

Chapter 6

Output Devices

1. Graphic Recorder
 - a. Strip chart Recorder e.g. ECG machine
 - b. X-Y Recorder
2. Magnetic Tape Recorder

One of the important consideration in an instrumentation system is the method by which the data acquired is recorded. A recorder records electrical and non-electrical quantities as a function of time. The recording method should be consistent with the type of system. If we are dealing with wholly analog system, then analog recording techniques should be used. On the other hand, if the system has a digital output digital recording devices are used. Thus, there are two types of recording devices:

- i. Analog Recorders
- ii. Digital Recorders

Analog Recorders

They can be broadly classified into :

- a) Graphic recorders
- b) Oscillographic Recorders
- c) Magnetic tape Recorders

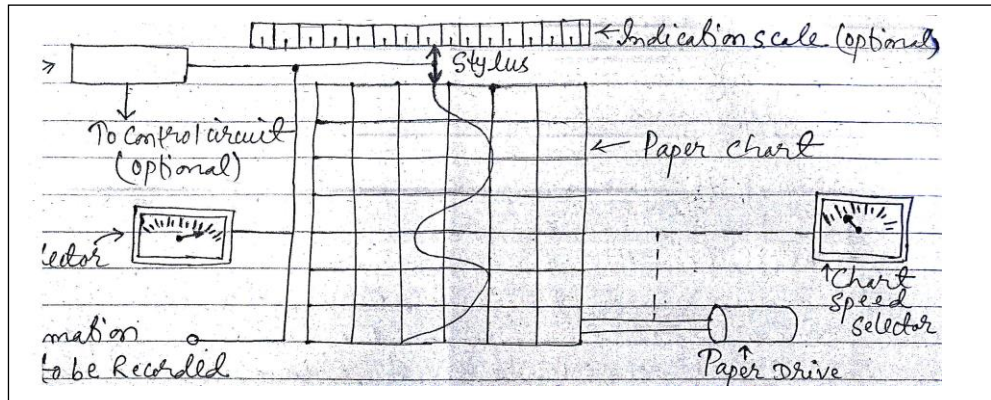
a) Graphic Recorders

Graphic recorders are devices which display and store a pen-and-ink record of the history of some physical event. Basic elements of a recorder include a chart for displaying and storing the recorded information, a stylus moving in a proper relationship to the paper and suitable means of interconnection to couple the stylus to the source information. It is of two types:

- i. Strip chart Recorder
A strip chart Recorder records one or more variables with respect to time, It is an X-t recorder.
- ii. X-Y Recorder
An X-Y recorder records one or more dependent variables with respect to an independent variable.

Strip Chart Recorder

Figure shows basic constructional features of a strip chart recorder. A strip chart recorder consists of :



1. A long roll of graph paper moving vertically.
2. A system for driving the paper at some selected speed. A speed selector switch is generally provided chart speeds of 1-100 mm/s are usually used.
3. A stylus for making marks on the moving graph paper. The stylus moves horizontally in proportional to the quantity being recorded.
4. A stylus driving system which moves the stylus in a nearly exact replica or analog of the quantity being recorded.
5. A range selector switch is used so that input to the recorder drive system is within the acceptable level.

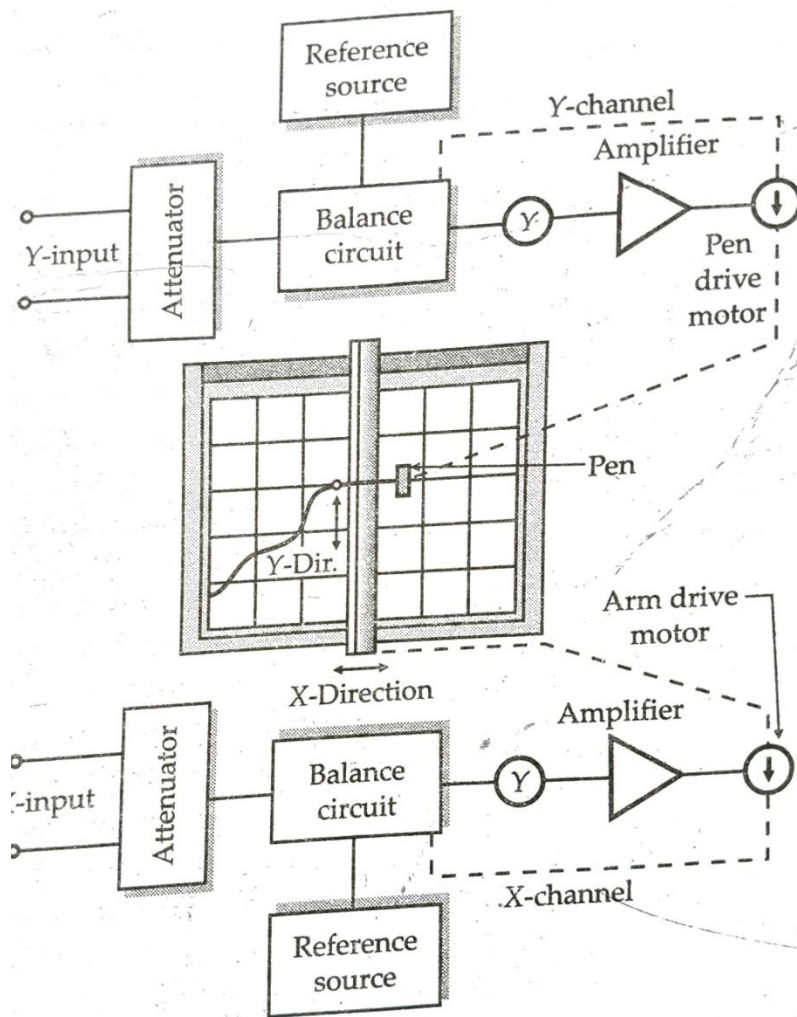
Most recorders use a pointer attached to the stylus. This pointer moves over a calibrated scale thus showing the instantaneous value of the quantity being recorded. An external control circuit for the stylus may be used.

