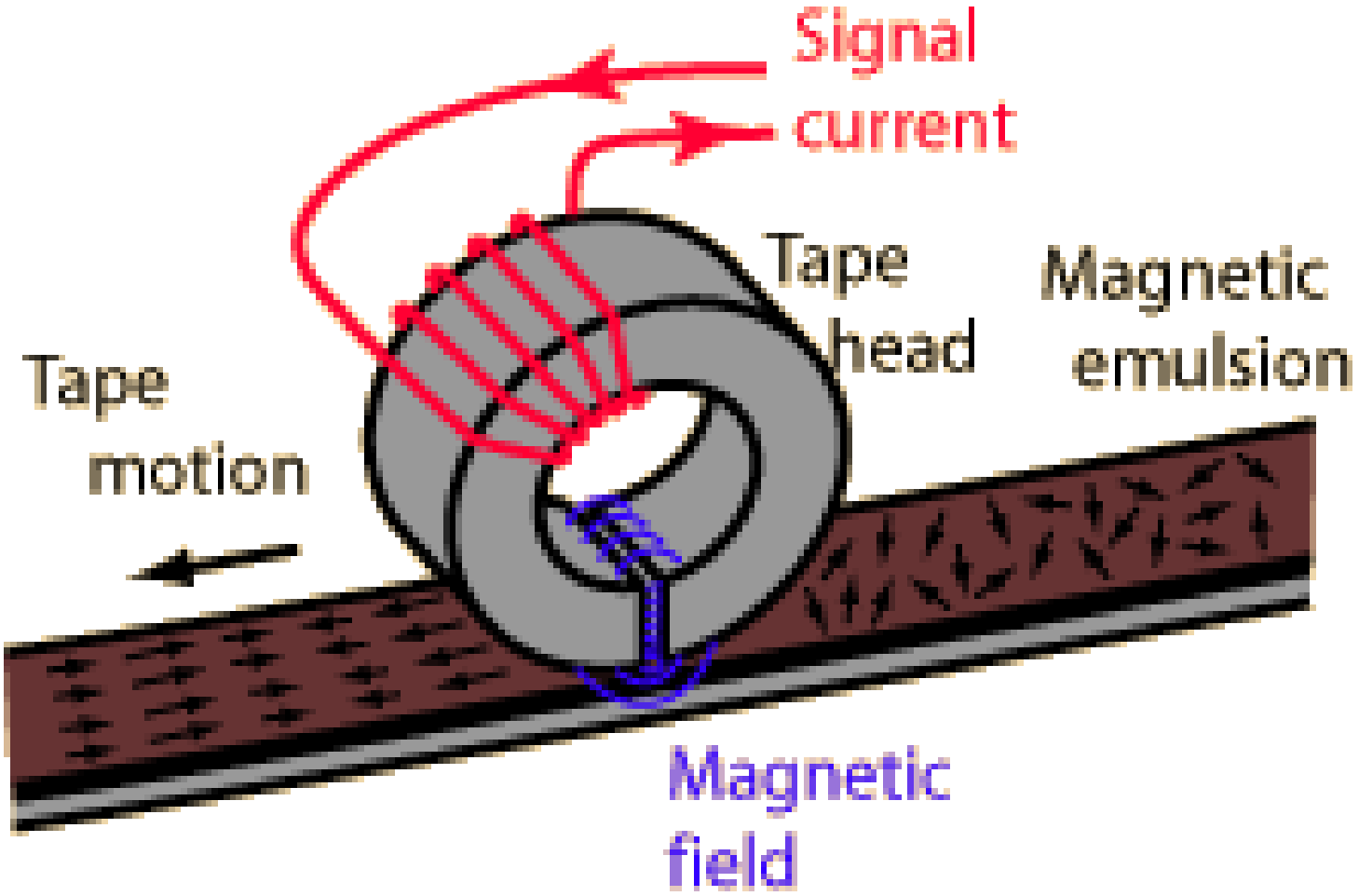


- During playback, the motion of the tape pulls a varying magnetic field across the gap.
- This creates a varying magnetic field in the core and therefore a signal in the coil. This signal is amplified to drive the speaker.
- Most audio magnetic recording system consist of:
    1. Record head
    2. Reproduce head
    3. Erase head

