Strain

Strain is the geometrical expression of deformation caused by the action of **stress** on a physical body. Strain is calculated by first assuming a change between two body states: the beginning state and the final state. Then the difference in placement of two points in this body in those two states expresses the numerical value of strain. Strain therefore expresses itself as a change in size and/or shape.

Strain Gauges

- If a metal conductor is stretched or compressed ,its resistance changes on account of the fact that both length and diameter of conductor change also there is a change in the value of resistivity of the conductor when it is strained and this property is called piezoresistive effect.
- Resistance strain gauges are also called piezoresistive gauges.

Strain gauges contd….

$$\epsilon = strain = \frac{\Delta L}{L}$$

The gauge factor can be given as

$$G_f = 1 + 2v + \frac{\Delta\rho/\rho}{\epsilon} \quad \text{.....(10)}$$

$$G_f = \frac{\Delta R/R}{\Delta L/L} = 1 + 2v + \frac{\Delta\rho/\rho}{\epsilon}$$

The g… y expressed in microstrain.

Strain gauge – the gauge factor

- $G_f = \Delta R/R / \Delta L/L$

R = the initial resistance in ohms (without strain)

ΔR = the change of initial resistance in ohms

L = the initial length in meters (without strain)

ΔL = the change of initial length in meters

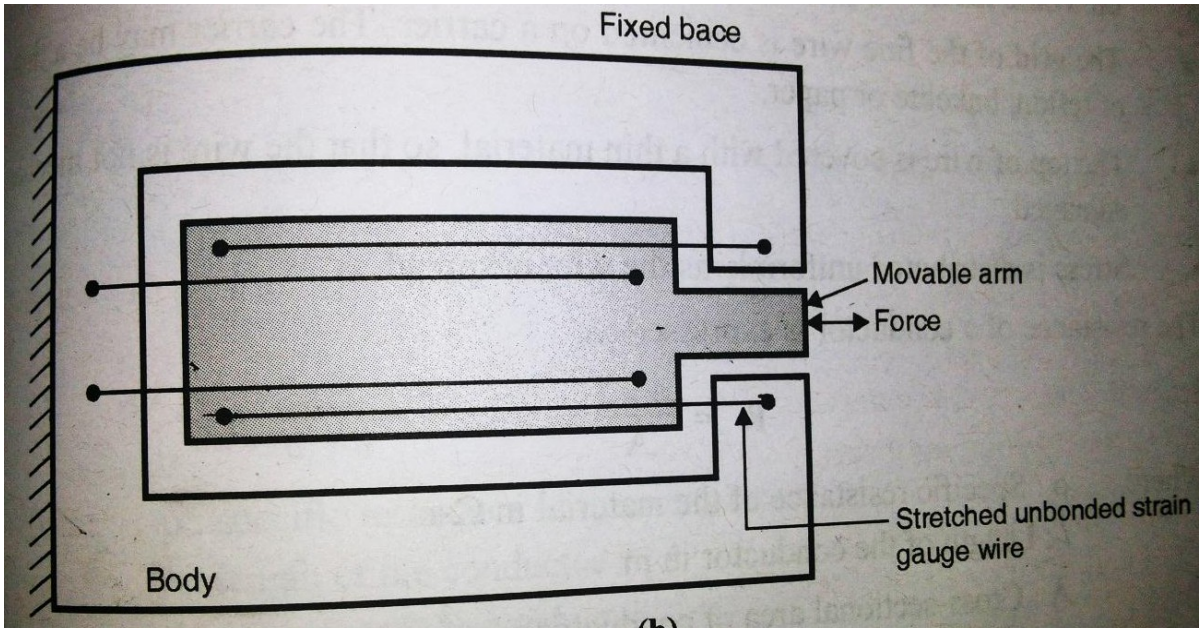
- The poisson's ratio for all metals is between 0 and 0.5.This gives a gauge factor of approximately ,2.

Strain gauge – contd……

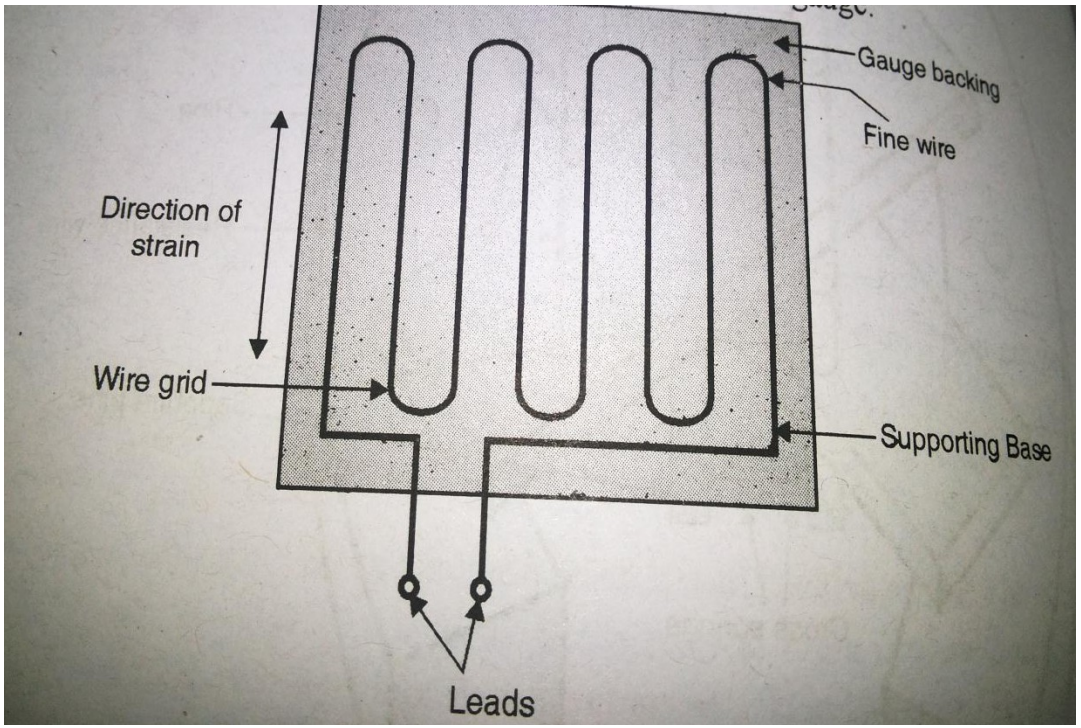
- A resistance wire strain gauge uses a soft iron wire of small diameter.The gauge factor is +4.2.Neglecting the piezoresistive effects,calculate the poisson's ratio.
- Ans:1.6

