COMPARATORS

Comparators are one form of linear measurement device which is quick and more convenient for checking large number of identical dimensions. Comparators normally will not show the actual dimensions of the work piece. They will be shown only the deviation in size. i.e. During the measurement a comparator is able to give the deviation of the dimension from the set dimension. This cannot be used as an absolute measuring device but can only compare two dimensions. Comparators are designed in several types to meet various conditions. Comparators of every type incorporate some kind of magnifying device. The magnifying device magnifies how much dimension deviates, plus or minus, from the standard size.

The comparators are classified according to the principles used for obtaining magnification. The common types are:

1) Mechanical comparators
2) Electrical comparators
3) Optical comparators
4) Pneumatic comparators

MECHANICAL COMPARATORS

Mechanical comparator employs mechanical means for magnifying small deviations. The method of magnifying small movement of the indicator in all mechanical comparators are effected by means of levers, gear trains or a combination of these elements. Mechanical comparators are available having magnifications from 300 to 5000 to 1. These are mostly used for inspection of small parts machined to close limits.

1. Dial indicator

A dial indicator or dial gauge is used as a mechanical comparator. The essential parts of the instrument are like a small clock with a plunger projecting at the bottom as shown in fig. Very slight upward movement on the plunger moves it upward and the movement is indicated by the dial pointer. The dial is graduated into 100 divisions. A full revolution of the pointer about this scale corresponds to 1mm travel of the plunger. Thus, a turn of the pointer b one scale division represents a plunger travel of 0.01mm.

Experimental setup

The whole setup consists of worktable, dial indicator and vertical post. The dial indicator is fitted to vertical post by on adjusting screw as shown in fig. The vertical post is fitted on the work table; the top surface of the worktable is finely finished. The dial gauge can be adjusted vertically and locked in position by a screw.

Procedure

Let us assume that the required height of the component is 32.5mm. Initially this height is built up with slip gauges. The slip gauge blocks are placed under the stem of the dial gauge. The pointer in the dial gauge is adjusted to zero. The slip gauges are removed.

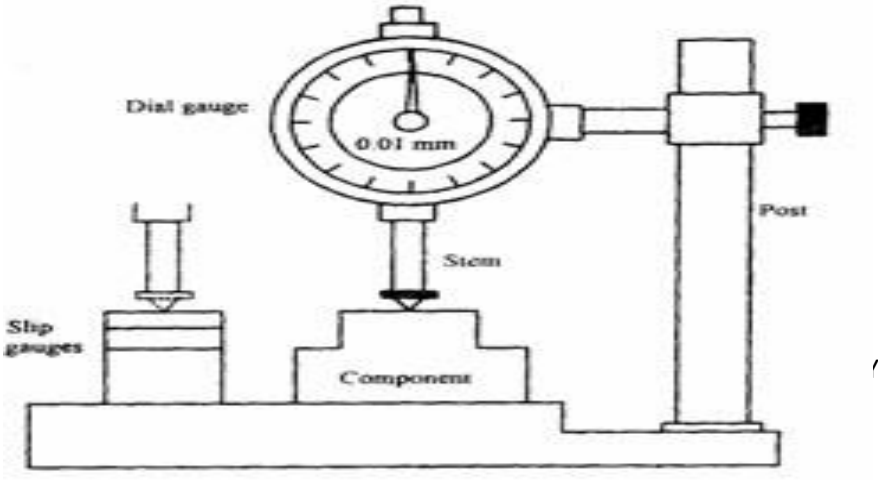

Fig 2.18 Dial Indicator

Now the component to be checked is introduced under the stem of the dial gauge. If there is any deviation in the height of the component, it will be indicated by the pointer.

Mechanism

The stem has rack teeth. A set of gears engage with the rack. The pointer is connected to a small pinion. The small pinion is independently hinged. I.e. it is not connected to the stern. The vertical movement of the stem is transmitted to the pointer through a set of gears. A spring gives a constant downward pressure to the stem.

