

SHOCK HAZARDS, MONITORS & RECORDS

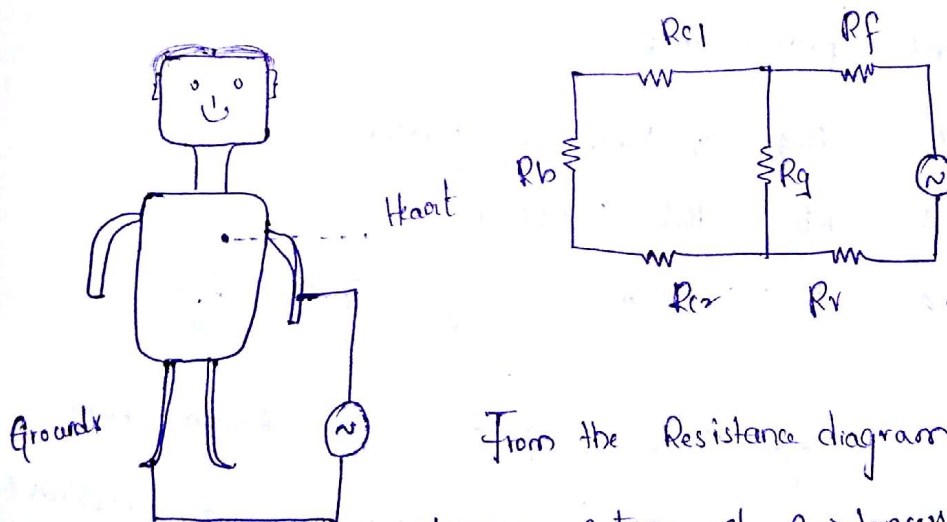
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Physiology of Electrical Current Effect :-

This physiology deals with electrical currents that are applied to the human body tissues. The applied potentials may create electrical accidents within the body. For applying potential to the body we had to take two contact points.

When this potential is applied then the tissues respond until certain potential. After the tissues may be burned & the organs may be damaged.

If the potential is applied b/w the right leg and any other part of the body except heart then it is known as macro shock, if the potential is applied between heart & right leg then it is known as micro shock. This illustration can be shown by the diagram along with Resistance Equivalent circuit.



From the Resistance diagram we can observe 6 type of Resistances that are present when the potential is applied.

R_b is the body Resistance.

R_{c1} is the first contact point Resistance.

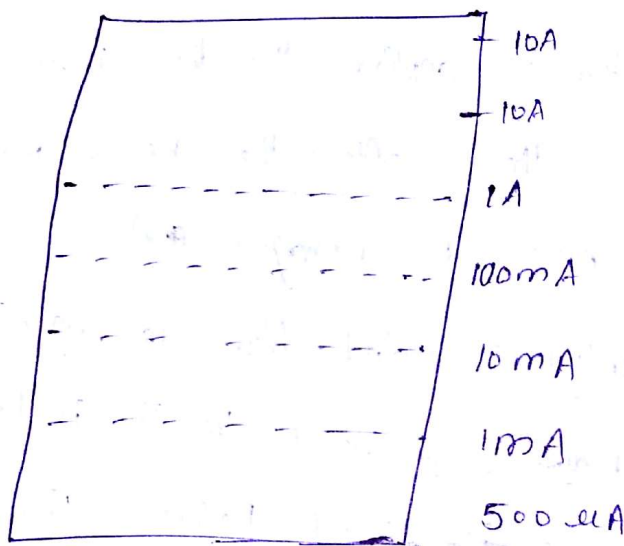
R_{c2} " " Second " " " "

R_f is the fault ~~to~~ Resistance.

R_r " " Resistance b/w Supply & ground.

R_g " " Ground Resistance

The limits of potential applied depends on the following Standards



for 500µA it is perception. (Some applied Source)

" 1mA it is also perception

" 10mA it is maximum let go current

" 100mA pain & Injury

" 1A danger of Ventricular problems

" 10A myo Cardial Contraction.

" >10A It is Serious burning of the organs

Skin is the largest resistance part in the human body.