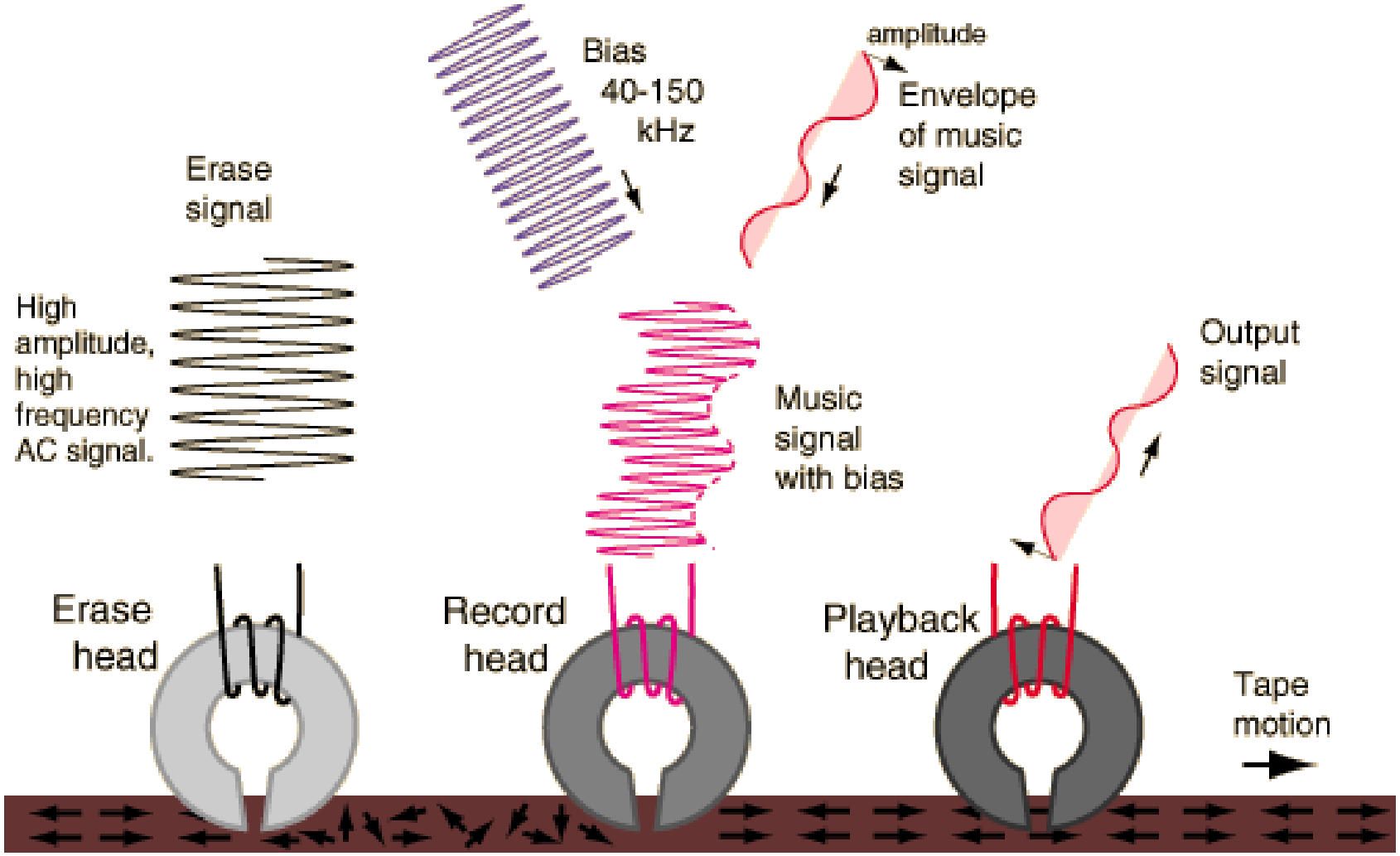
Tape Recorder head



Tape Motion


Signal
current
Tape
head
Magnetic
emulsion
Tape
motion
Magnetic
field

Tape Recording Process



Erase Head

- Before passing over the record head tape passes over the erase head which applies a high amplitude, high frequency AC magnetic field to the tape to erase any previously recorded signal

Record Head

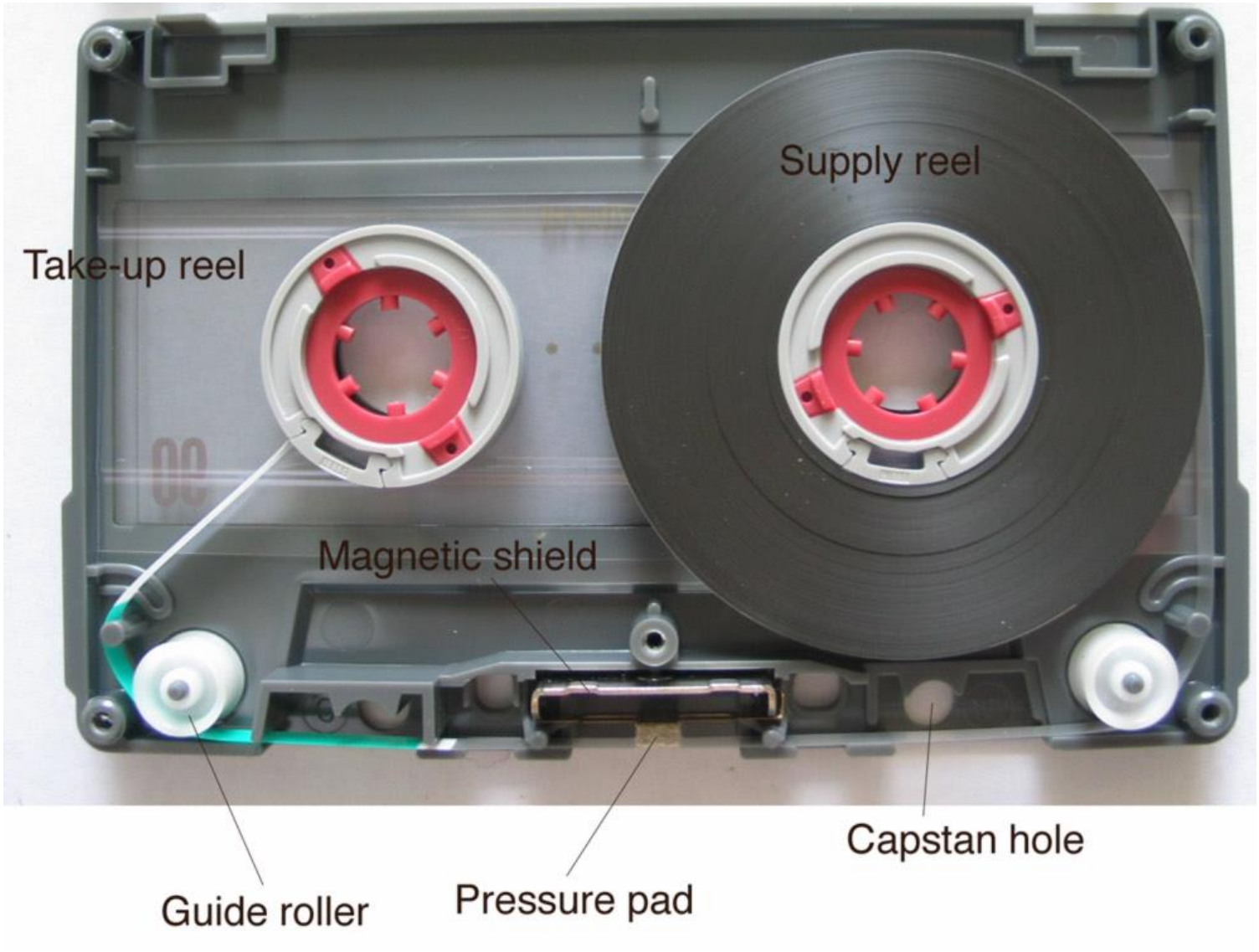
- It consist of coil wound on an iron core.
- When audio current flows through the coil, the core is magnetized and the variation in magnetization is in accordance with the audio variation of current