2. Read type mechanical comparator

In this type of comparator, the linear movement of the plunger is specified by means of read mechanism. The mechanism of this type is illustrated in fig. A spring-loaded pointer is pivoted. Initially, the comparator is set with the help of a known dimension eg. Set of slip gauges as shown in fig. Then the indicator reading is adjusted to zero. When the part to be measured is kept under the pointer, then the comparator displays the deviation of this dimension either in ± or— side of the set dimension.

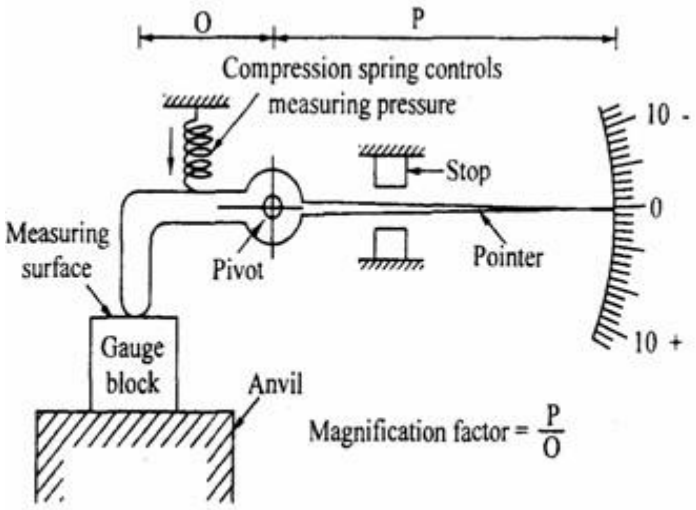

Fig 2.18 Read type Mechanical Comparator

Advantages

1) It is usually robust, compact and easy to handle.
2) There is no external supply such as electricity, air required.
3) It has very simple mechanism and is cheaper when compared to other types.
4) It is suitable for ordinary workshop and also easily portable.

Disadvantages

1) Accuracy of the comparator mainly depends on the accuracy of the rack and pinion arrangement. Any slackness will reduce accuracy.
2) It has more moving parts and hence friction is more and accuracy is less.
3) The range of the instrument is limited since pointer is moving over a fixed scale.

ELECTRICAL COMPARATOR:

An electrical comparator consists of the following three major part such as
1) Transducer
2) Display device as meter
3) Amplifier

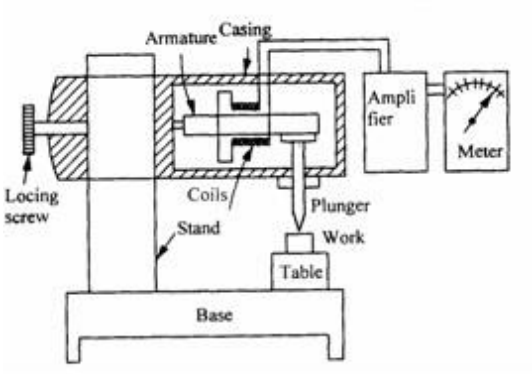

Fig 2.19 Electrical Comparator

Transducer

An iron armature is provided in between two coils held by a lea spring at one end. The other end is supported against a plunger. The two coils act as two arms of an A.C. wheat stone bridge circuit.

Amplifier

The amplifier is nothing but a device which amplifies the give input signal frequency into magnified output

Display device or meter

The amplified input signal is displayed on some terminal stage instruments. Here, the terminal instrument is a meter.

Working principle

If the armature is centrally located between the coils, the inductance of both coils will be equal but in opposite direction with the sign change. Due to this, the bridge circuit of A.C. wheat stone bridge is balanced. Therefore, the meter will read zero value. But practically, it is not possible. In real cases, the armature may be lifted up or lowered down by the plunger during the measurement. This would upset the balance of the wheat stone bridge circuit. Due to this effect, the change in current or potential will be induced correspondingly. On that time, the meter will indicate some value as displacement. This indicated value may be either for larger or smaller components. As this induced current is too small, it should be suitably amplified before being displayed in the meter.