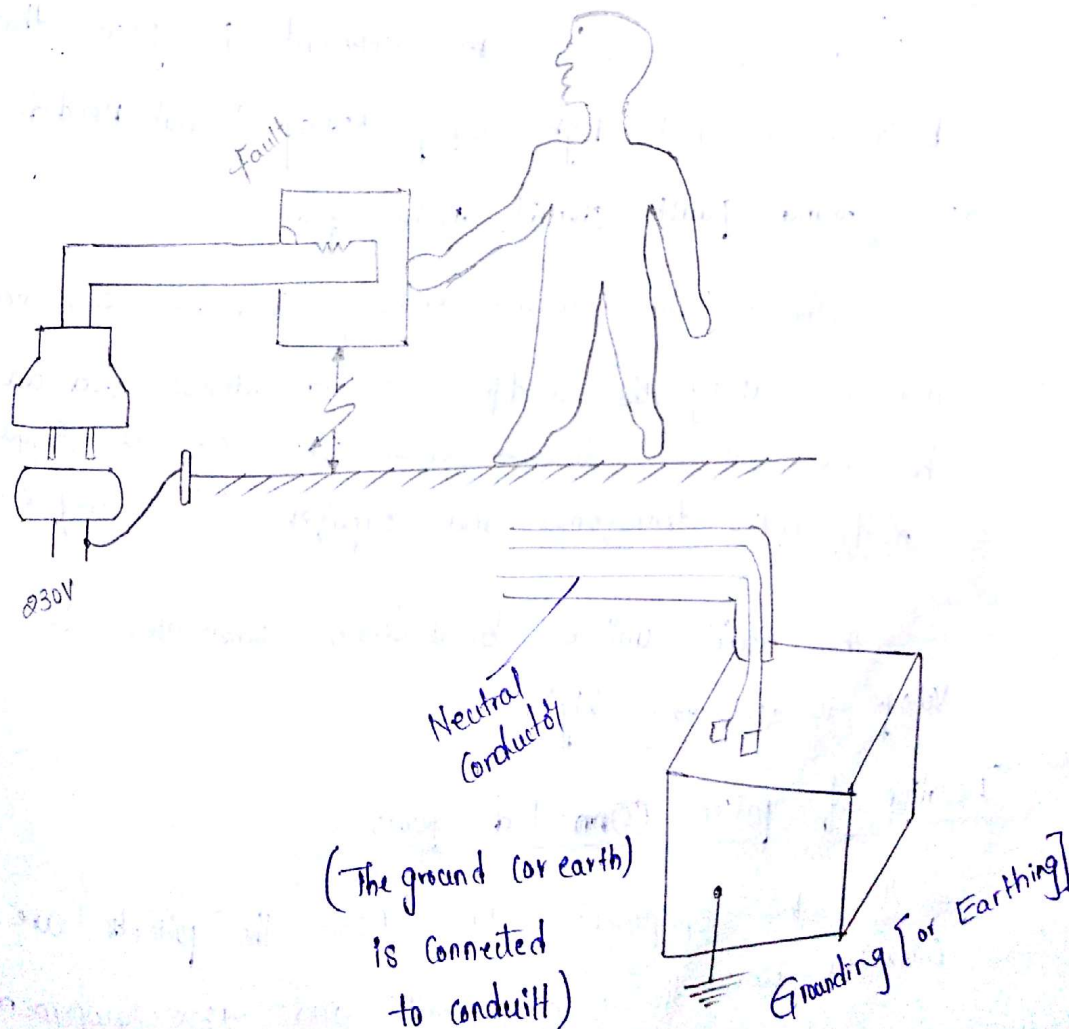
The electrode paste & cathodes reduce the body resistance.

Shock Hazards from the Electrical Equipment :-

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* Generally in hospitals we use step down transformer for a 3 phase - supply (415V), (50Hz) & single phase supply (230V) (50Hz) is used for supplying the current for the electrical equipment. An operator is required for using this electrical equipment. The electrical shocks may be occurred when the live wire any conductive material are in contact. Insulation breakdown, mechanical damages also must be considered. The room radiators, insulation are also must be connected properly to avoid electrical equipment accidents. The six resistances $R_B, R_{C1}, R_{C2}, R_F, R_r$ & R_g must be calculated for applying the potential.