Playback Head

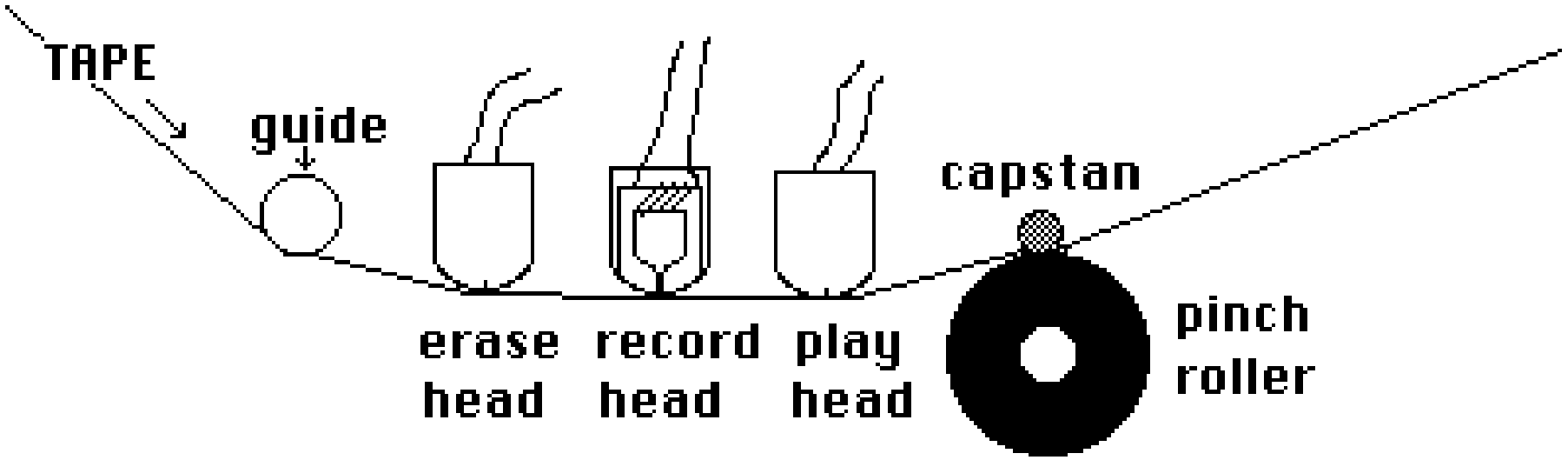
- When magnetized tape passes under the playback head of a tape recorder, the ferromagnetic material in the tape head is magnetized it produce a magnetic filed around the coil.
- Any change in this magnetic field induces a voltage in the coil according to Faraday's law.
- This induced voltage forms an electrical image of the signal which is recorded on the tape.

