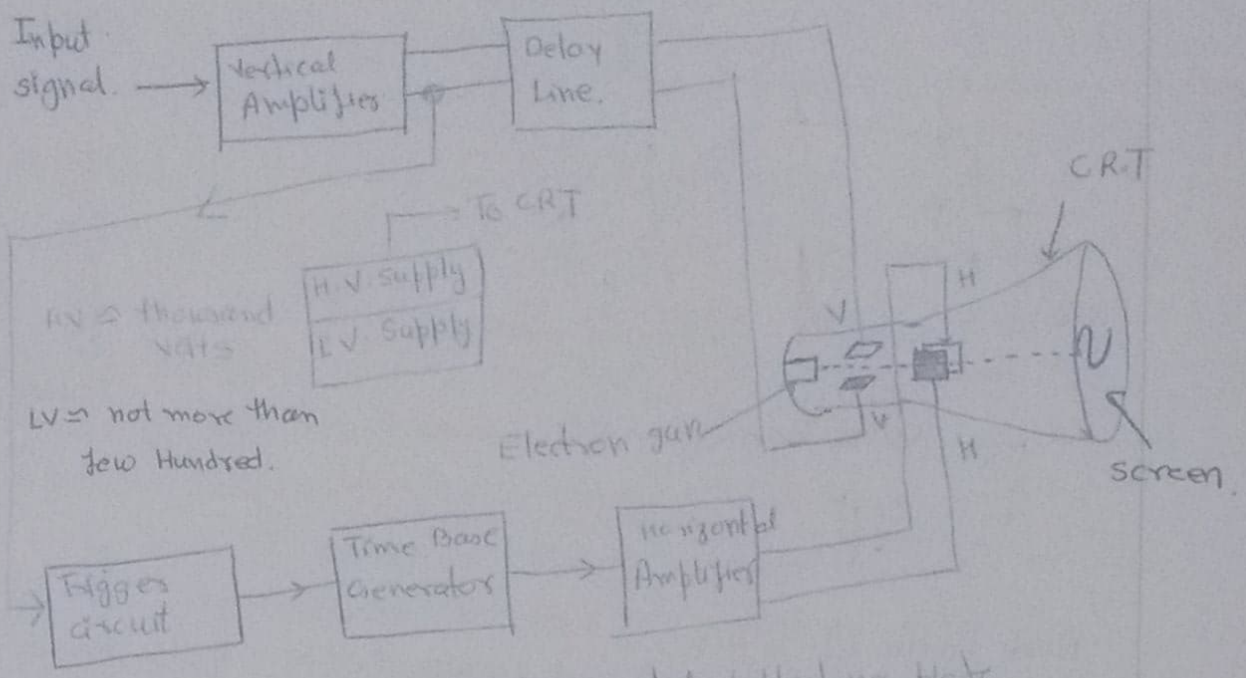
Block diagram of C.R.O.



(a) :- Cathode Ray Tube [C.R.T]

(b) :- Trigger circuit.

(c) :- Delay line.

(d) :- Time base generator.

