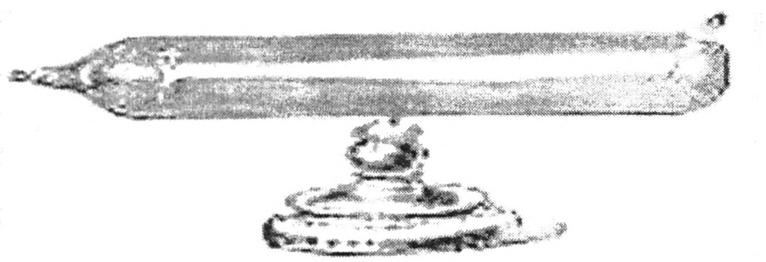
CATHODE RAY TUBE

H.P.J.L.Priyadarshana

Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka, Kuliyapitiya

History

The earliest version of the CRT was invented by the German physicist Ferdinand Bunin 1897 and is also known as the 'Braun tubes. It was a cold cathode diode, a modification of the Crookes tube with a phosphor-coated screen. The first version to use a hot cathode was developed by John B. Johnson (who gave his name to the term Johnson noise) and Harry Weiner Reinhardt of Western electric, and became a commercial product in 1922.



Description

The cathode ray tube (CRT) is a vacuum tube containing an electron gun (a source of electrons) and a fluorescent screen, with internal or external means to accelerate and deflect the electron beam, used to create images in the form of light emitted from the fluorescent screen. The image may represent electrical waveform (oscilloscope), pictures (television, computer monitor), radar targets and others.

Color CRTs have three separate electron guns (shadow mask) or electron guns that share some electrodes for all three beams (Sony Trinitron, and licensed versions)

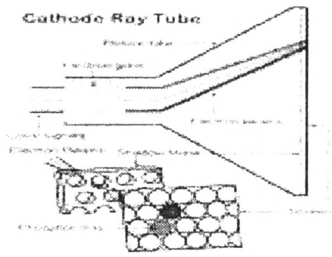
The CRT uses an evacuated glass envelope which is large, deep, heavy, and relatively fragile. Display technologies without these disadvantages, such as screen, liquid crystal display, DLP, OLED displays have replaced CRTs in many applications and are becoming increasingly common as costs decline.

An exception to the typical bowl-shaped CRT would be the flat CRT used by Sony in their Wotchmanseries. One of the last flat-CRT models was the ED-120-A. The CRT in these units was flat with the electron gun located roué(the Fd-210 was introduced in 1982)glee at right angles below the display surface thus requiring sophisticated electronics to create an undistorted picture free from effects such as key stoning

The cathode rays are now known to be a beam of electrons emitted from a heated cathode inside a vacuum tube and accelerated by a potential difference between this cathode and an anode. The screen is covered with a crystalline phosphorescent coating (doped with transition metals or rare earth element), which emits visible light when excited by high-energy electrons. The beam (or beams, in color CRTs) is deflected either by a magnetic or an electric field to move the bright dot(s) to the required position on the screen. External electromagnets deflect the beams magnetically, while internal plates placed near to and alongside the beam deflect it electrostatic ally. (Electrostatic deflection is used only for single-beam tubes.)

In television set and computer monitors the entire front area of the tube is scanned repetitively and systematically in a fixed pattern called raster. A raster is a rectangular array of closely-spaced parallel lines, scanned one at a time, from left to right (and, ever so slightly, "downhill", because the beam is moving steadily down while drawing the image frame). An image is produced by modulating the intensity of each of the three electron beams, one for each primary color (red, green, and blue) with a received video signal (or another signal derived from it). In all CRT TV receivers except some very early models (The earliest commercial TV receivers used electrostatic deflection, even by the end of the 1940s, many of them relying on the famous 7JP4), the beam is deflected by *magnetic deflection*, a varying magnetic field generated by coils (the *deflection yoke*), driven by electronic circuits, around the neck of the tube.

Electro gun



The source of the electron beam is the electron gun , which produces a stream of electrons through thermionic emission, and focuses it into a thin beam. Earlier, black-and-white TV CRTs used magnetic focusing, but electrostatic focus has totally superseded focus coils. The gun is located in the narrow, cylindrical neck at the extreme rear of a CRT and has electrical connecting pins, usually arranged in a circular configuration, extending from its end. These pins provide external connections to the cathode, to various grid elements in the gun used to focus and modulate the beam, and, in electrostatic deflection CRTs, to the deflection plates. Since the CRT is a hot-cathode device, these pins also provide connections to one or more filament heaters within the electron gun. When a CRT is operating, the heaters can often be seen glowing orange through the glass walls of the CRT neck. The need for these heaters to 'warm up' causes a delay between the time that a CRT is first turned on, and the time that a display becomes visible. In older tubes, this could take fifteen seconds or more; modern CRT displays have fast-starting circuits which produce an image within about two seconds, using either briefly increased heater current or elevated cathode voltage. Once the CRT has warmed up, the heaters stay on continuously. The electrodes are often covered with a black layer, a patented process used by all major CRT manufacturers to improve electron density.

The electron gun accelerates not only electrons but also ions present in the imperfect vacuum (some of which result from out gassing of the internal tube components). The ions, being much heavier than electrons, are deflected much less by the magnetic or electrostatic fields used to position the electron beam. Ions striking the screen damage it; to prevent this the electron gun can be positioned slightly off the axis of the tube so that the ions strike the inside of the CRT neck instead of the screen. Permanent magnets (the ion trap) deflect the lighter electrons so that they strike the screen. Some very old TV sets without an ion trap show browning of the center of the screen, known as ion burn. The aluminum coating used in later CRTs eliminated the need for ion traps; they are no longer used.

When electrons strike the poorly-conductive phosphor layer on the glass CRT, it becomes electrically charged, and tends to repel electrons, reducing brightness (this effect is known as "sticking"). To prevent this interior side of the phosphor layer can be covered with a layer of aluminum connected to the conductive layer inside the tube, which disposes of this charge. It has the additional advantages of increasing brightness by reflecting, towards the viewer, the light emitted towards the back of the tube. The aluminum layer also protects the phosphors from ion bombardment.

References

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