

Section: D

Television

1. INTRODUCTION

- Television – “far sight”.. to see from a distance
- Earlier – Selenium photosensitive cells were used for converting light from pictures into electrical signals
- Real breakthrough – invention of CRT
- First Camera tube – iconoscope
- 1935 – TV broadcasting started
- 1959 – in India

Television Systems

Three Monochrome Systems developed

- 525 line American
- 625 line European
- 819 line French

UK – 415 line – but changed to 625 line system

India – 625B Monochrome system

Colour TV standards

NTSC – National television Systems Committee
USA – 1953

adopted by Japan, Canada

PAL – Phase Alteration by Line

Germany – reduces colour display errors
adopted by UK, Australia, Spain,
India(compatible with 625B)

SECAM – Sequential a memorie

France – 1967

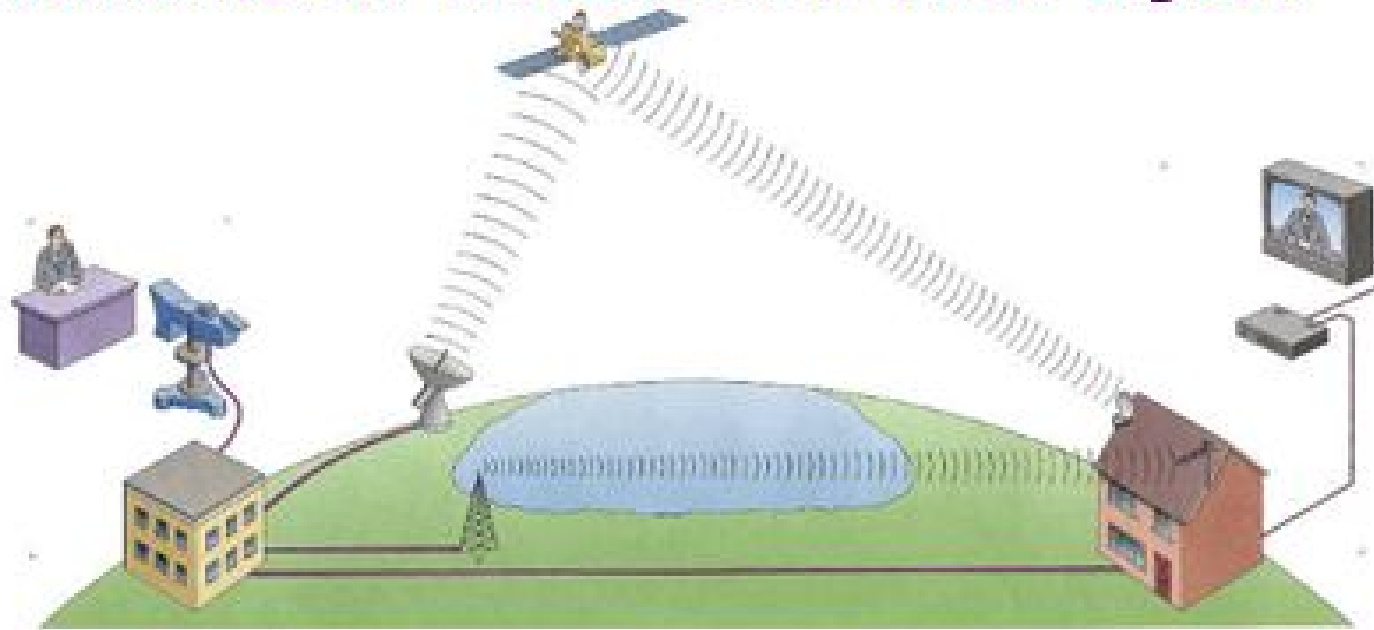
SECAM IV & V – developed at National Institute
of Research, Russia and called as NIR-SECAM :
adopted by Hungary

***Deciding factor for adoption : compatibility with the already
existing monochrome system***

Band Width, Frequency Band & Coverage

- **Band Width** : Around 7 MHz
 - America – 6 MHz
 - British – 8 MHz
 - France – 14 MHz
- **Frequency Band** :
 - Started in VHF band: 41 – 68 MHz & 174 – 230 MHz
 - Later added UHF band : 470 – 890 MHz
- **Coverage**: limited to Line of Sight distance: 75 – 140 Km
 - can be extended by relay stations /satellites

Transmission of Audio and Video Signals



- ◆ The image captured is combined with other electronic content (text and graphics) plus audio.
- ◆ The combined image is amplified and transmitted via AM (amplitude modulation) and FM (frequency modulation) carrier waves to either a satellite feed or from direct transmission to a television receiver.