(e) :- Vertical Amplifier

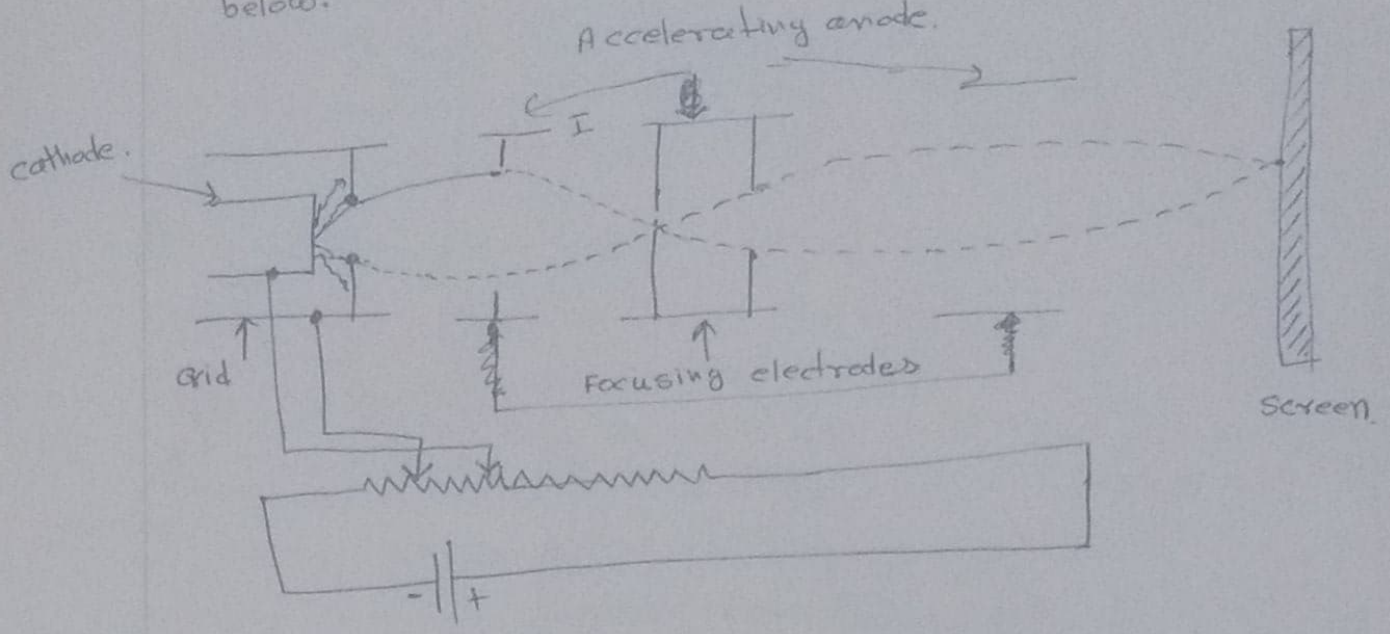
(f) :- Horizontal Amplifier.

Description of the components in conventional C.R.O.

(a). Cathode Ray Tube (C.R.T).

Cathode Ray tube is a vacuum sealed glass envelope that has a source of electrons (electron gun), which emits electrons (cathode rays), that are accelerated to pass through two-sets (pairs) of plates (one set each of vertical and horizontal plates) before striking a phosphor coated on the screen internally so as to provide a visual display of signal. ~~C.R.T Block diagram~~

Cathode Ray Tube: (C.R.T) :- CRT block diagram is shown below.



Main Parts of C.R.T.

(i) Electron gun – Produces electron and focuse it. Main parts are
   (a) Cathode. (c) Accelerating Anode.
   (b) control Grid (d) Focussing or first anode.
   (e) Final or second anode.

(ii) Deflecting plate. [X-X (horizontal), Y-Y (vertical) plates].

(iii) Screen.

Electron Gun assembly: Electrons are produced by direct or indrect heating of cathode. The cathode is indirectly heated through a filament heater, and this mode of operation is considered advantageous despite being less efficient compared to direct heating. However, indirect heating provides uniform heater control with even heat distribution resulting in stable electron emission, ~~besides uniform heater control with even heat~~ besides allowing the usage of easily available ac voltage supply. The

generation of electron from the cathode is mainly thermionic in nature where in current passed through the filament heater, which heats up the cathode. The electrons thus emitted are in form of an envelope, much like a solid angle.

The control grid affixed immediately after cathode is biased more negative with respect to it (cathode), and it controls the numbers of electrons ~~being~~ reaching at the screen, or we can say that it controls the intensity of the beam. The -ve HV supply of the C.R.O is associated with a bleeder resistance (mA, range current carrying capacity) which is able to provide intermediate voltages that control intensity, focus and positioning of electron beam. The electron beam after passing through the grid tends to dilate (spread-out) as a solid cone and the constitute electrons tend to lose velocity, and they cannot at the screen Hence we have to accelerate them.

Three anodes are chronologically named as per their functions.

(a). First or pre accelerating anode.
(b) Second ~~one~~ focusing anode, and,
(c) third or final accelerating anode.

The first anode is in the form of a hollow cylinder ~~tota~~ with a hole in a diaphragm at its centre. The diaphragm directs back all the electrons striking it. A narrow beam of electrons is achieved after the first anode ~~is in the form of a~~

however due to mutual repulsion amongest the electrons the beam tents to spread.