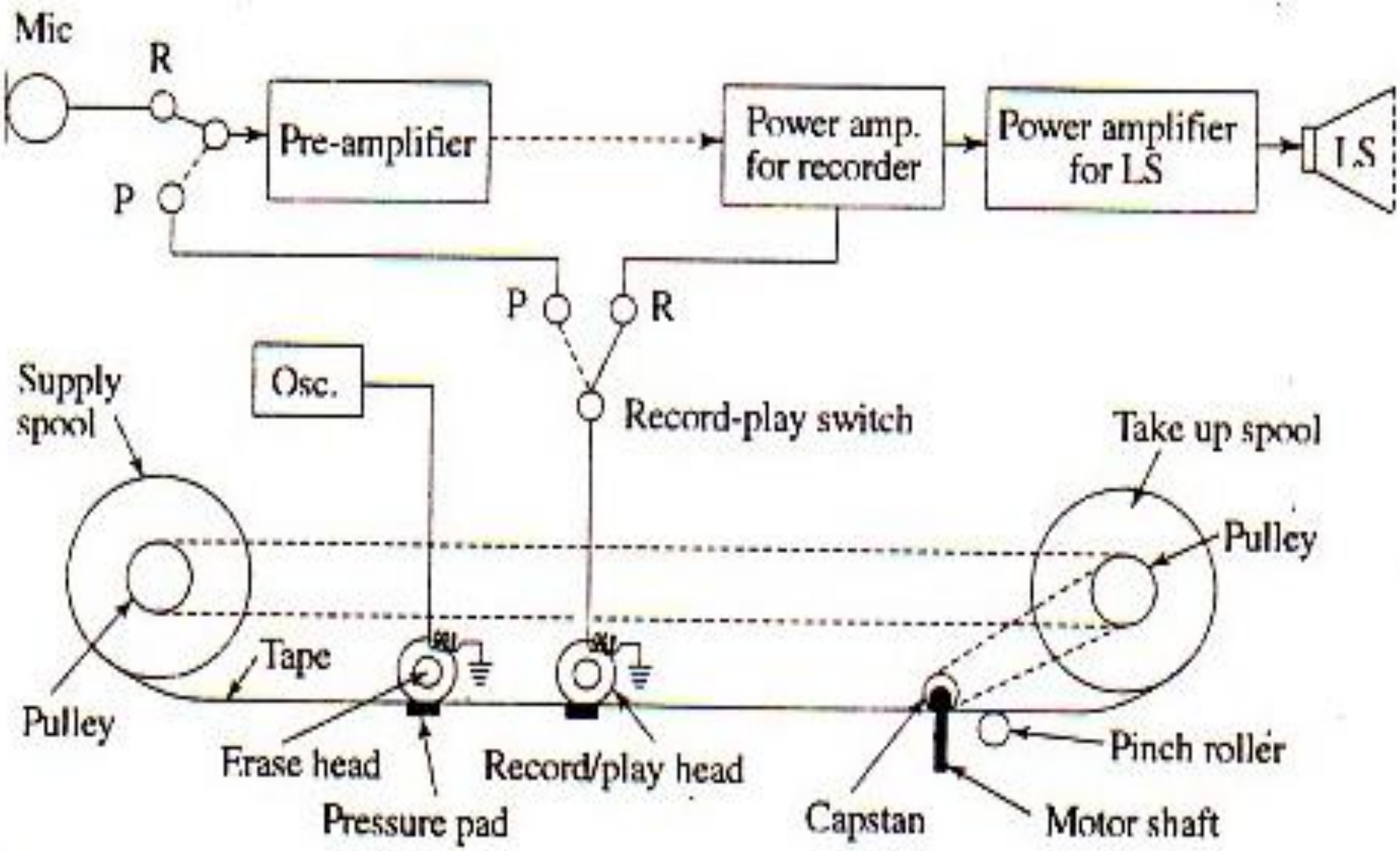
Biasing

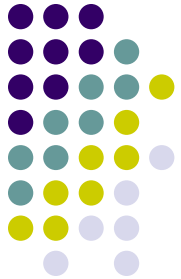
- A high frequency bias signal is applied to the tape through the tape head along with the music signal to remove the effects of any magnetic history.
- This large bias signal typically 40 to 150 KHz in frequency.