The receiver decodes the signal



- The electronic signal is decoded by the receiver; splitting the FM wave to the audio section and the AM wave to the video section of the television.
- <http://www.howstuffworks.com/tv.htm>

ELEMENTS OF A TELEVISION SYSTEM

- Fundamental aim : To extent the sense of sight beyond its natural limit along the sound associated with the scene
- In 625 line monochrome system:
 - Picture signal - amplitude modulated
 - Sound signal – frequency modulated

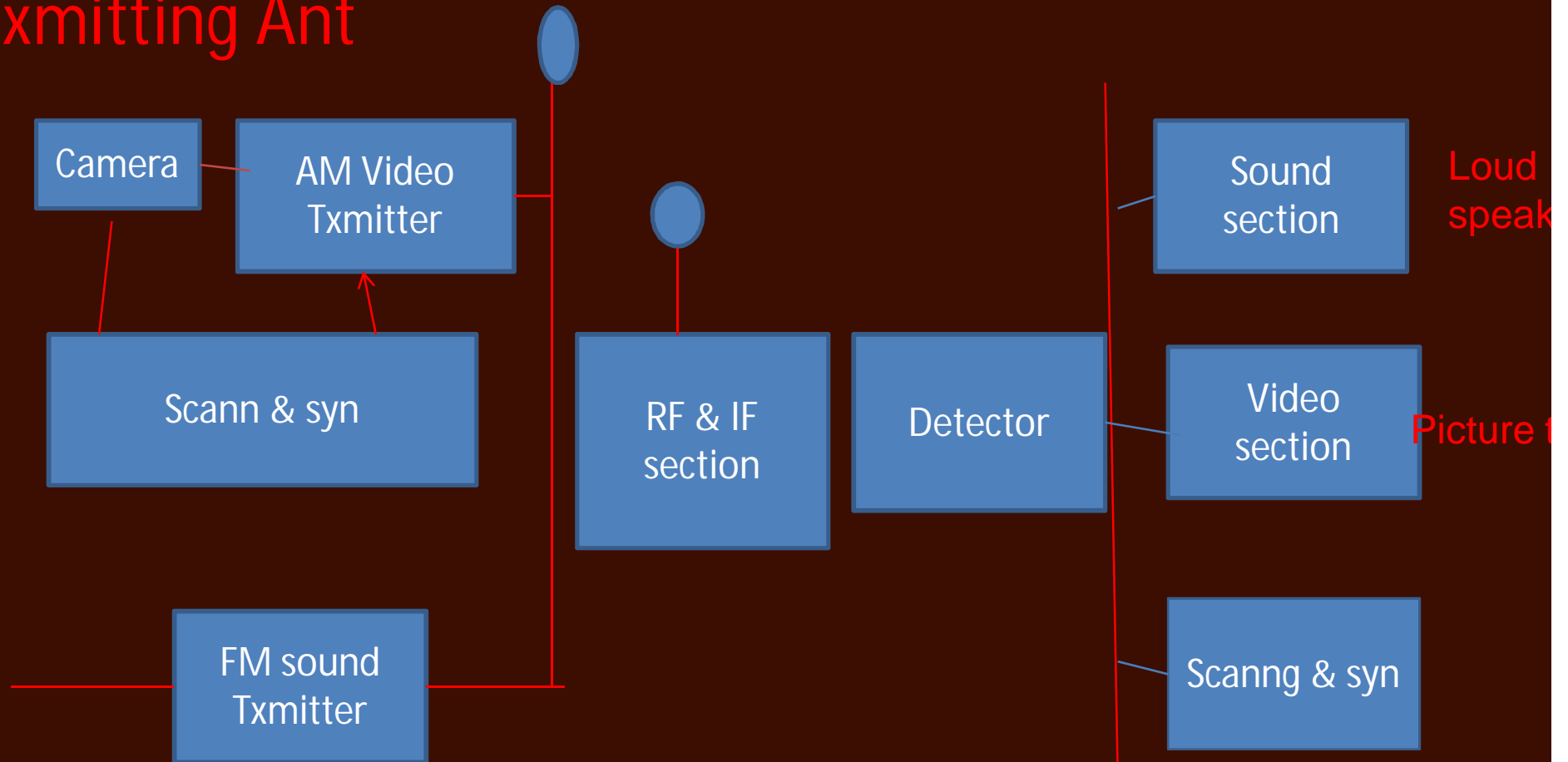
Carrier frequencies are suitably spaced and modulated outputs radiated through a common antenna