Checking of accuracy

To check the accuracy of a given specimen or work, first a standard specimen is placed under the plunger. After this, the resistance of wheat stone bridge is adjusted so

that the scale reading shows zero. Then the specimen is removed. Now, the work is introduced under the plunger. If height variation of work presents, it will move the plunger up or down. The corresponding movement of the plunger is first amplified by the amplifier then it is transmitted to the meter to show the variations. The least count of this electrical comparator is **0.001mm (one micron).**

ELECTRONIC COMPARATOR

In electronic comparator, transducer induction or the principle of application of frequency modulation or radio oscillation is followed.

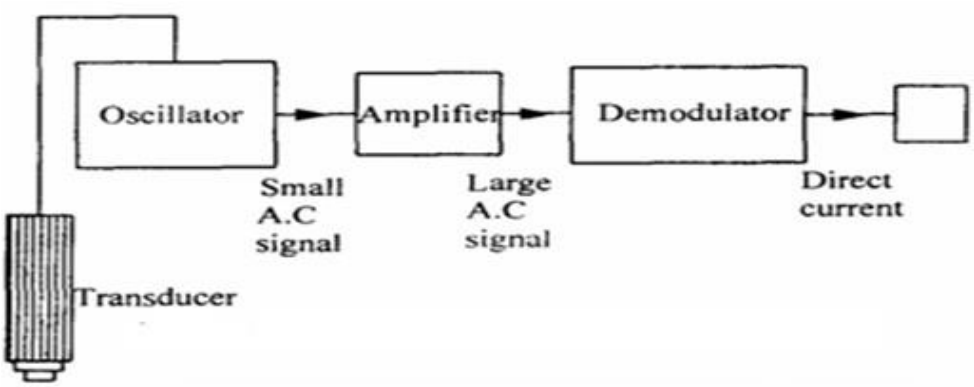

Fig 2.20 ***Principle of operation in electric gauging***

Construction details

In the electronic comparator, the following components are set as follows:

i. Transducer

ii. Oscillator

iii. Amplifier

iv. Demodulator

v. Meter

(i) Transducer

It converts the movement of the plunger into an electrical signal. It is connected with oscillator.

(ii) Oscillator

The oscillator which receives electrical signal from the transducer and raises the amplitude of frequency wave by adding carrier frequency called as modulation.

(iii) Amplifier

An amplifier is connected in between oscillator and demodulator. The signal coming out of the oscillator is amplified into a required level.

(iv) Demodulator

Demodulator is nothing but a device which cuts off external carrier wave frequency. i.e. It converts the modulated wave into original wave as electrical signal.

(v) Meter

This is nothing but a display device from which the output can be obtained as a linear measurement.

Principle of operation

The work to be measured is placed under the plunger of the electronic comparator. Both work and comparator are made to rest on the surface plate. The linear movement of the plunger is converted into electrical signal by a suitable transducer. Then it sent to an oscillator to modulate the electrical signal by adding carrier frequency of wave. After that the amplified signal is sent to demodulator in which the carrier waves are cut off. Finally, the demodulated signal is passed to the meter to convert the probe tip movement into linear measurement as an output signal. A separate electrical supply of D.C. is already given to actuate the meter.

Advantages of Electrical and Electronic comparator

1) It has less number of moving parts.
2) Magnification obtained is very high.

3) Two or more magnifications are provided in the same instrument to use various ranges.

4) The pointer is made very light so that it is more sensitive to vibration.

5) The instrument is very compact.

Disadvantages of Electrical and Electronic comparator

6) External agency is required to meter for actuation.

7) Variation of voltage or frequency may affect the accuracy of output.

8) Due to heating coils, the accuracy decreases.

9) It is more expensive than mechanical comparator.