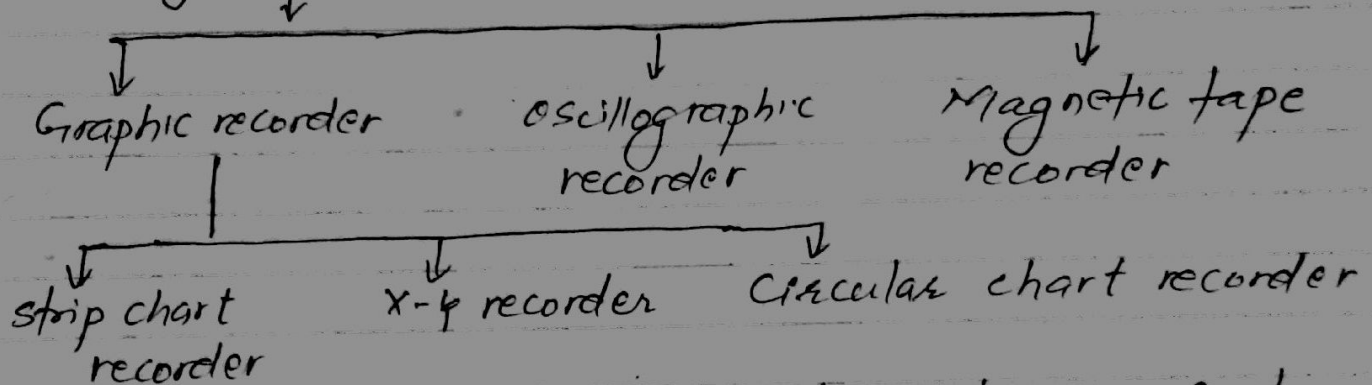


Output Devices

Recorders:- A recorder is a measuring instrument that displays a time varying signal in a form easy to examine and re-examine, perhaps long after the original signal has ceased to exist. Recording preserves the experimental data in a manageable and usable form. Recording preserves the experimental data in a manageable and usable form.

Recording devices are of 2 types:

- (i) Analog recorders (ii) Digital recorders



Graphic Recorder:- It may be defined as an instrument which draws a graph that relates two or more variables to time or to each other.

(i) Strip-chart Recorder:- A strip chart records one or more variables w.r. to time. It is an X-Y recorder. A strip-chart recorder consists of:

- * A long roll of graph paper moving vertically
- * A system for driving the paper at some selected speed.
- * A stylus for marking marks on the graph paper.
- * A stylus driving system which moves the stylus in a nearly exact replica of the quantity being recorded
- * A range selector is used so that the i/p to the recorded drive system is within the acceptable level.