Picture Transmission

- Picture information – optical in character – assembly of a large number of bright and dark areas, each representing a picture element – infinite number of pieces – existing simultaneously
- Information is a function of two variables: *Time and Space*
- Instead of using infinite number of channels simultaneously, we use *Scanning*
- *Scanning: Optical information is converted into electrical form and transmitted element by element, one at a time in a sequential manner to cover the entire scene to be televised*
- - *done at very fast rate*
 - *repeated a number of times per second to create an illusion of simultaneous pick-up*

Basic TV system

Txmitting Ant



Basic Monochrome Television Transmitter

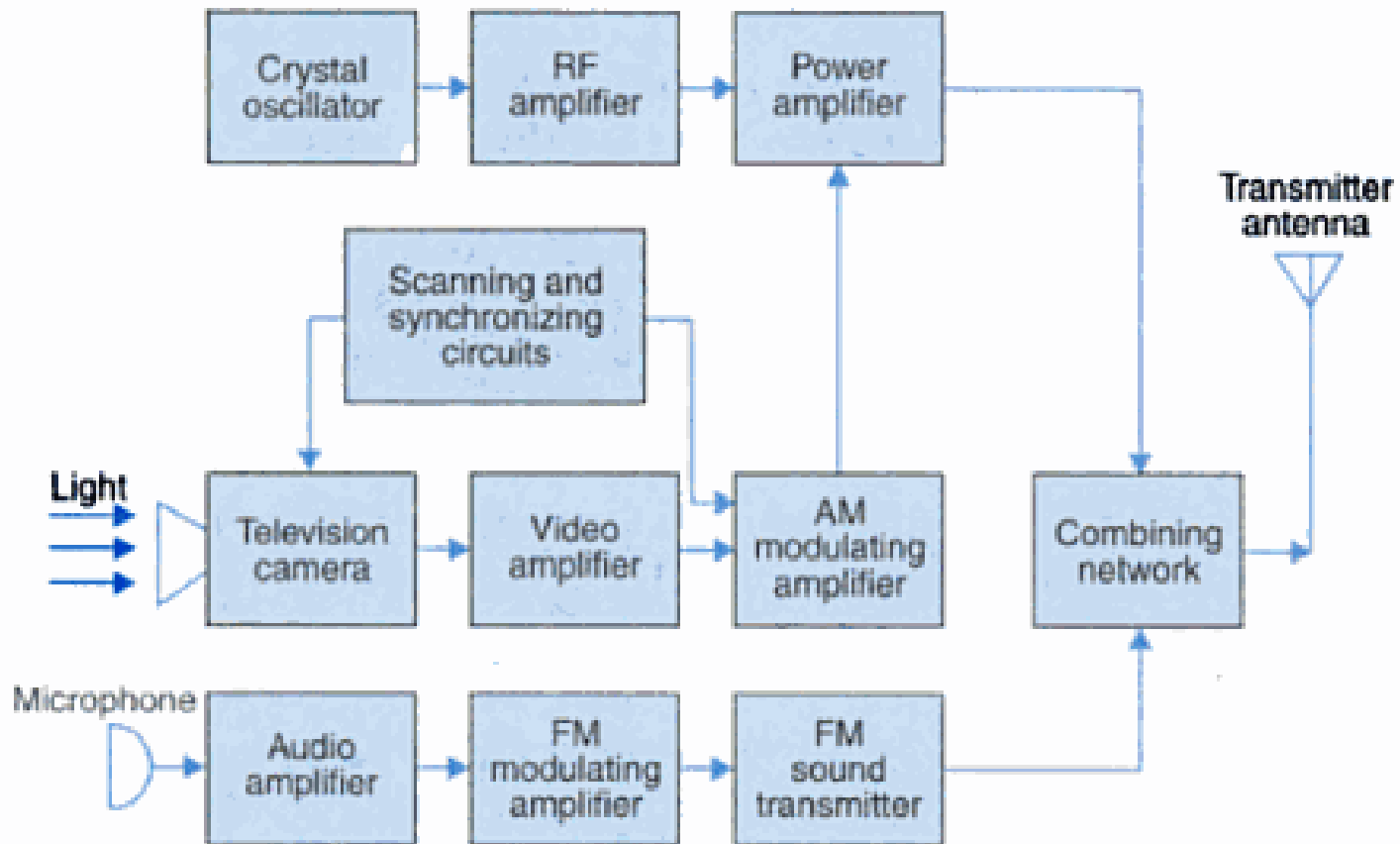


Fig. 1.1 (a) Basic monochrome television transmitter.