Supply reel
Take-up reel
Magnetic shield
Capstan hole
Guide roller
Pressure pad

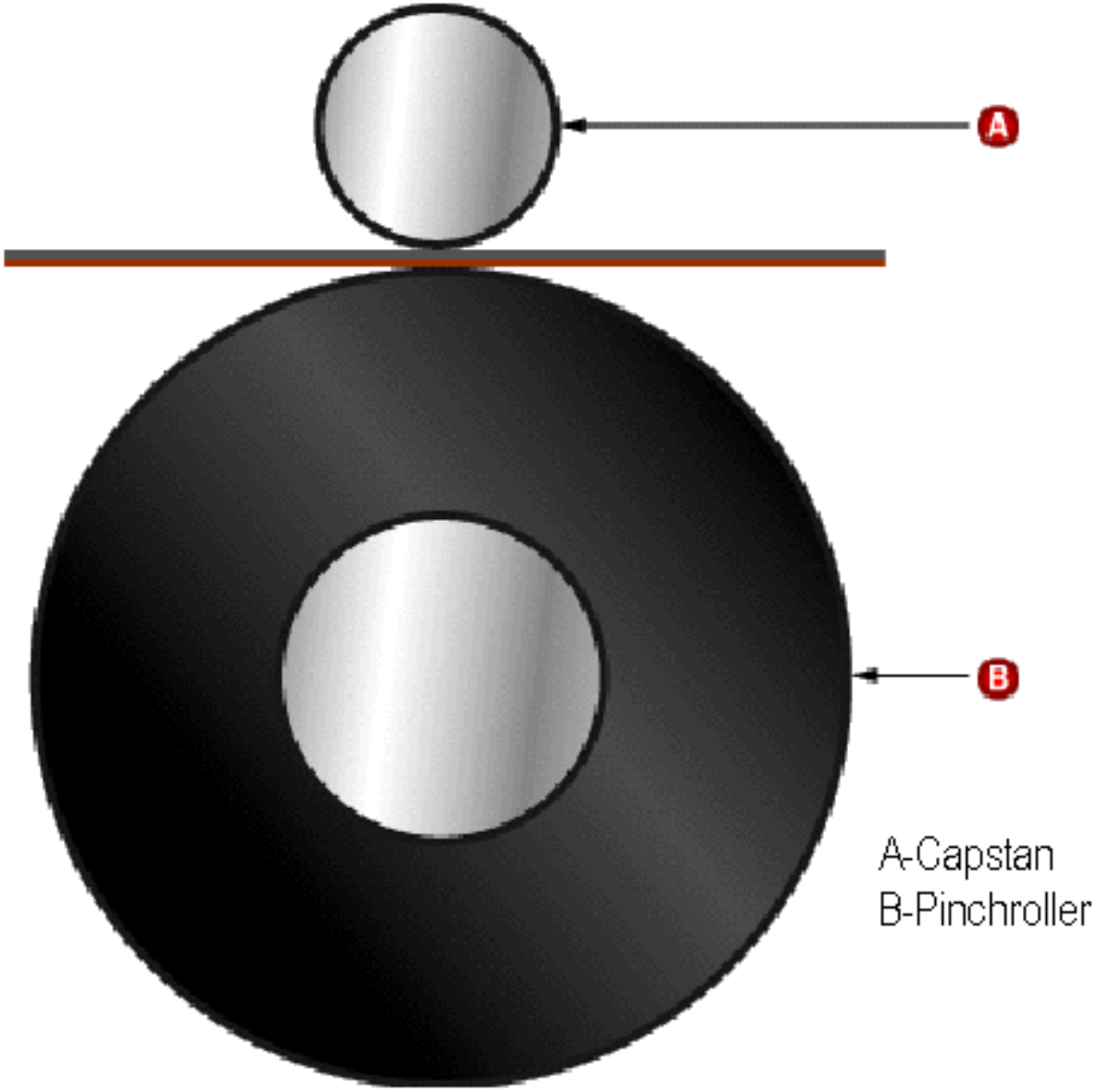
The tape transport system




Mic
R
P
Pre-amplifier
Power amp. for recorder
Power amplifier for LS
LS
P
R
Record-play switch
Osc.
Supply spool
Take up spool
Pulley
Tape
Pulley
Erase head
Record/play head
Pressure pad
Pinch roller
Capstan
Motor shaft



- The head on the left is a bulk erase head to wipe the tape clean of signals before recording.
- The head in the center is the record and playback head containing the two tiny electromagnets.
- On the right are the **capstan** and the **pinch roller**.
- The capstan revolves at a very precise rate to pull the tape across the head at exactly the right speed.
- The **roller** simply applies pressure so that the tape is tight against the capstan.


A
B
A-Capstan
B-Pinchroller

Optical Recording

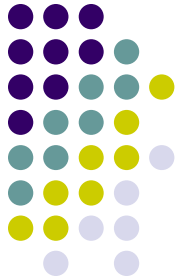
- Optical recording of sound is of two type

1. Recording on Photographic films: this is done by converting audio signals into variation of light intensity falling on the film.

   such recording of sound appears in the form of sound track 2.5mm wide near one edge of the movie cinema film.

2. Recording on compact disc: this is done by laser beam ON and OFF by digitized audio signals. These beams fall on a photoresist material on a rotating disc and cause pits of varying width and fixed depth and thus record signal in binary form

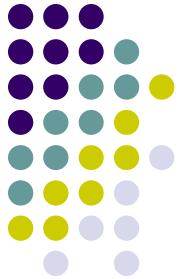
Methods of optical Recording of Sound on Film:



- There are two methods for varying the intensity of light in accordance with the sound pressure variations.