Types of strain gauges

- Unbonded metal strain gauges



Bonded metal wire strain gauges



- Bonded metal foil strain gauges.

- Vacuum deposited thin metal film strain gauges.
- Sputter deposited thin metal strain gauges.
- Bonded semiconductor strain gauges.
- Diffused metal strain gauges.

Semiconductor Strain Gauges

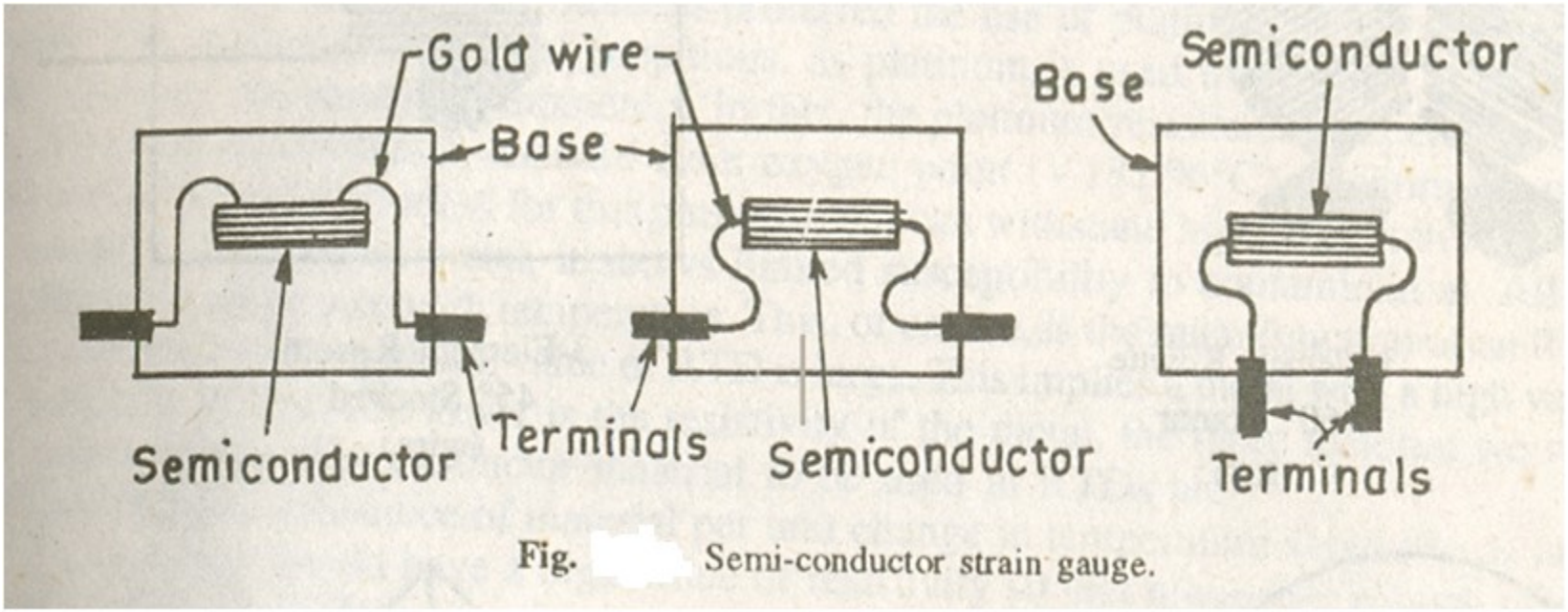


Fig. Semi-conductor strain gauge.

Semiconductor Strain Gauges

- These gauges are used where a very high gauge factor is required.
- The resistance of the semiconductors changes with change in applied strain.
- The semiconductor strain gauge depend for their action upon piezo-resistive effect,i.e the change in the value of the resistance due to change in resistivity.

Semiconductor Strain Gauges

- Si and Ge are used as resistive materials for semiconductor strain gauges.
- A typical strain gauge consists of a strain sensitive crystal material and leads that are sandwiched in a protective matrix.
- The production of these gauges employs conventional semiconductor technology.

Semiconductor Strain Gauges

- Gold leads are generally employed for making the contacts.
- These gauges can be fabricated along with IC operational amplifiers which can act as pressure sensitive transducers.

Semiconductor Strain Gauges

- Advantages :-

- They have high gauge factor of about $\pm$ 130.
- This allows measurement of very small strains of order of .01 microstrain.
- Hystersis characteristics of these gauges are excellent.
- Fatigue life is in excess and frequency response is upto 10^{12} Hz.

Semiconductor Strain Gauges

- They are very small ranging in length from .7 to 7 mm.
- Disadvantages :-
- They are very sensitive to changes in temperature.
- Linearity of the semiconductor strain gauge is poor.
- More expensive and difficult to attach to the object under study.

Rosettes

- In addition to single element strain gauges, a combination of strain gauges called "rosettes" are available in many combinations for specific stress analysis or transducer applications.