The focusing anode has two diaphragms, both having holes at their centres. By means of an electric field a cylindencal shaped converging electrostatic lens is formed and which functions to shape the linearly accelerated beam of electrons into a fine spot.

~~Three~~ Electrostatic lenses are realized by applying suitable potential to a pair of diaphragms wherein the electron beam can ~~pass~~ be passed through the holes at their centres. The focal length is varied by varying the potentials on the diaphragms.

Electrostatic lenses are of two types a) aperture lens and b) cylindrical lens. Electron gun is a combination of both.

The third or final anode imparts another level of amplified linear acceleration to the electron beam and focuses it toward the screen.

Electrical Deflection System: It consist of two pairs of plate [Vertical Deflecting Y and horizontal deflecting plate H]. The incoming electron beam is influenced to move in both horizontal as well as vertical directions in accordance with the input signal strength. The signals which are to be analyzed is fed directly to the Y plates / X plate. with the help of BNC connector. [Bayonet Neill concelmm] These plates are so oriented that signal voltages when applied to each of the pairs, makes the electron beam move either horizontally or vertically thereby providing the option to deflect in the entire length and

breadth of entire screen.

In Dual trace CRO two vertical and two horizontal deflecting plates are there. Y_1-Y_1, Y_2-Y_2 and X_1-X_1, X_2-X_2).

CRT Screen:- CRO screen is coated with a natural or synthetic phosphor that emits visible light when the electron beam impinges on it. The phosphor tends to absorb the kinetic energy of the impinging electron, and re-emits the same absorbed energy in the visible spectrum. This phenomenon is called Fluorescence.

Fluorescent material some times also posses a secondary property called Phosphorescence., wherin they continue to emit light even after the source of excitation is removed. The length of the time during which afterglow occurs is in called persistence of the phousphor.

Luminance is another property of phosphor that gives an idea about the intensity of light emitted from the phosphor. The choice of phosphor depends on its characteristics, of phosphorescence, Luminance and persistence, determines whether high (fast) or low frequency (slow) can be seen on a particular CRO.

Luminance depends on.

(i) physical characteristics of phosphor.

(ii) Intensity of electrons bombarding the screen.

(iii) Enhance/Accelerating potential of electron beam.

(iv) Faster time base reduces the luminance

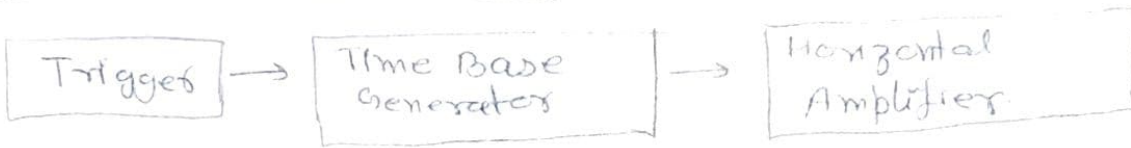
since electron beam gets less time to interact with the coated phosphor.
Phosphor coating is done on the inside glass portion of C.R.T. A high density of electrons on screen for a larger time exposure, destroy the phosphor coating and it must be avoided.

$Zn_2SiO_4:Mn$ – Green, 528 nm
$ZnS:Cu(Ag)B^{V}$:– Blue green – 543 nm
$ZnS:Be;Si\ 50$:– Yellow 602 nm

Horizontal Deflection System (HDS)

The function of this system is to deflect the trace (spot) at a constant rate as a function of time and which is a function of input signal to be tested. It consists of (a) trigger circuit, (b) time base generator, and (c) horizontal amplifier together.

Block Diagram of HDS.



(a). Trigger circuit :– This circuit ensures that generation of the horizontal time-base (sweep) starts at the same point of the vertical input signal

(b) Time-base :– The time-base (sweep) generator controls the rate with which the electron beam is scanned across the face of the screen of the C.R.T. The same is adjusted from the front panel of the C.R.O.

