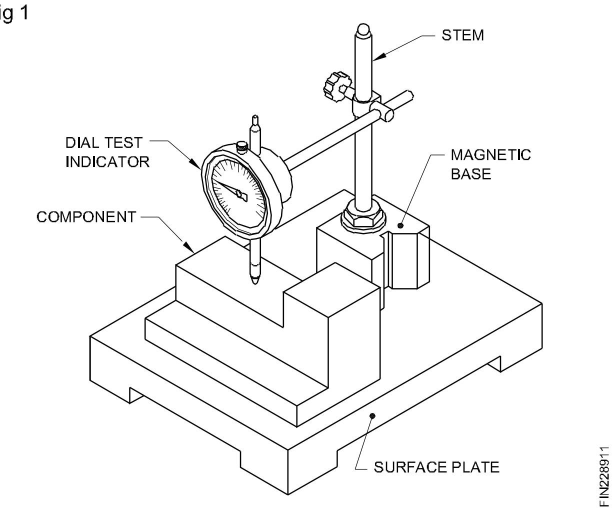
Dial test indicator, comparators, digital dial indicator

Objectives: At the end of this lesson you shall be able to
- **state the principle of a dial test indicator**
- **identify the parts of a dial test indicator**
- **state the important features of a dial test indicator**
- **state the functions of a dial test indicator**
- **identify the different types of stands.**

Dial test indicators are instruments of high prescision, used for comparing and determining the variation in the sizes of a component. (Fig 1) These instruments cannot give the direct reading of the sizes like micrometers and vernier calipers. A dial test indicator magnifies small variations in sizes by means of a pointer on a graduated dial. This direct reading of the deviations gives an accurate picture of the conditions of the parts being tested.

Fig 1



Principle of working

The magnification of the small movement of the plunger or stylus is converted into a rotary motion of the pointer on a circular scale. (Fig 2)

Types

Two types of dial test indicators are in use according to the method of magnification.They are

Plunger type (Fig 3)

Lever type (Fig 4)

The Plunger Type dial test indicator

The external parts and features of a dial test indicator are as shown in figure 3.

Dial test indicators are made out of Inver steel material

Fig 3

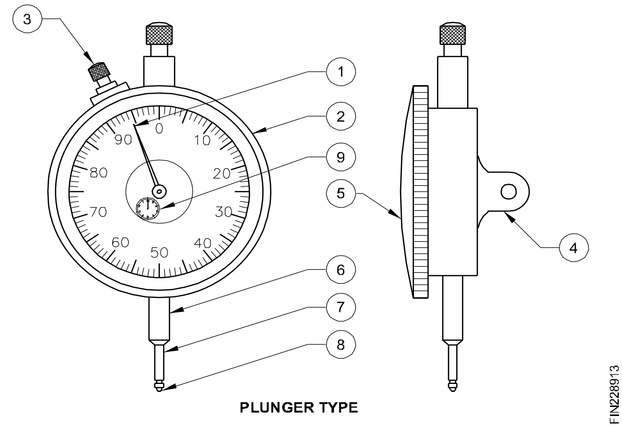
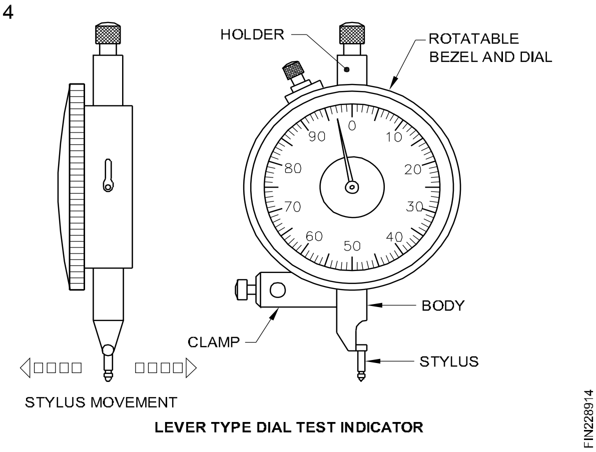