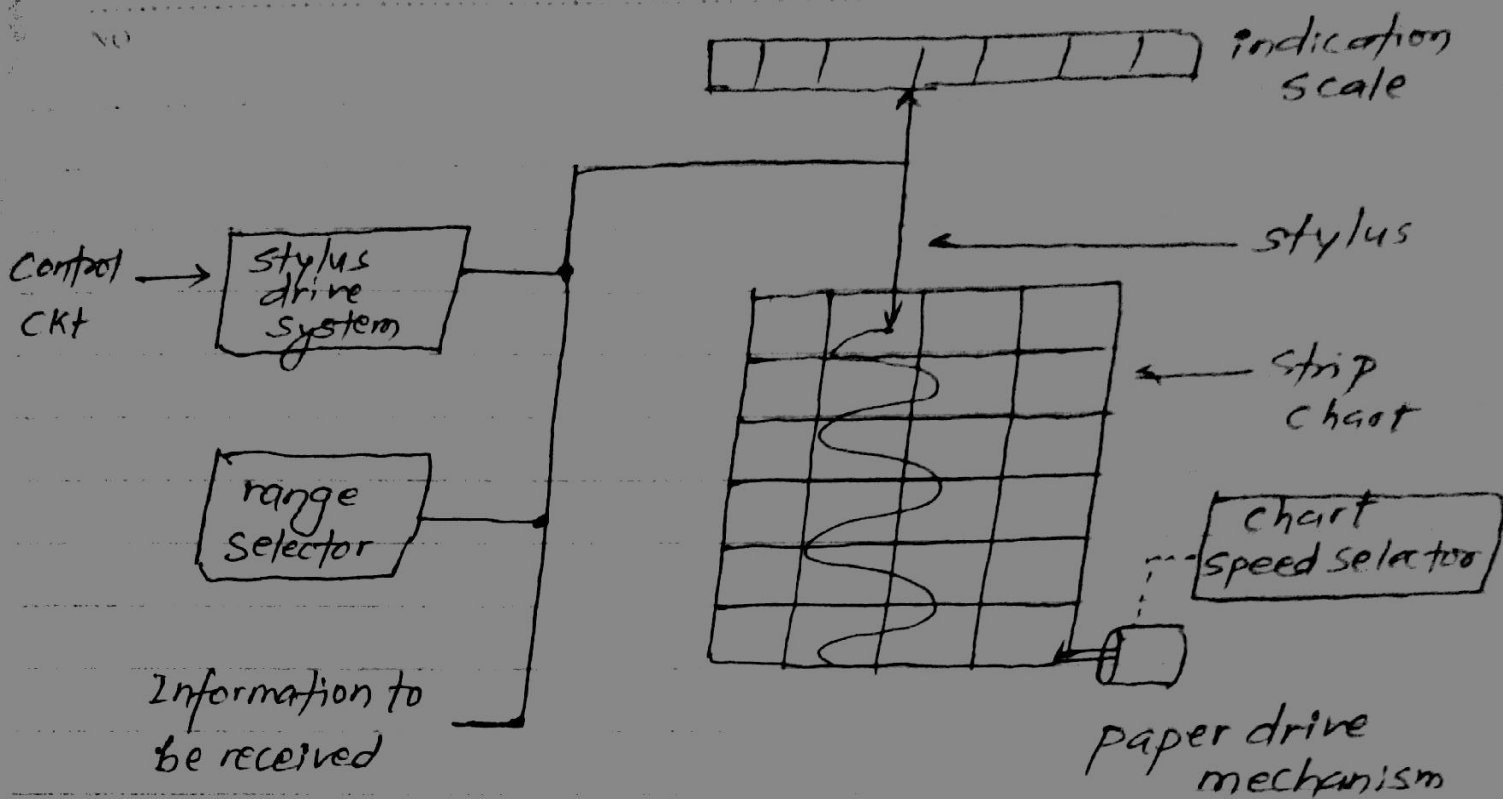


Fig: strip-chart recorder

A) Paper Drive System:-

It consists of long roll of paper called chart moving vertically usually driven by synchronous motor equipped with a speed selector.

B) Marking Mechanism:- There are many types of mechanisms used for making marks on the paper. The most commonly used are:-

- i) Marking with ink filled stylus: → ink filled stylus and normal paper
- (ii) Marking with heated stylus → uses heat sensitive paper
- (iii) Chopped bar (impact printing) → uses pressure " "
- (iv) Electric stylus marking → uses current " "
- (v) Optical Marking → " light " "
- (vi) Electrostatic stylus: Stylus which produces high voltage discharge thereby producing a permanent trace on electrosensitive paper.

(c) tracing system:- There are two types of tracing system used for producing graphic representations.

1) Curvilinear system:- In the curvilinear system, the stylus is mounted on a central pivot and moves through an arc which allows a full-width chart marking. If the stylus makes a full range recording, the line drawn across the chart will be curved and the time intervals will be along this curved segments. This type of system is used on many records, with pmmc galvanometers actuating the stylus filled with ink. The disadvantage of this method of tracing is the charts are difficult to analyse because of curved time based lines.

2) Rectilinear system:- A line of constant time is ~~proportional~~ perpendicular to the time axis and therefore this system produces a straight line across the width of the chart. ~~The~~ The stylus is actuated by a drive cord over pulleys to produce the forward and reverse motion as determined by the drive mechanism.

Types of Strip-chart :- (i) Galvanometer Type
(ii) Null type.