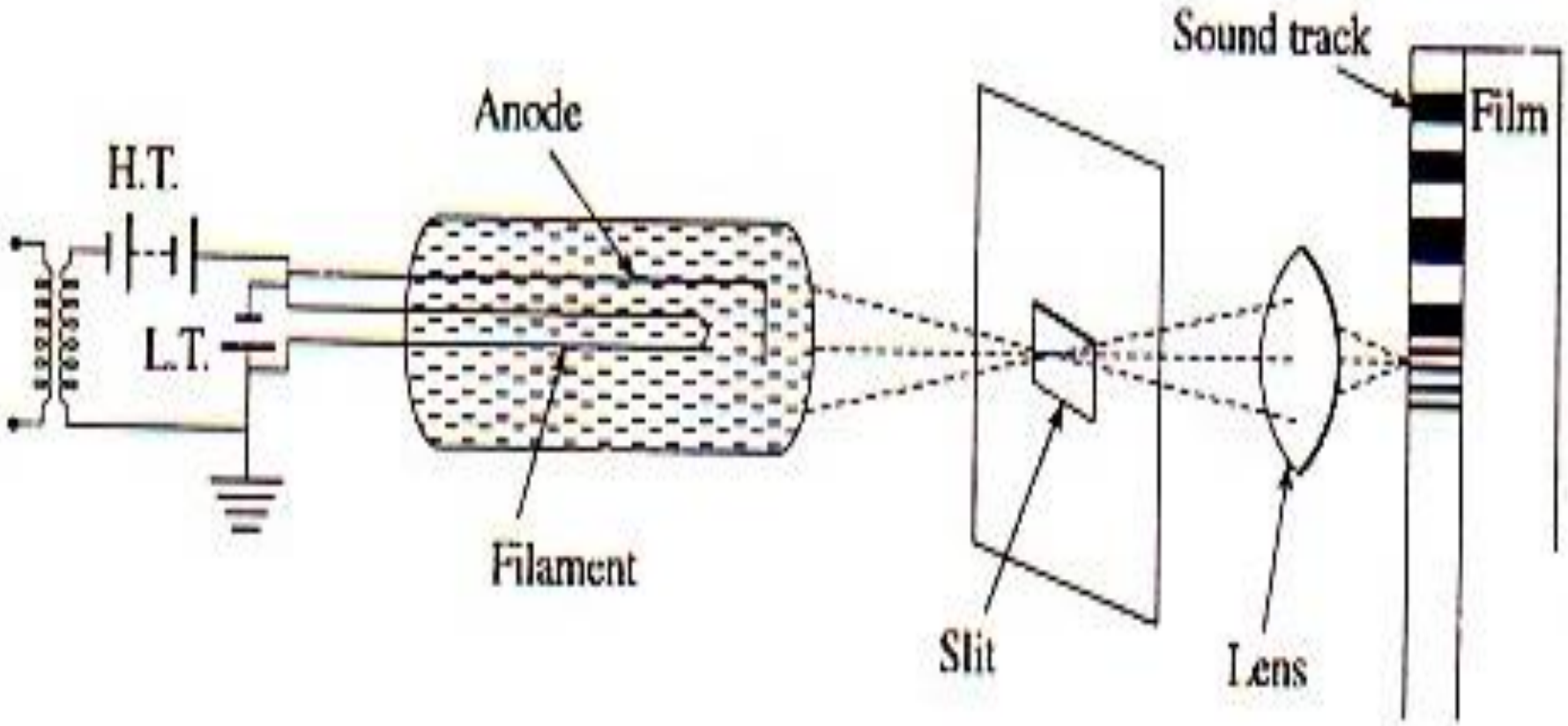
1. Variable density method
2. Variable area method

- **Variable density method:** in this method, sound is picked up by the microphone, converted into electrical signals which are amplified**.**
- Audio output of the amplifier is fed to the anode of a special type of vacuum tube called AEO lamp.



- The lamp contains a little quantity of helium gas.
- the intensity of light coming out from the lamp various in accordance with the audio signal.
- This varying light passes through a slit and a focusing lens. The focused light falls on a moving photographic film where image is recorded in the form of bars of varying density and distance on the film.