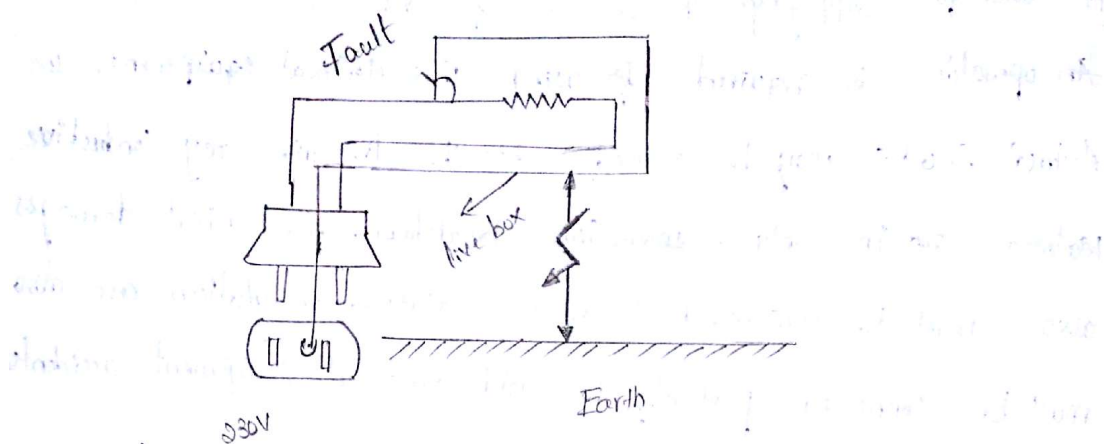
Earth Shock Hazard



Methods of Electrical Shock Accident prevention :

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1. Grounding Method :- A ground earth wire is connected to the equipment so, that the extra current supplied will be passed through earth wire to the ground.



2. Double Insulation :- plastic or rubber insulation is generally used for handling the conducting materials to avoid electrical shocks.

3. protection by low voltage :-

The supply to the ~~req~~ equipment is given through batteries. so, that high supply voltage is not needed.

4. Ground Fault circuit Interrupter :-

Whenever the current entering into the equipment is monitored using ~~the~~ a differential transformer and an amplifier the ckt will be broken down whenever the supply voltage Differential transformer and amplifier :- is very very high.

The circuit will be broken down whenever the supply voltage is very very high.

Isolation of patient connected parts :-

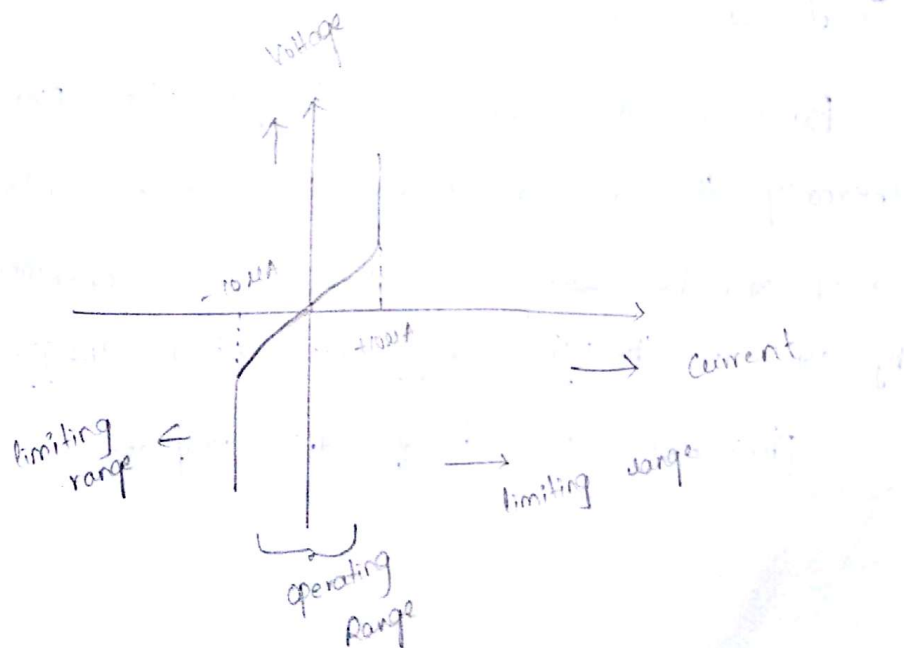
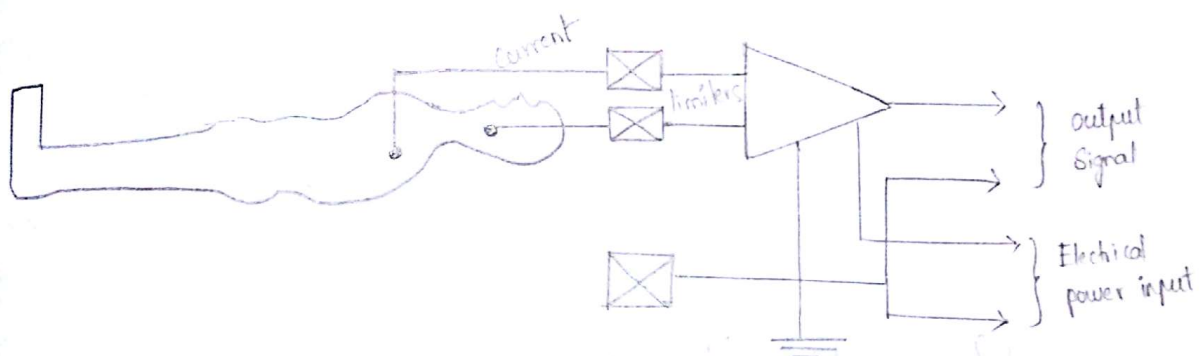
In the equipment like ECG the patients are directly connected with the equipment and this equipment is