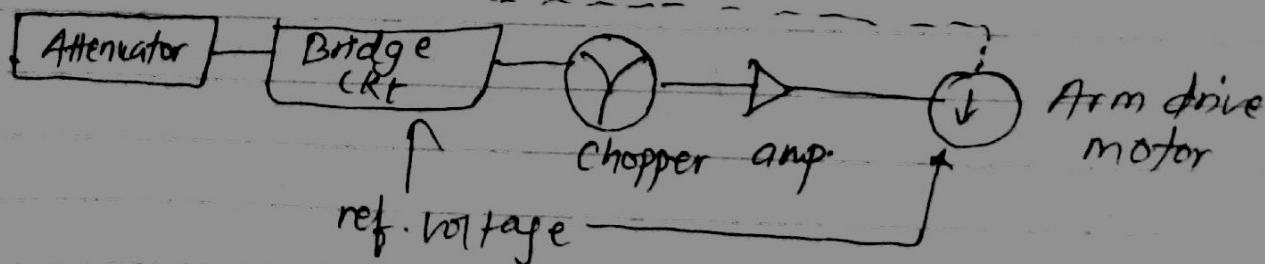
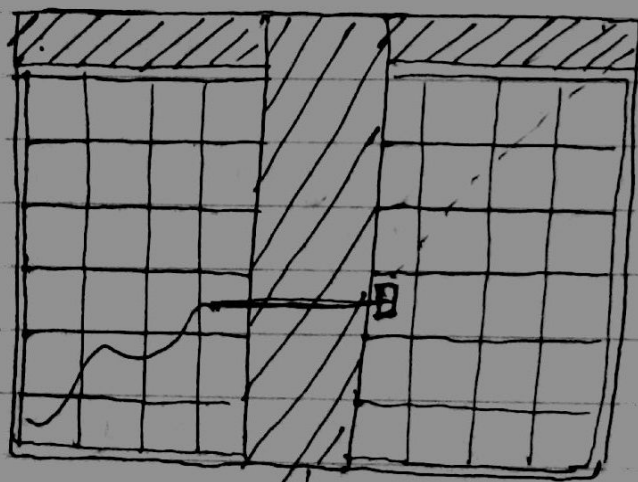
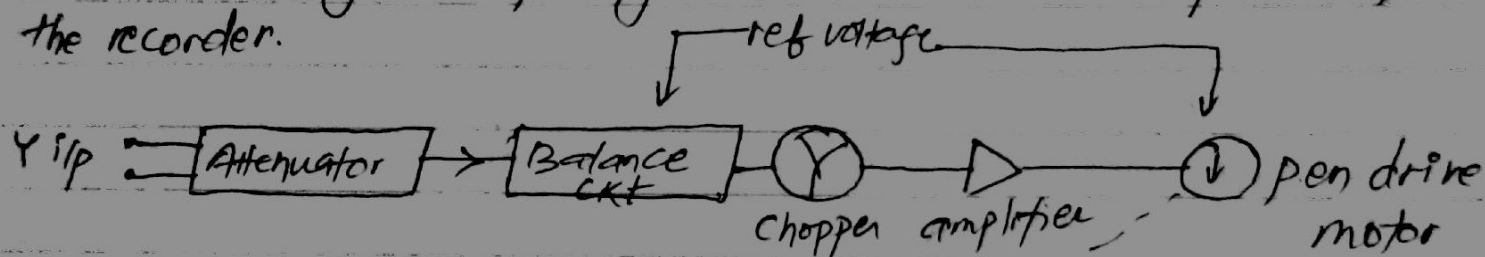
(i) X-Y Recorder:- This instrument is employed where it is desired to plot relationship between 2 variables.

In ^{some} ~~this~~ recorder one self balancing potentiometer ckt moves a recording pen (stylus) in the x-direction while another self balancing potentiometer ckt moves the recording pen (stylus) in y-direction at right angle to the x-direction while the paper remains stationary.

There are many variations of X-Y recorders. The

emf used for the operation of X-Y recorders, may not necessarily measure only voltages. The measured emf may be the o/p of the transducer that may measure displacement, force, pressure, strain, light intensity or any other physical quantity. Thus with the help of X-Y recorders and appropriate transducers, a physical quantity may be plotted against another physical quantity.