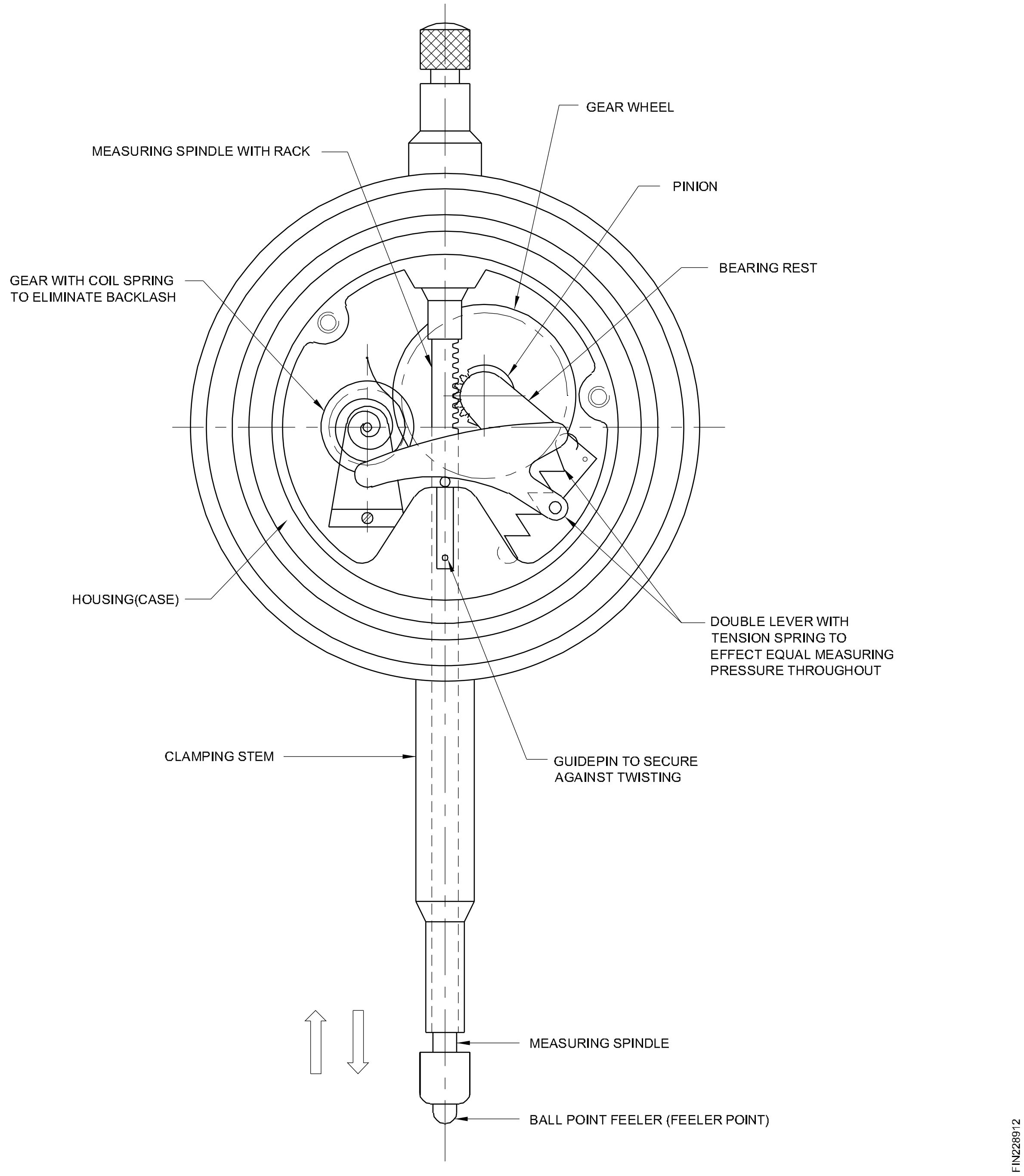
Fig 4



1 Pointer
2 Rotatable bezel
3 Bezel clamp
4 Back lug
5 Transparent dial cover
6 Stem
7 Plunger
8 Anvil
9 Revolution counter