directly connected to the power supply whenever high voltages are passed through this equipment the patient may be effected to (106) electrical accidents.

The preventive measures for avoiding these electrical accidents can be done by using the following circuits and equipment.

1. Current limiter Circuits :-

These ckt's are used for limiting the current to a certain value, if the current increases more than the limit the ckt will breakdown the power supply.



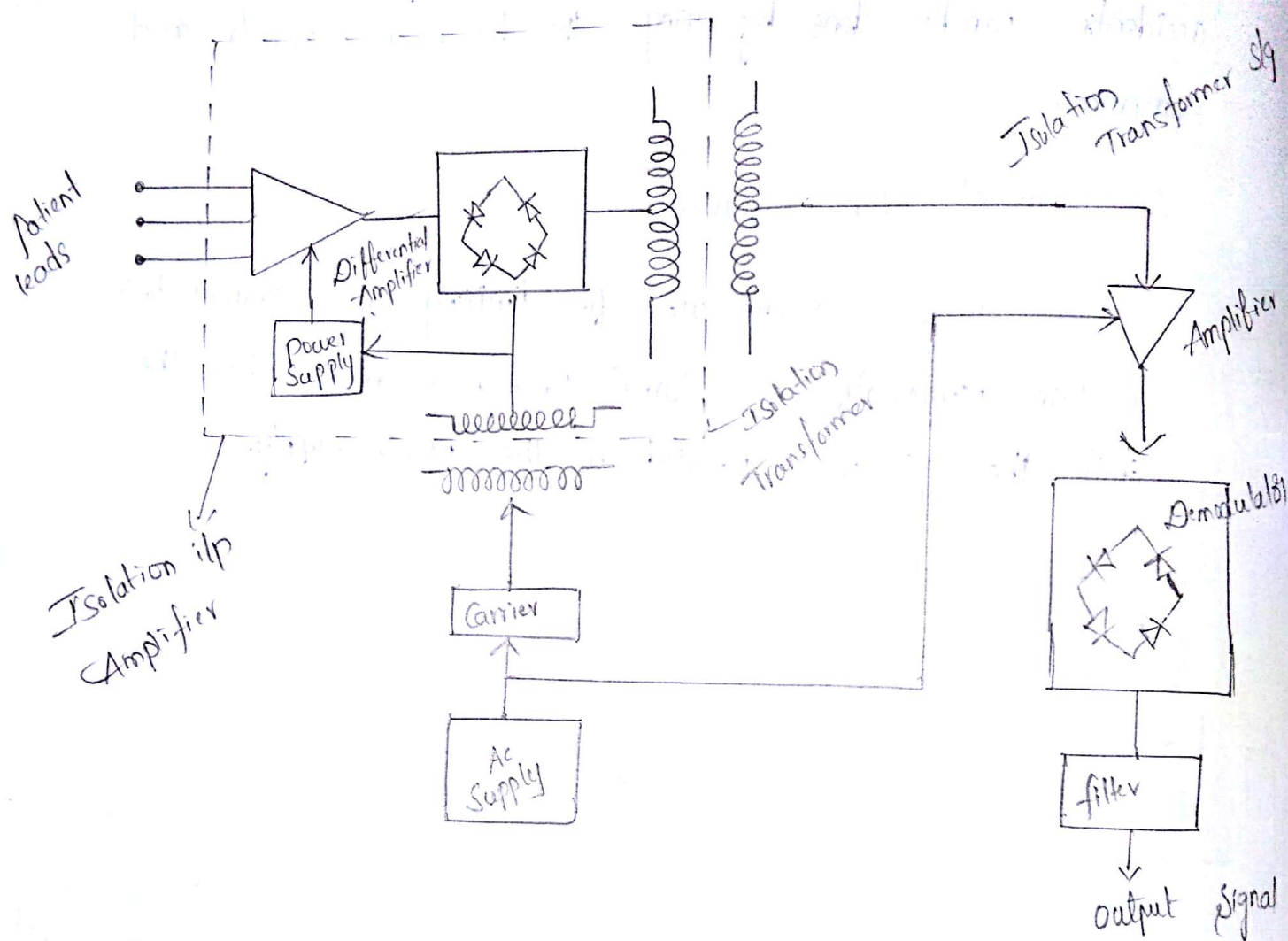
By using Isolation transformers :-

Using Isolation Transformers we can provide

Protection for the equipment

by connecting the transformer as shown below.

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Using Optical Isolation :-

Batteries are used for supplying the power and internally the electrical energy is converted into light energy and the readings are taken at the equipment and by converting the light energy into electrical energy.