Variable Density Method

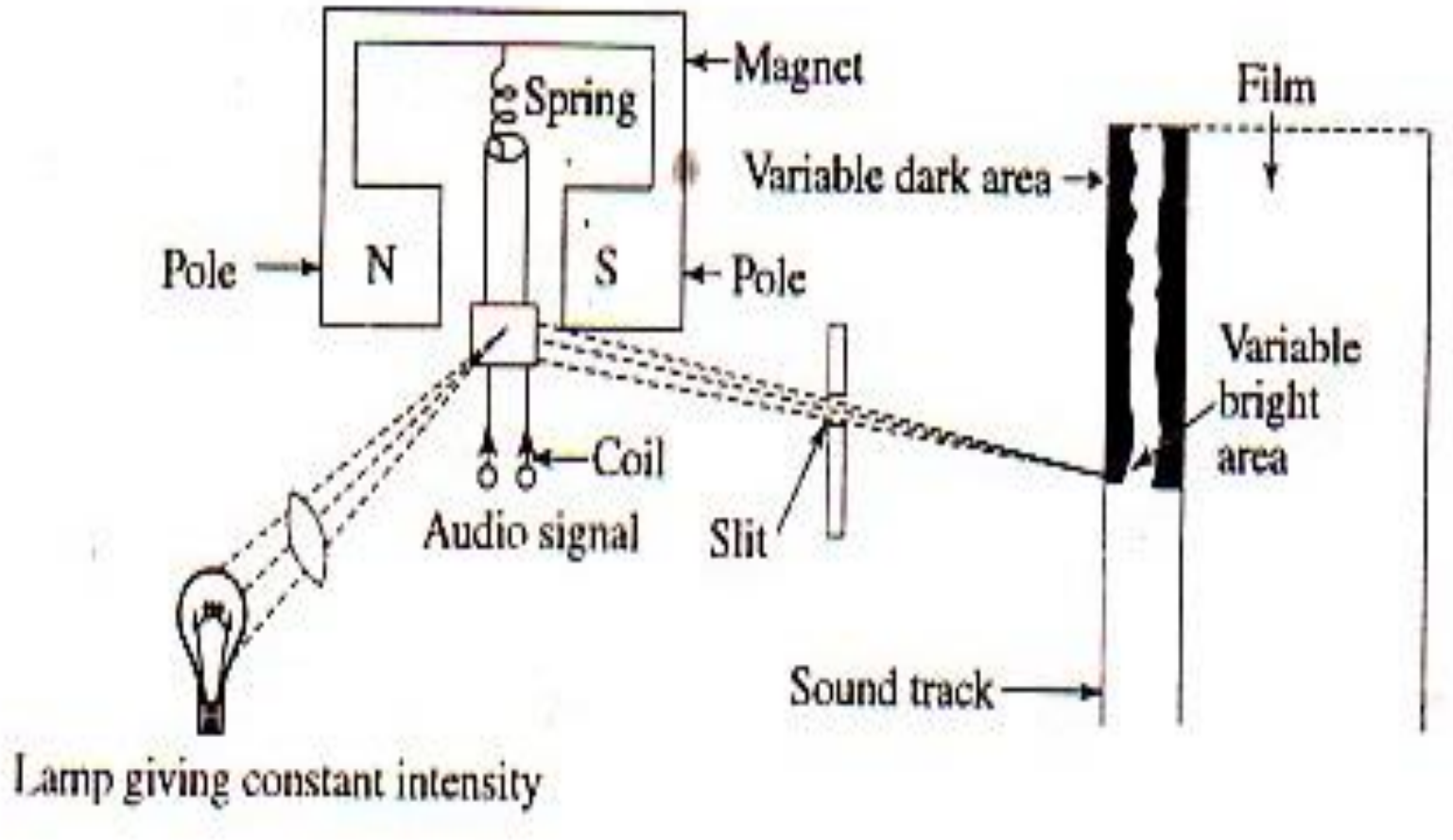


Variable area method

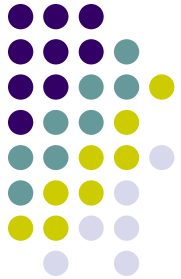
- In this method, light of constant intensity falls on a slit.
- The area of slit opened for this light varies in accordance with variation of sound pressure.
- Sound is first converted into electrical (audio) signals by a microphone.
- The audio signals are amplified and reach the coil of a mirror galvanometer.
- The current carrying coil is placed in a magnetic field and hence, deflects in accordance with amplitude of the audio signal.
- A mirror is attached to the coil assembly. The mirror is also deflected.

- Light from the lamp, duly focused by a lens system, is made to fall on the mirror.
- The light reflected from the mirror goes to narrow slit.
- when the mirror deflects, the slit area exposed to the light changes.
- The light from the variable area of slit falls on the sound track edge of the film and is recorded in the form of photograph of variable area.