For converting the linear motion of the plunger, a rack and pinion mechanism is used. (Fig 2)

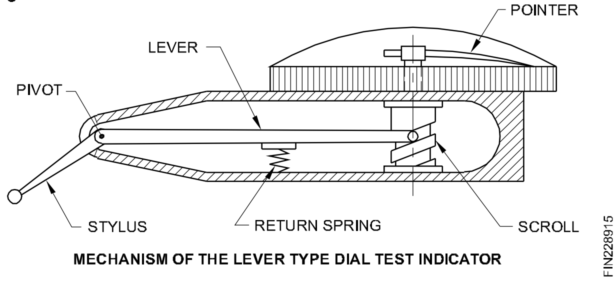
Fig 2



The lever type dial test indicator (Fig 4)

In the case of this type of dial test indicators, the magnification of the movement is obtained by the mechanism of the lever and scroll. (Fig 5)

Fig 5



MECHANISM OF THE LEVER TYPE DIAL TEST INDICATOR

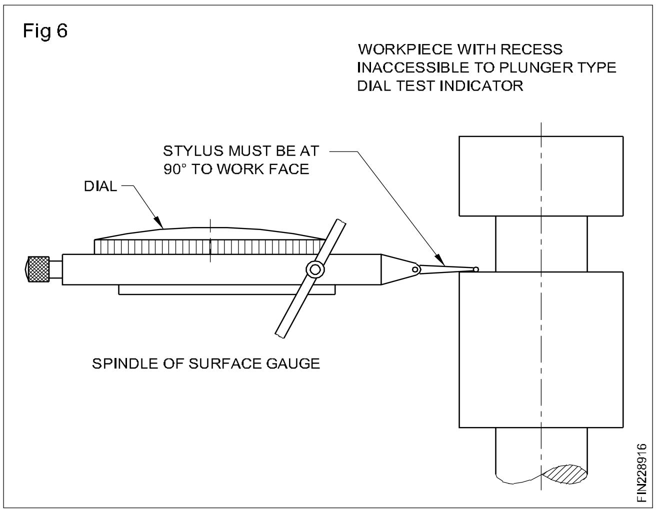
It has a stylus with a ball- type contact, operating in the horizontal plane.

This can be conveniently mounted on a surface gauge stand, and can be used in places where the plunger type dial test indicator application is difficult. (Fig 6)