Basic Monochrome Television Receiver

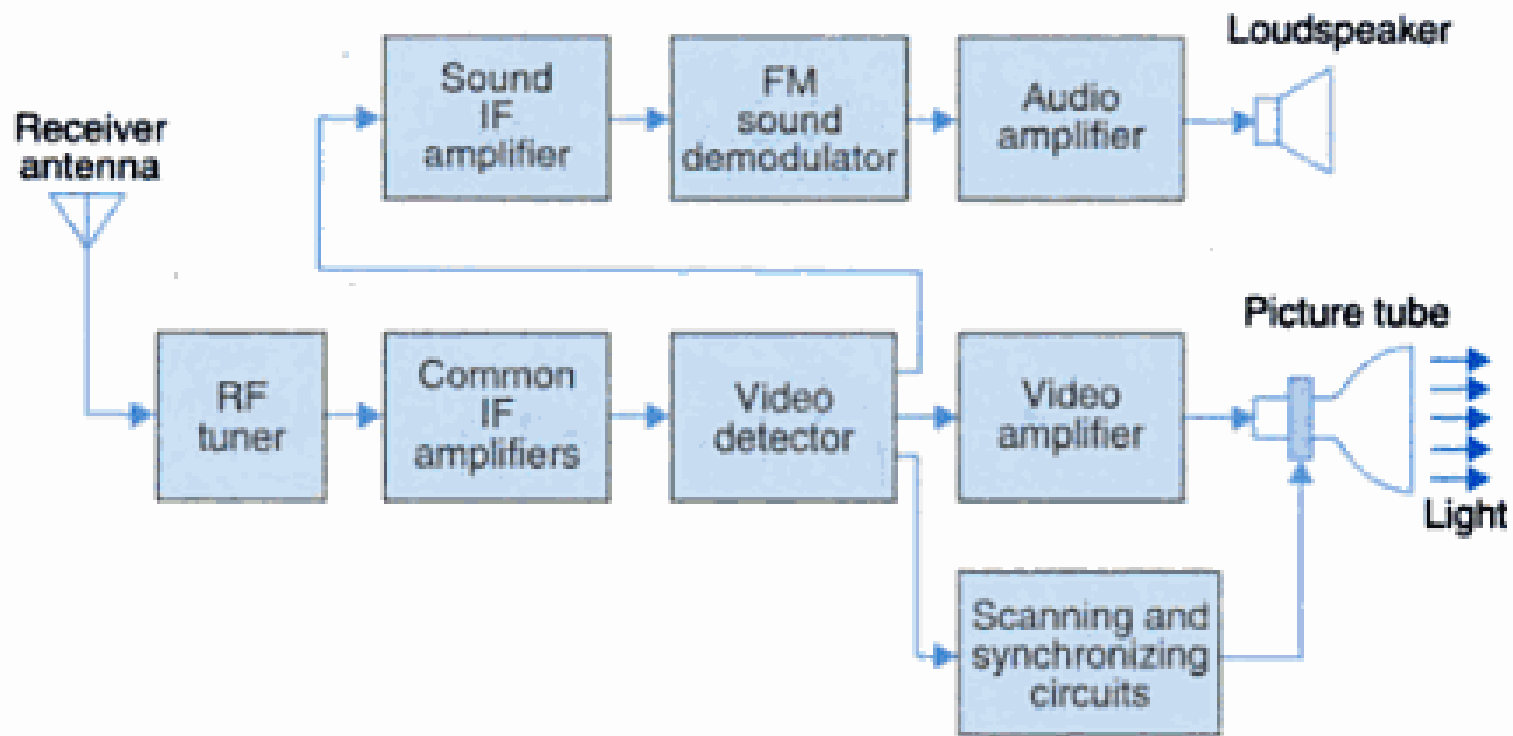