Photo diode is used for this purpose.

Bio potential Amplifier :-

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Bio potentials are of few mill Amp (or) micro Amp. picked up by the electrodes or available at the output of transducer.

These Amplifiers are connected to AC power supply.

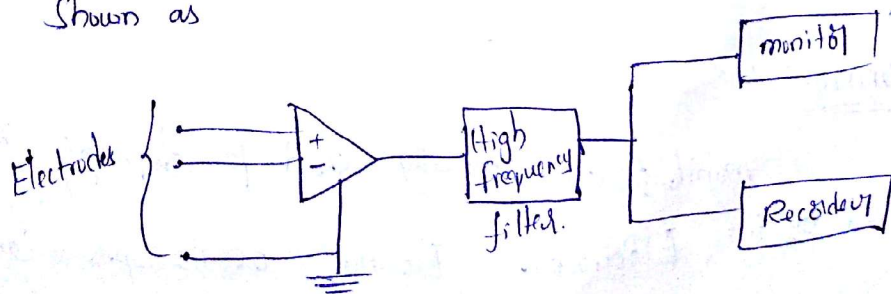
therefore due to Capacitive Coupling interference will be formed. To overcome this interference we must use high i/p impedance amplifiers which have the following properties,

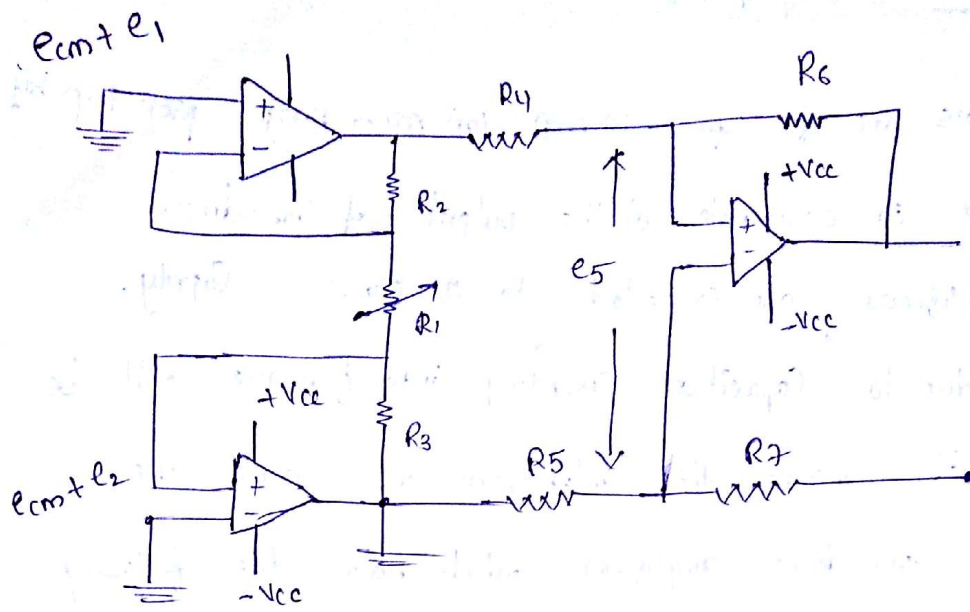
1. Input Impedance must be capable of handling 10mw.
2. CMRR - common mode rejection ratio.
must be very high
3. gain of the amplifier must be more than 100
4. magnetic field must be minimized.
5. Isolation circuits for safety