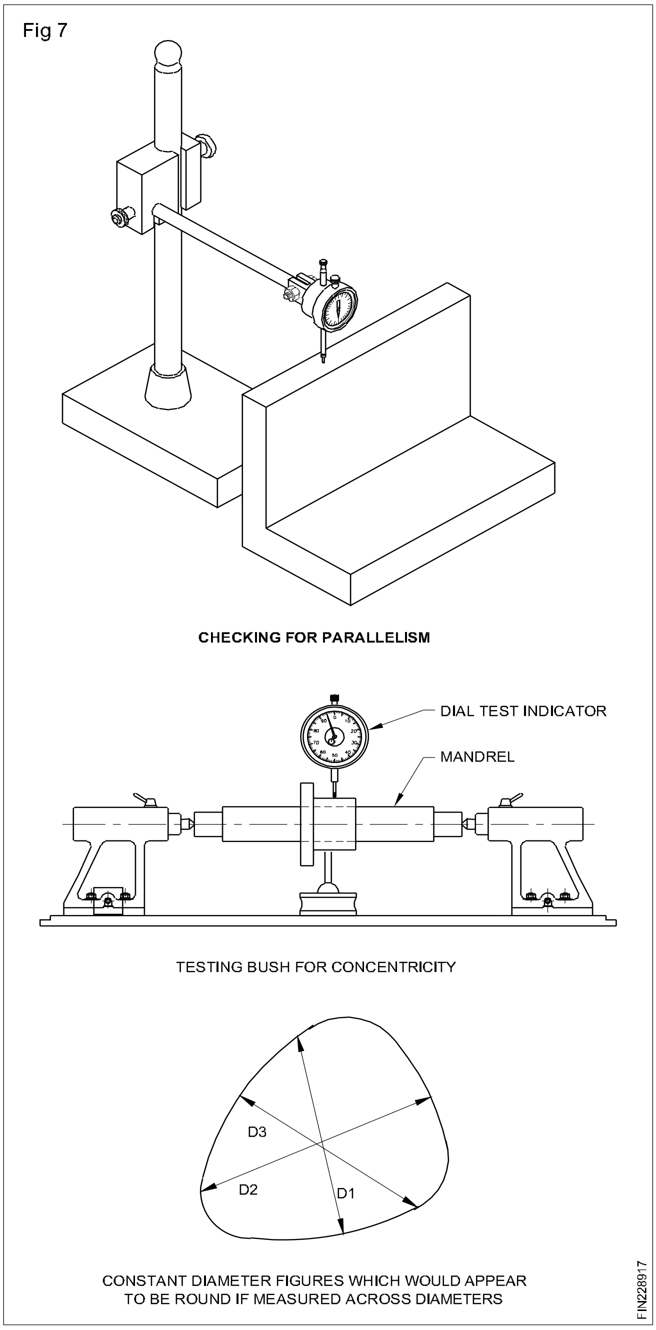
Important features of dial test indicators

An important feature of the dial test indicator is that the scale can be rotated by a ring bezel, enabling it to be set readily to zero.

Many dial test indicators read plus in clockwise direction from zero, and minus in the anti-clockwise direction so as to give plus and minus indications.



Uses (Figure 7 shows few applications)



To compare the dimensions of a workpiece against a known standard, eg.slip gauges.

To check plane surfaces for parallelism and flatness.

To check parallelism of shafts and bars.

To check concentricity of holes and shafts.

Indicator stands (Fig 8)

Dial test indicators are used in conjunction with stands for holding them so that the stand itself may be placed on a datum surface of machine tools.

The different types of stands are (Fig 9)

- Magnetic stand with universal clamp
- Magnetic stand with flexible post
- General purpose holder with cast iron base.

The arrows indicate the provisions in the clamps for insertion of the dial test indicator.

Care and maintenance of dial test indicator.

- Keep the dial test indicator spindle and point clean using a soft cloth.
- Store the dial test indicator in a safe, dry place and cover them to keep the dust and moisture out.
- Do the dial test indicator under gaging conditions at intervals during the operating day.