Variable Area Method

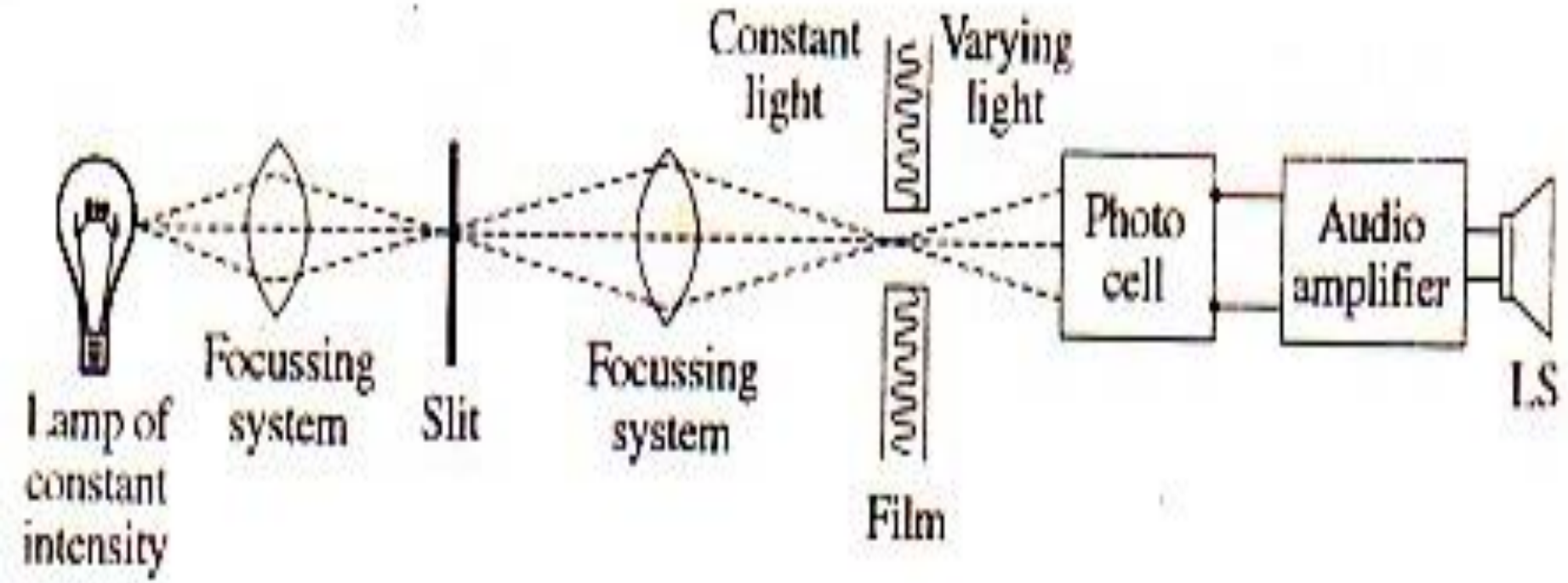


Reproduction of sound from films

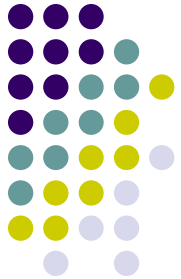


- A sharply focused narrow beam of light is made to fall on the sound track of the film.
- As film moves, light passing through bright and grey shaded portions in case of variable density record and through bright portion of variable area record, falls on photo-cell which converts this light into electrical signals.
- The output of photo-cell will, therefore, be audio voltage which can be amplified and fed to a loudspeaker which finally converts into sound

Reproduction of sound

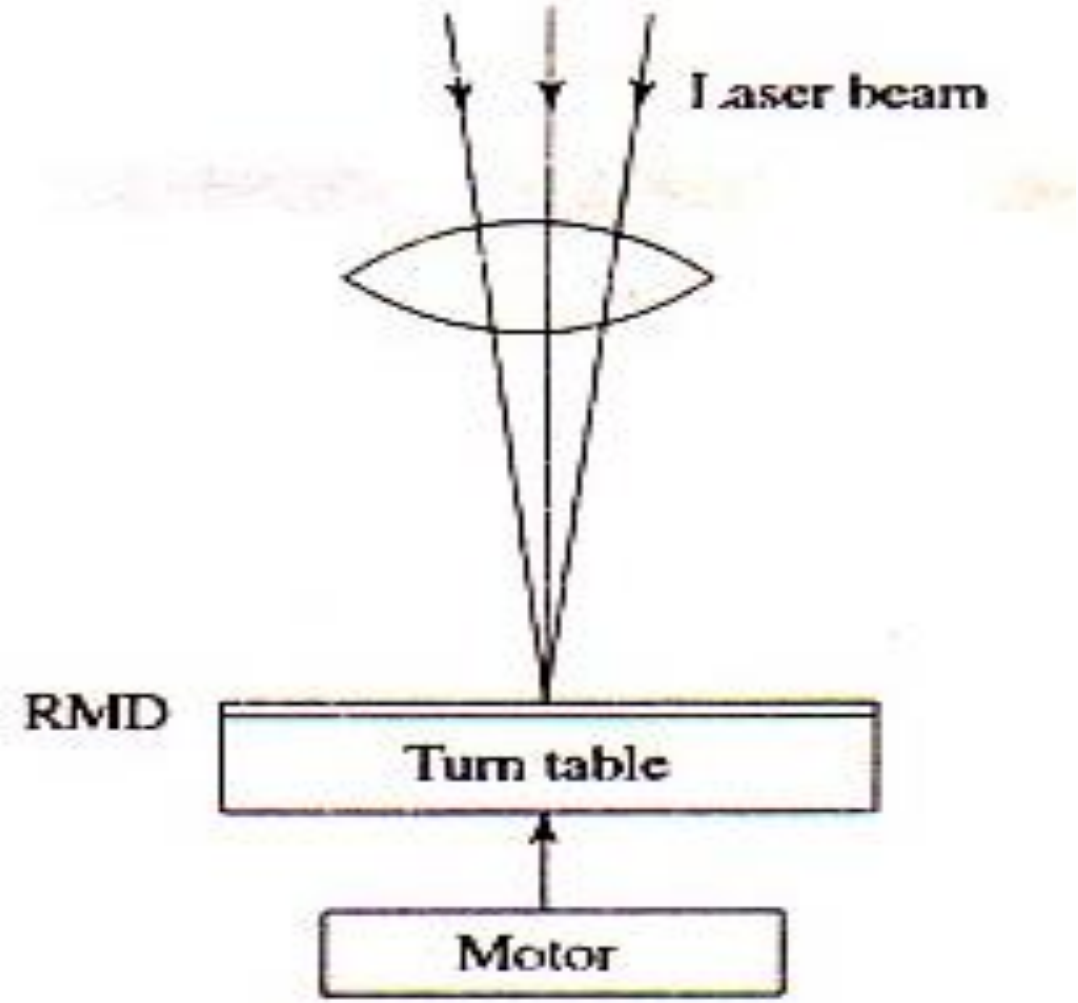


Optical recording on Disc



- A compact disc contains record of digital audio signals in the form of pits of 1micro meter depth and 0.5 micro meter width but of variable length.
- Recording done on disc with the help of powerful laser beam. The laser beam is modulated by digitized audio signal.
- When laser beam is ON, a pit is formed and when OFF, a flat is formed.

Optical recording on Disc



Reproduction

- Laser beam, produced by solid state laser of semiconductor aluminum gallium arsenide is incident on the compact disc through half silvered mirror.
- The mirror allows the beam to pass through itself but does not allow the returning beam to pass.
- The returning beam is reflected from aluminum flat surface.
- Thus the returning beam is the replica of original laser beam modulated by binary digits of audio signal.

Reproduction from Disc