Hence, an X-Y recorder consists of a pair of servo systems driving a recording pen in two axes thru a proper sliding pen and moving arm arrangement, reference to a stationary paper chart. Attenuators are used to bring the i/p signals to the levels acceptable by the recorder.



A signal enters each of the two channels. The signals are attenuated to the inherent full scale range of the recorder (often 0.5 mV). The signal then passes to a balance ckt where it is compared

to an internal reference voltage. The error signal (ie. the difference betⁿ the i/p signal & reference voltage) is fed to a chopper which converts dc signal into ac signal. The signal is then amplified in order to actuate a servomotor which is used to balance the system and hold it in balance as the value of the quantity being recorded changes. The action described above takes place in both axes simultaneously. Thus, we get a record of one variable with respect to another.

An X-Y recorder may have a sensitivity of $10 \mu V/mm$, a skewing speed of $1.5 m/s$ and a frequency response about $6 Hz$ for both the axes. The chart size is $250 \times 180 mm$. The accuracy of X-Y recorder is about $\pm 0.3\%$.

X-Y recorders are used to plot :

- (i) V-I curves of diode and transistor.
- (ii) B-H " " magnetic material
- (iii) Speed-torque characteristics of motor
- (iv) Resistance vs temp, etc.

(iii) Magnetic Tape Recorder :-

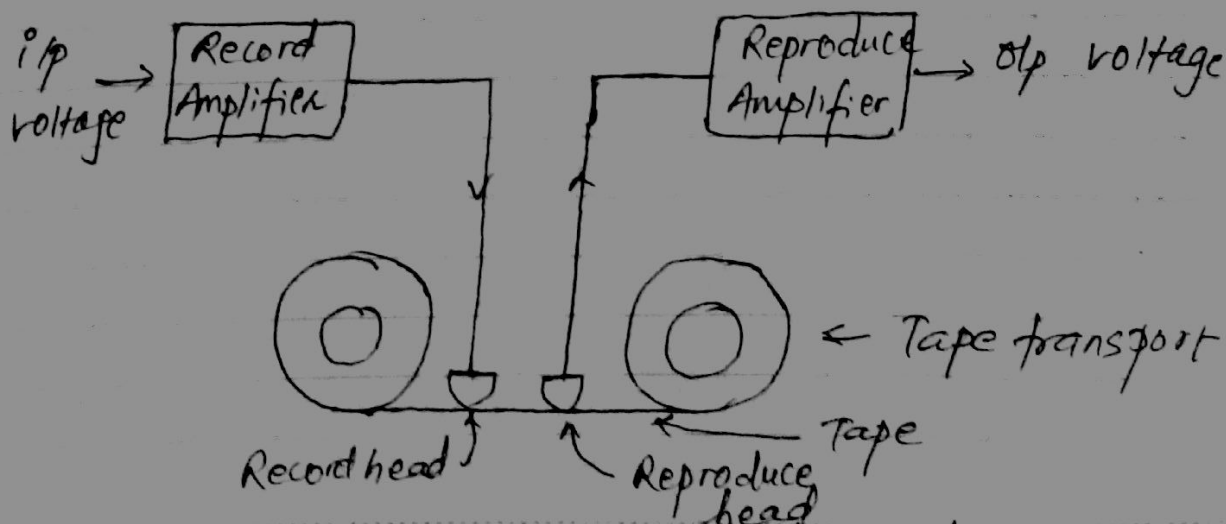
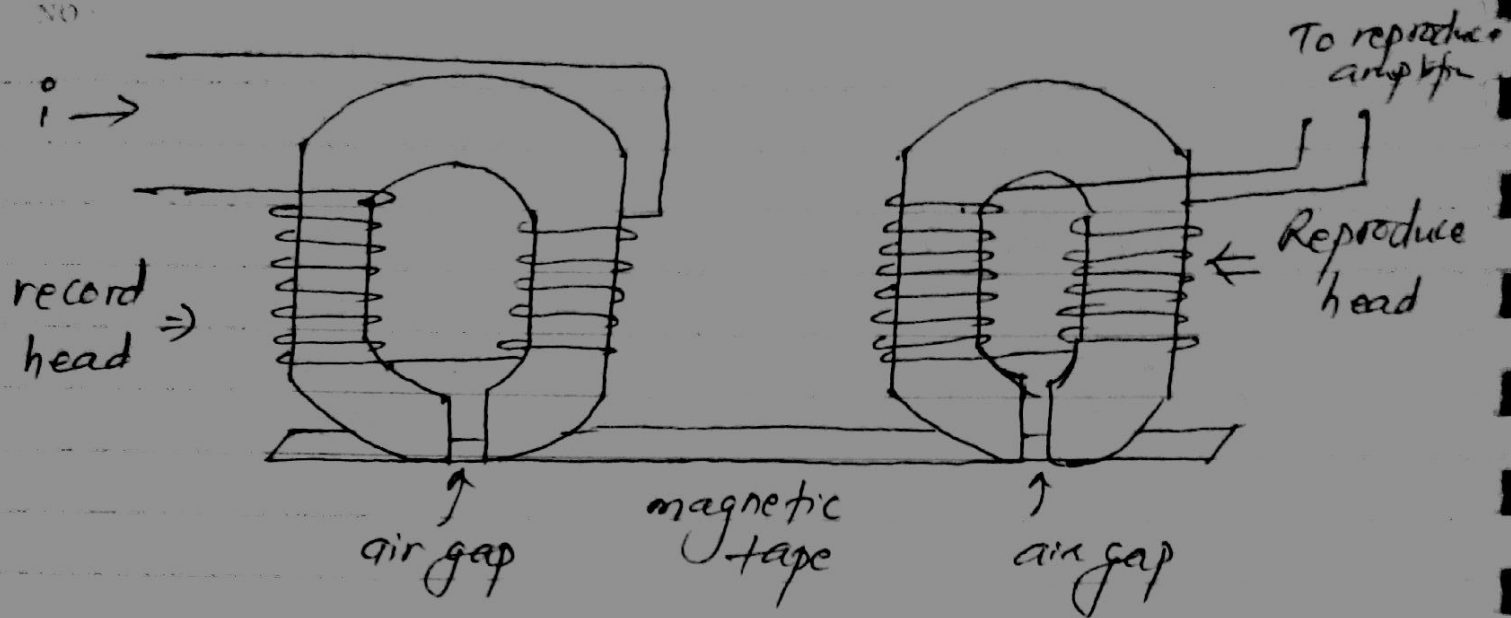