for providing these properties we use op amp's.

The eg circuit is Instrumentation Amplifier. We can also use differential amplifiers for providing the Bias at the output stage.

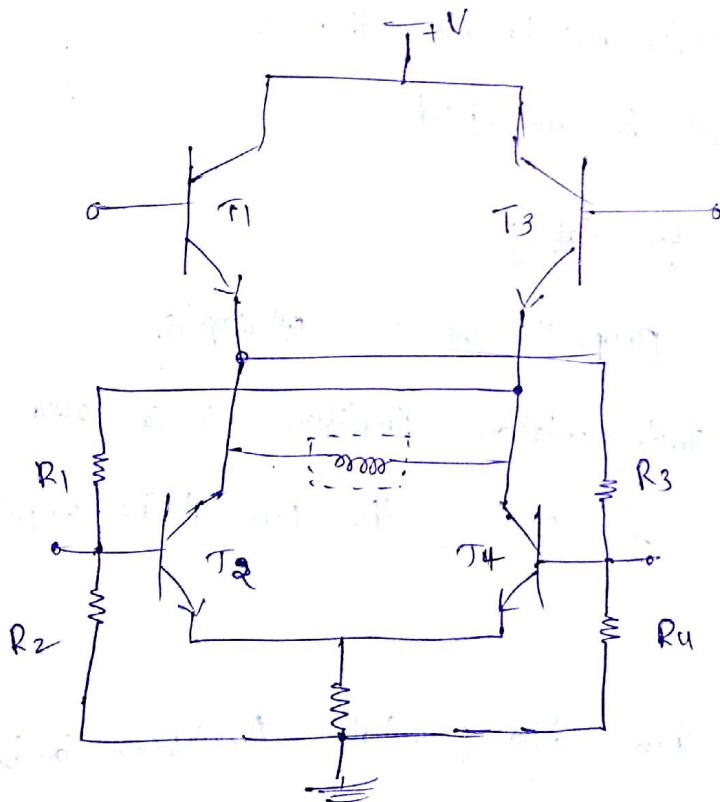
The diagram for these Bio-potential Amplifiers can be shown as





$$R_4 = R_5 = R_6 = R_7$$

$$e_s = \left\{ 1 + \frac{2R_2}{R_1} \right\} \times (e_2 - e_1)$$



Monitors :-

monitors are generally used for displaying wave forms obtained by the Electrodes. Normal oscilloscopes can not

Display the low frequency parameters. The display also must be properly configured for obtaining the continuous wave forms. Therefore we use digital oscilloscope with digital memory and digital memories and rolling displays.

Video Monitors :-

In ICU and Intensive Cardio Care unit (I.C.C.) we are going to use special type of video monitors which are placed along the bedside of the patient with the following properties. It has a display of 300×360 .

Recorders :-

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Recorders are generally used for recording the wave forms of the bio-potentials obtained from the electrodes and transducers.

There are generally 2 types of Recorders :
i) Analog
ii) Digital.
These Analog Recorders are further divided into 3 types.