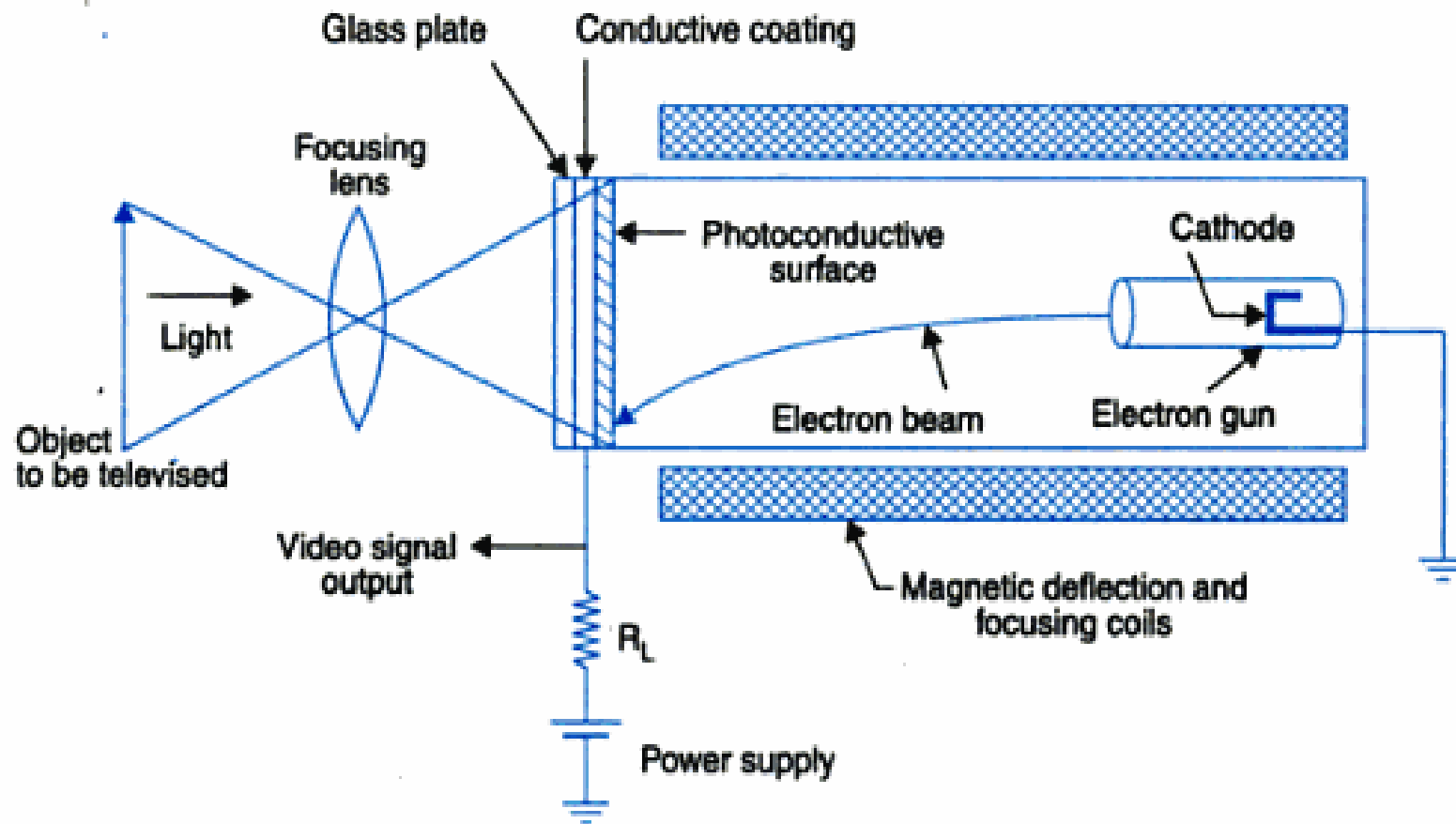