Fig: Magnetic tape Recorder/Reproducer



Components Used:-

- (1) Magnetic tape:- It is composed of a coating of fine magnetic iron oxide (Fe_2O_3) particle on a plastic ribbon.
- (2) Recording head:- It is a device that impresses a residual pattern upon it in response to an amplified i/p electrical signal. It consists of core of high permeability material with a coil and fine air gap ($10 \mu m$). The air gap is shunted by passing the magnetic tape and coil current creates flux to bridge the air gap. Thus the flux created in the air gap passes thru the magnetic tape and magnetizes the Fe_2O_3 particles as they pass the gap.
- (3) Reproduce head:- Similar to recording head. For reproduction, the magnetic tape is passed over a reproducing head thereby resulting in an e/p voltage proportional to the magnetic flux in the tape across the coil of the reproducing head.
- (4) Tape transport Mechanism:- This mechanism moves the tape along the recording head or reproducing head at constant speed without any strain, distortion and wear. The tape

should be in contact with the head. Arrangements for fast winding and reversing are also provided.

⑤ Conditioning device: These devices consist of amplifiers, and filters required for modifying the signal to a format that can be properly recorded on a tape.

Advantages of magnetic tape recorder:

- ① They have wide frequency range from d.c. to several MHz.
- ② They have low distortion.
- ③ The magnitude of electrical i/p signal is stored in magnetic memory and this signal can be reproduced whenever required.
- ④ The recorded signal is immediately available. The recorded signal can be played back or reproduced as many times as required without the loss of signal.
- ⑤ The tape can be erased & ~~res~~ reused to record a new set of data.