- i. Graphic Recorder
- ii. Oscillo Graphic Recorder.
- iii. Magnetic Tape Recorder

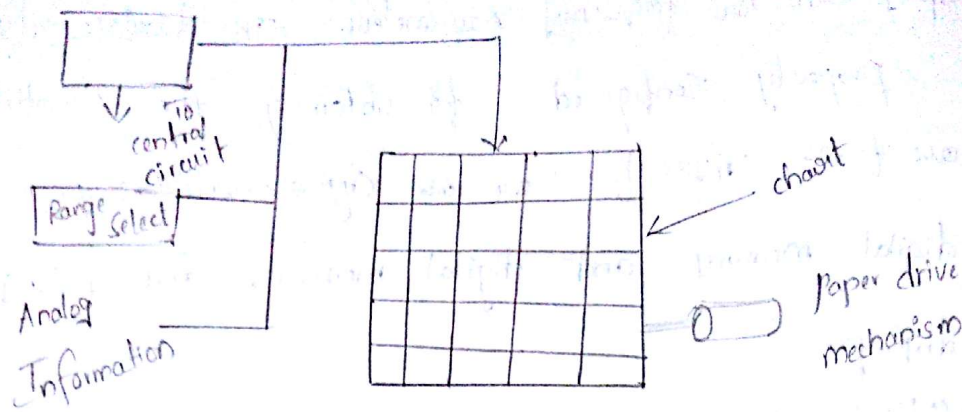
Types of Recorders :-

i. Strip chart Recorder :-

This is analog type of Recorder. This

Strip chart Recorder uses low cost Technology and diff types of mechanisms for marking the

Graph.



Proper drive System is used for moving the paper at uniform Speed.

Stylus is used for marking the chart. there are different types of marking mechanism.

Ink-filled Stylus :- This Stylus have ink inside the capillary

- The advantage is It has diff Speeds.
 - The disadvantages is it is of low frequency Heated.
- A thin wax coating is used for marking on a black chart. The frequency is 40Hz. The disadvantage is high Cost.

Electric Stylus :-

Current is passed through the Stylus & this trace is taken on a Special Coating paper.

Optical marking :- light is used for tracing the mechanism.

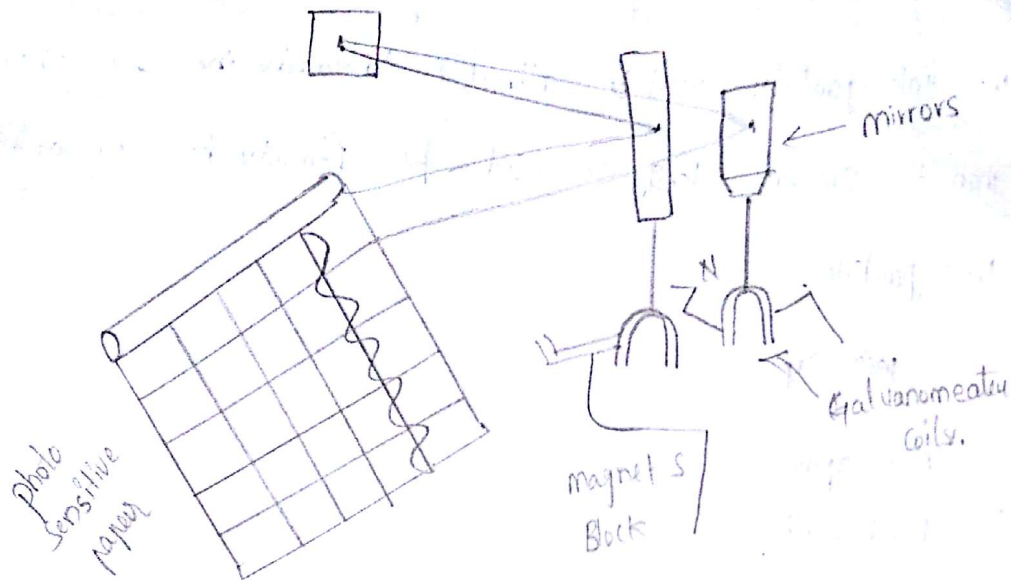
Tracing Mechanism :-

Tracing mechanisms are 2 types there are

- i. Rectilinear
- ii. Curve linear

Ultra - Violet Recorder :-

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The potential is applied to the Magnetic blocks. due to this the galvanometer coils will be affected so that there will be some movement in the galvanometer mirrors.