Fig. 1.1 (b) Basic monochrome television receiver.

Simplified cross-sectional view of a Vidicon TV camera tube



TV Camera

- Heart of a TV camera is a Camera tube
- Camera tube – converts optical information into corresponding electrical signal
- Amplitude proportional to brightness
- Optical image is focused by a lens assembly to a rectangular glass face-plate
- Transparent conductive coating at the inner side of the glass face-plate
- On which is laid a thin layer of photoconductive material – having a very high resistance when no light falls on it.
- Resistance decreases when the intensity increases
- Electron beam – used to pick up the picture information available on the target plate in terms of varying resistance
- Beam is formed by an electron gun – deflected by a pair of deflection coils kept mutually perpendicular on the glass plate - to achieve scanning of the entire target area

- Deflection coils are fed separately from two oscillators – continuously generates saw-tooth waveforms having different desired frequency
- Uses magnetic deflection
- Deflection by first coil – horizontal motion of the beam (L to R) and then brings quickly to the left side to commence the trace of the next line
- Deflection by the second coil – vertical motion (T to B) and its quick retrace back to the top to start the process all over again

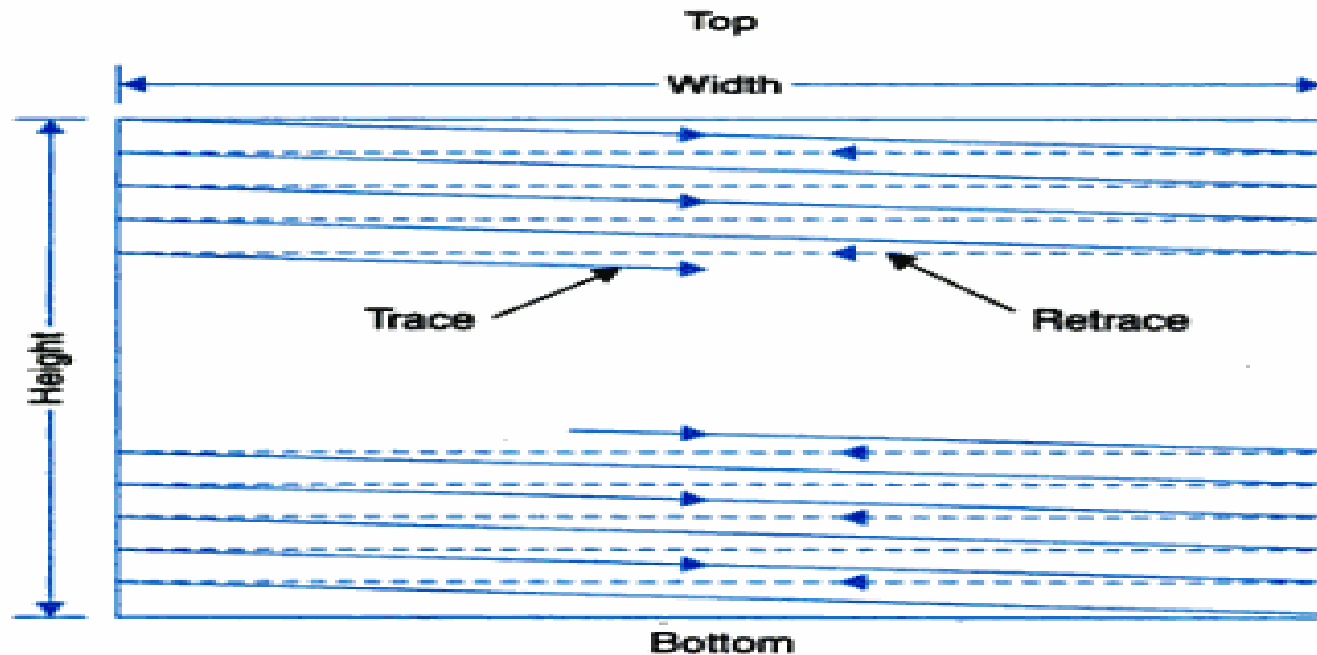


Fig. 1.2 (b) Path of scanning beam in covering picture area.

- Encounters different resistance across the target plate
- Results in a flow of current which varies in magnitude during scanning
- Current pass through a load resistance R_L - varying voltage appears across R_L corresponding to the optical information of the picture
- Very high scanning rate – so that the scene content do not have enough time to move perceptibly in the time required for one complete scan of the image
- We get the true information of the scene
- Scanning converts the information existing in space and time coordinates into time variations only – called a video signal
- Video signal is amplified – amplitude modulated with channel picture carrier frequency – fed to the transmitter antenna for radiation along with the sound signal

Sound Transmission

- Microphone converts the sound associated with the picture into proportional voltage
- Single valued function of time – so needs a single channel
- Amplified – frequency modulated using assigned carrier frequency – combined with the AM picture transmitter output – fed to common antenna – radiated in the form of electromagnetic waves

Picture reception

- Receiving antenna intercepts the radiated picture and sound carrier signal – feeds to RF tuner
- Receiver – heterodyne type
- Employs 2 or 3 stages of IF amplification
- Demodulated to recover video signal
- Amplified and coupled to picture tube (same as CRT) – which converts the electrical signal back into picture elements – with same degree of black and white