It is used to indicate record and control and used in refineries, steel plants, paper mills etc.

X-Y Recorder

An X-Y recorder consists of a pair of servo systems, driving a recording pen in two areas through a proper sliding and moving arm arrangement with reference to a stationary paper chart. Attenuators are used to bring the input signals to the levels acceptable by the recorder.

Figure shows a block diagram of a typical X-Y recorder. A signal enters each of the two channels. The signals are attenuated to the inherent full scale range of the recorder. The signal then passes to a balance circuit where it is compared with an internal reference voltage. The error signal i.e. the difference between the input signal voltage and the reference voltage is fed to a chopper which converts d.c. signal to an a.c. 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.

This type of recorder can be successfully used for.

- i. Speed torque characteristics of motors.
- ii. Plotting of characteristics of vacuum tubes, zener diodes, rectifiers, transducers etc.
- iii. Regulation curves of power supplies.
- iv. Electrical characteristic of materials
- v. Plotting stress-strain curves, hysteresis curves and vibrations amplitude against swept frequency in laboratories which simplifies the measurements and tests.

Magnetic Tape Recorder

The strip chart recorder and X-Y recorder are basically frequency recorders but magnetic tape recorders have response characteristics which enable them to be used at higher frequencies. Therefore, magnetic tape recorder is extensively used in instrumentation system.

Recording data in such a way that it can be retrieved or reproduced in electrical form again is frequently desirable and necessary; magnetic tape recording is the most common and most useful way of achieving this. A magnetic tape recorder consists of the following basic components:

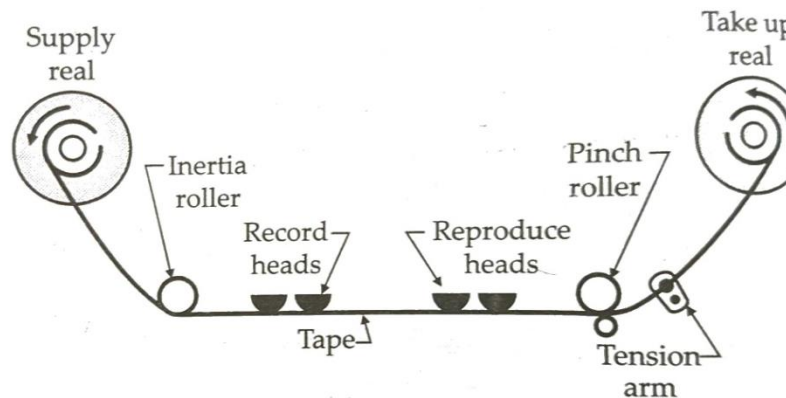


Fig. Tape Transport Mechanism

1. Recording Head

This device responds to an electrical signal in such a manner that a magnetic pattern is created in a magnetisable medium.

2. Magnetic Tape

It is composed of a coating of fine magnetic iron oxide particles (Fe_2O_3) on a plastic ribbon. A typical tape is 12.7 mm wide and 25.4 μm thick.

3. Reproducing Head

It detects the magnetic pattern in them and converts it back to original signal. It is similar in appearance to that of recording head.

4. Tape Transport mechanism

This mechanism moves the tape along the recording or the reproducing heads at a constant speed. The tape mechanism must be capable of handling the tape during various modes of operation without straining, distorting or wearing the tape. Arrangements for fast winding and reversing are also provided.

5. Conditioning Devices

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

Principle of Tape Recorders

When a magnetic tape is passed through a recording head, any signal recorded on the tape appears as magnetic pattern dispersed in space along the tape. When the same tape is passed through a reproduce head, there will be induction of voltage in the tape by magnetization. The induced voltage is proportional to the rate of change of flux linkages given by

$$E_{rp} \propto N \frac{\partial \phi}{\partial t}$$

where N is the number of turns of the winding put on the reproduce head.

Thus, the output signal from the reproduce head is a derivative of the input signal. The magnitude of the output signal is not only proportional to the flux recorded on the tape but also the frequency of the recorded signal.

Advantages of magnetic Tape Recorder:

1. Magnetic tape recorder have wide frequency range.
2. They may have a low distortion
3. The magnitude of the electrical input signal is stored in magnetic memory and this signal can be reproduced whenever desired.
4. The recorded signal is immediately available with no time loss in processing and can be played back as many times as desired without loss of signal.
5. When the information has been processed, the tape can be erased and re-used to record a new set of data can be erased and reused to record a new set of data.
6. It permits multi-channel recording
7. Data may be recorded at very fast speeds (1.52 or 3.05 m/s) and played back at speeds (4.76 or 2.38 cm/s) slow enough to be recorded with low frequency recorders.

Indicating instruments

An instrument is a device for determining the value or magnitude of quantity or variable. Indicating instruments are those instruments which indicate the magnitude of a quantity being measured. They generally make use of a dial and a pointer for this purpose. e.g. ordinary voltmeters, ammeters and wattmeter.