Fig 8

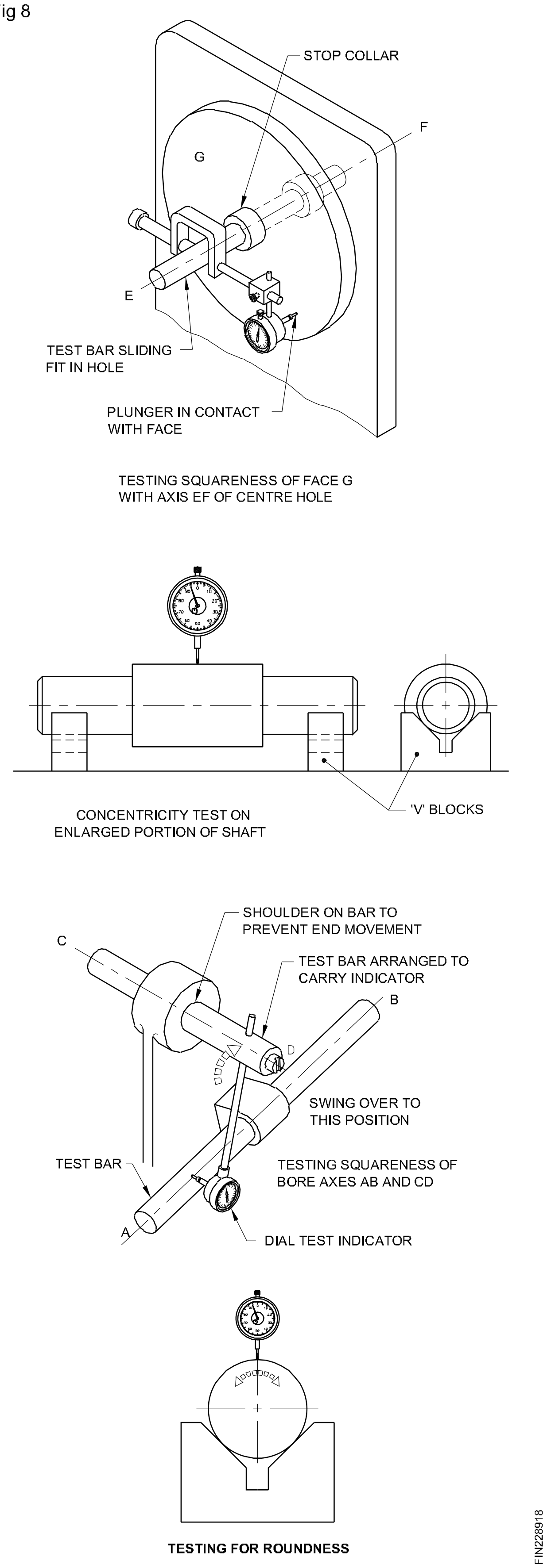

STOP COLLAR
F
G
E
TEST BAR SLIDING
FIT IN HOLE
PLUNGER IN CONTACT
WITH FACE
TESTING SQUARENESS OF FACE G
WITH AXIS EF OF CENTRE HOLE
CONCENTRICITY TEST ON
ENLARGED PORTION OF SHAFT
'V' BLOCKS
SHOULDER ON BAR TO
PREVENT END MOVEMENT
C
TEST BAR ARRANGED TO
CARRY INDICATOR
B
D
SWING OVER TO
THIS POSITION
TEST BAR
TESTING SQUARENESS OF
BORE AXES AB AND CD
A
DIAL TEST INDICATOR
TESTING FOR ROUNDNESS
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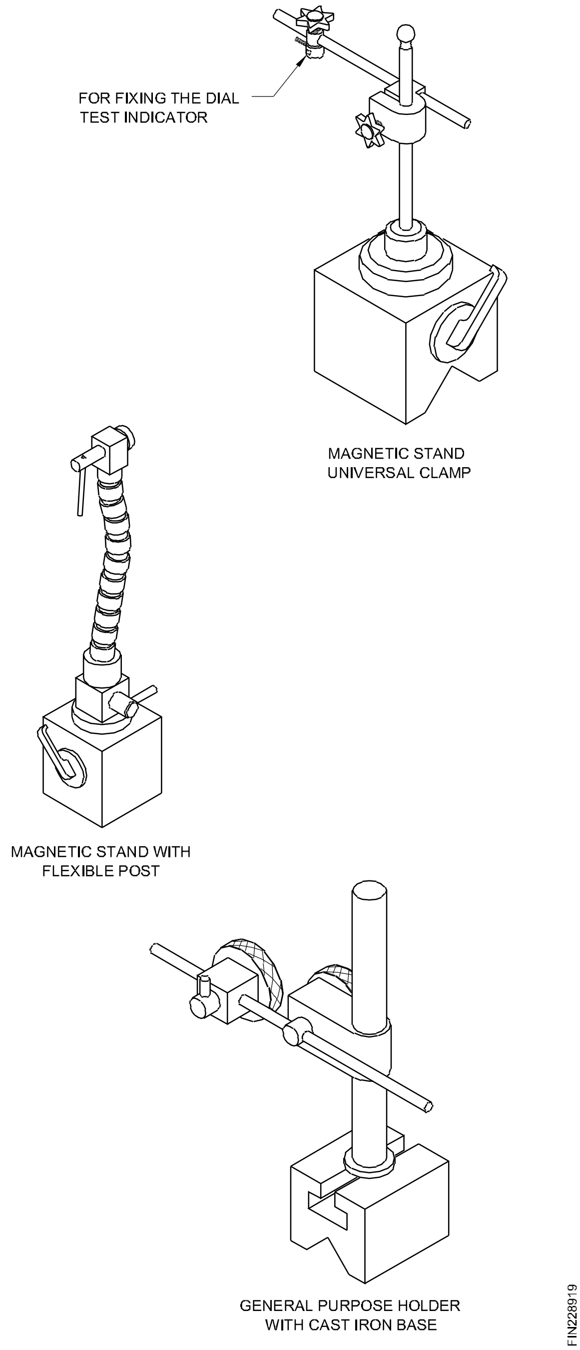
Fig 9