Picture Tube

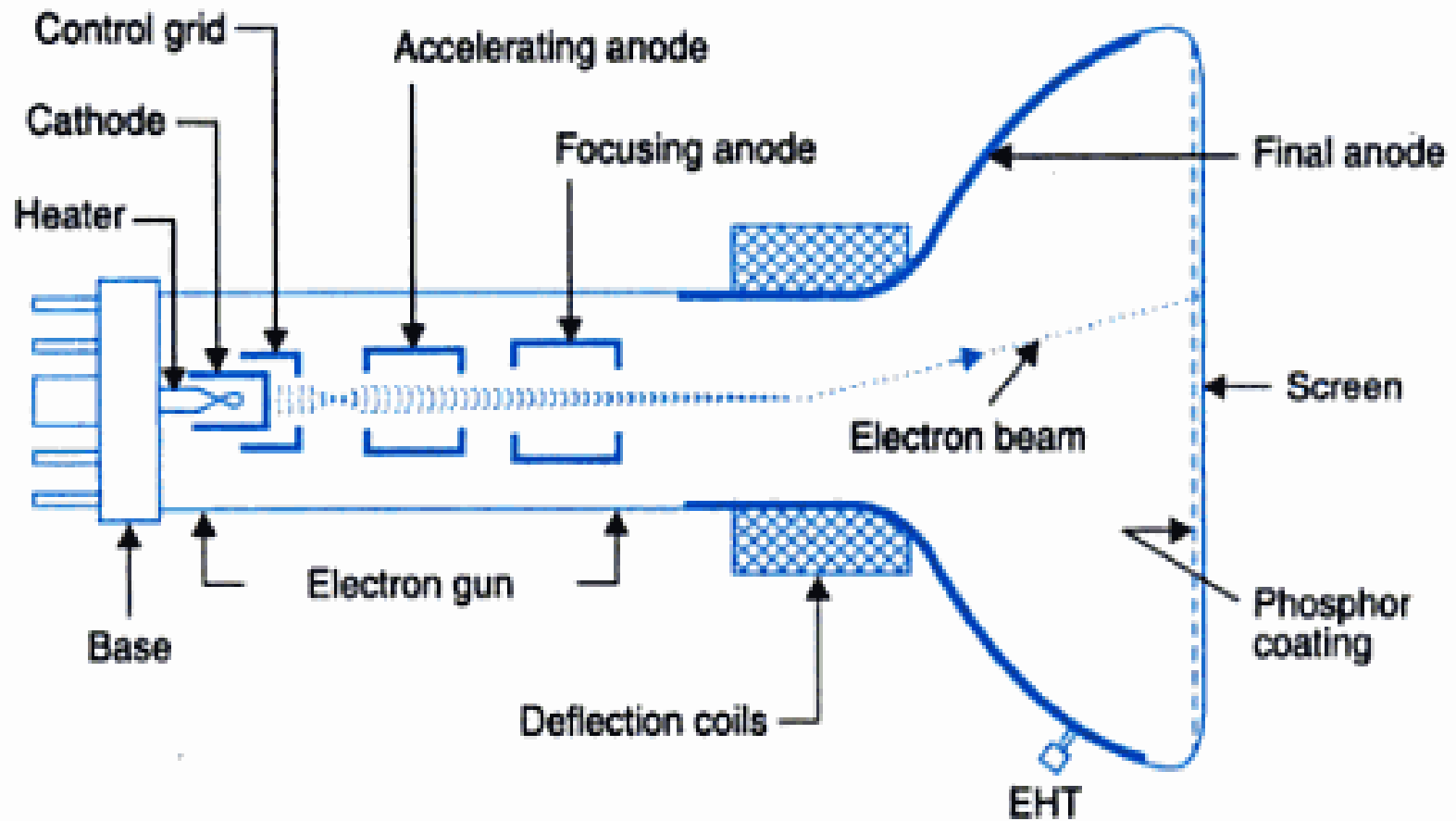


Fig. 1.3 Elements of a picture tube.

- Beam is deflected by a pair of deflecting coils in the same way and rate as the beam scans the target area in the camera tube
- Video signal is fed to the grid or cathode of the picture tube
- When the varying signal voltage makes the control grid less negative, the beam current is increased , making the spot on the screen brighter
- More negative grid voltage reduces brightness

Sound reception

- Sound signals are separated from the picture signals in the video detector section
- Amplified – demodulated (FM detector)
- Fed to audio amplifier and loud speaker

Synchronization

- To ensure perfect synchronization between scene being televised and the picture produced on the raster
- Synchronizing pulses are transmitted during retrace ie flyback intervals
- Distinct for horizontal and vertical motion control
- Radiated along with the picture details
- Processed at the receiver and fed to the picture tube sweep circuitry

Receiver controls

- Channel selector - for selecting desired channel
- Fine tuning control – for obtaining best picture details in the selected channel
- Hold control – to get steady picture in case it rolls up or down
- Brightness control – varies the beam intensity of the picture tube
- Contrast control – gain control of the video amplifier
- Volume and tone control – part of audio amplifier

Colour Television

- Based on the theory of additive colour mixing : all colours including white can be created by mixing red, green and blue lights
- Video signal for red, green and blue information are combined and transmitted along with the brightness(monochrome) signal
- At the receiver, the three colour signals are separated and fed to the three electron guns of the colour picture tube
- Screen of the picture tube has red, green and blue phosphors arranged in alternate dots
- Each gun produces an electron beam to illuminate the three colour phosphors separately on the fluorescent screen
- Our eye then integrates the red, green and blue colour information and their luminance to perceive the actual colour and brightness of the picture being televised