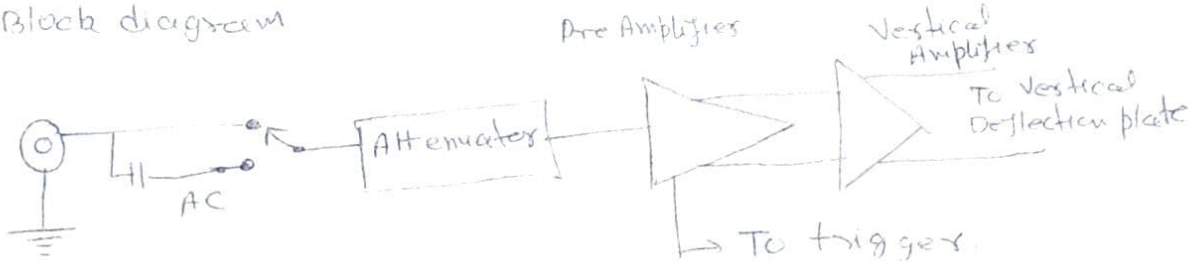
Horizontal Amplifier

The function of the amplifier is to enhance the level of the signals generated in the time-base generator to the level required by the HDS plate.

Trigger circuit:- It is a link between the signal waveform to be observed (vertical input) and the time-base (horizontal time-base). It synchronizes the horizontal deflection of the electron beam with the vertical input signal wave form. It ensures that at each time the horizontal deflection starts at the same point of the vertical input.

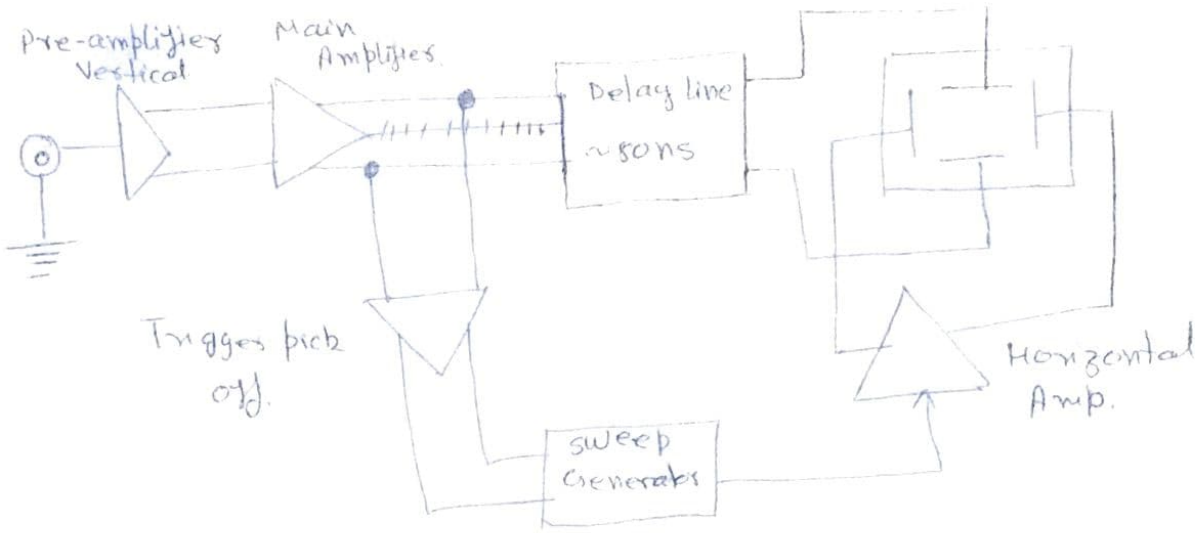
Vertical Deflection system:

Block diagram



The main function of this system is to suitably amplify the input signal such that its basic characteristics do not undergo any change or modification. This has a switchable input coupling capacitor which helps to view the ac signal even within high voltage DC. The capacitor helps to filter out the ac component from within dc. During dc measurements the capacitor is bypassed.

Delay line:



The horizonal signal (X-plate), (time base sweep voltage) is initiated or triggered by a portion of the input applied to the vertical CRT plates. signal processing in the horizontal channel consists of generating and shaping a trigger pulse, that starts the sweep generator, whose output is fed to the horizontal amplifier and then to horizontal deflecting plates.

This whole process takes the time of the order of 80 ns. To allow the operator to observe the leading edge of the signal waveform, the signal derive for the vertical CRT plates must therefore be delayed at ~~length~~ least by the same amount of time. This is the function of ~~the~~ delay line.