The ultra violet rays will be focused on the mirrors. Then the reflected signal will be available on the chart.

iii. Electrostatic Recorder :-

The disadvantage of UV Recorder is it takes more time for recording the wave form. This Electrostatic Recorder can be used upto several kHz's at a frequency of 254 mm/sec. This Recorder consists of Imaging Head, tracing Head, Tuning Head & vacuum knife.

It consists of 1000 wire element and on each side of these wire elements there are 32 copper bars.

As the paper moves over the imaging head a -ve voltage is applied for the wire elements, +ve voltage is

applied to the copper bars. The paper is passed through the tuning head and positively charged ink particles. So, that (114)
The ink particles will be attracted towards the -ve potential
Then the vacuum knife is used for removing the unwanted ink particles.

~~peak~~ Cap

- peak capture
- Band width

Peak capture :- peak capture is the shortest pulse which can be represented by the recorder (40 m sec).

Band width :- B.W. is defined as the maximum sine wave which can be recorded with accuracy (5 kHz).

IV. Ink Jet Recorder :-

This Ink Jet Recorder consists of capillary tube which is placed b/w two electro magnets.

The capillary tube is connected to the permanent magnet then the amplified signal of biopotential is applied to the electromagnets. Due to this the

electromagnets will attract the permanent magnet, so that the capillary tube will be moved from its position

the capillary tube effects the nozzle of the recording

and the printing of charge takes place this

recorder can measure up to 60ms of different size.

Colour printer :-

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There are different types of printers & these printers can be classified into 2 types.

! Impact printers :-

Dot matrix printers are considered as an example.

! Non-Impact printers :-

Ink jet printers, laser printers are the examples of non-impact printers. Different parts used in the colour printer.

! print head :-

It consists of different nozzles for sampling the ink on the paper.

ii Ink cartridge used for supplying different colours of ink like Cyan, magenta, yellow, black.

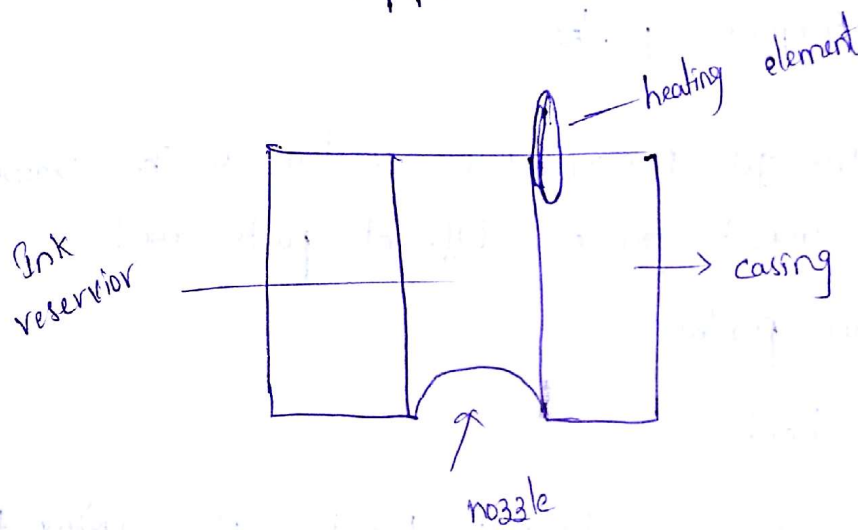
iii printer head stepper motor :-

This is used for moving the print head by using a belt so that the paper can be replaced from the paper tray.

By heating (or) vibrating we can print the required information.

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by Spilling the Ink. Cannon & hp. (Chewlett Packard) uses thermal bubble method for heating the Cartridge where as Epson uses physio-electric principle by applying, electro - electric principle by applying Electro charge to the pizeo electric. crystal, And the vibrations will be formed for Spilling the ink on the paper.



Potentio metric recorder:-

Here a coil is taken & it is connected to the battery this coil is denominated as a.b coil.

An unknown Dc Supply is applied b/w points A & C the 'Ipslg' is applied to the chopper Amplifier & also point 'A' is connected to the chopper Amplifier. After the chopper Amplifier. After the chopper Amplifier is connected to a Servo motor. which is connected to the

pen of the recorder. So that ~~the~~ the wave 117
form can be drawn on the chart. by internal
compensation. (Galvanometric recorder),

Thank You