FOR FIXING THE DIAL
TEST INDICATOR
MAGNETIC STAND
UNIVERSAL CLAMP
MAGNETIC STAND WITH
FLEXIBLE POST
GENERAL PURPOSE HOLDER
WITH CAST IRON BASE
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Comparators

Objectives: At the end of this lesson you shall be able to
- **state the principle of working of comparator gauges**
- **state the essential features of a good comparator gauge**
- **state the purpose of a comparator gauge.**

Purpose of a comparator gauge

The purpose of all comparator gauges is to indicate the difference in the size between the standard (slip gauge or ring gauge) and the work being measured by means of some form of pointer on a scale at a magnification which is sufficient to read to the accuracy required. Almost every possible principle known to the Science of Physics for providing magnification has been used for the construction of these comparator gauges.

Essential features of a good comparator gauge

- Should be compact.
- Maximum rigidity.
- Maximum compensation for temperature effects.
- No backlash in the movement of the plunger and recording mechanism.
- Straight line characteristics of the scale readings.
- Most suitable measuring pressure which remains uniform throughout the scale.
- Indicator should be consistent in its return to zero.
- Method of indication should be clear and the pointer 'dead beat' (ie. free from oscillations).
- Should be able to withstand reasonable wrong usage.
- Should have a wide range of operations.

Principles of working

The following principles are employed in the commonly used comparator gauges.

- Mechanical
- Electronics
- Pneumatic
- Optical

Mechanical comparators

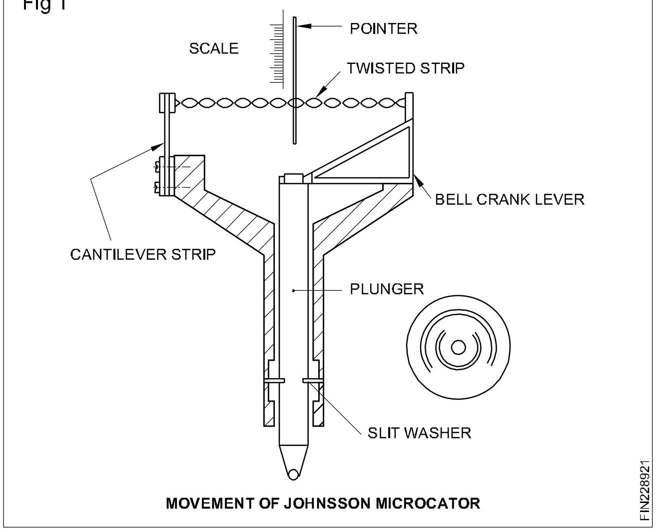
These are widely used and the familiar ones are the dial indicator fitted to the comparator stand, microcator, sigma comparator and red comparator.

Dial indicator fitted to the comparator stand.

Here, the plunger type dial indicator is used. The magnification is achieved by a suitable combination of gears, rack and pinion, steel band and levers. Generally the magnification range is between 100 or 1000 (least count 10 micron or 1 micron).

Microcator (Fig 1)

Fig 1



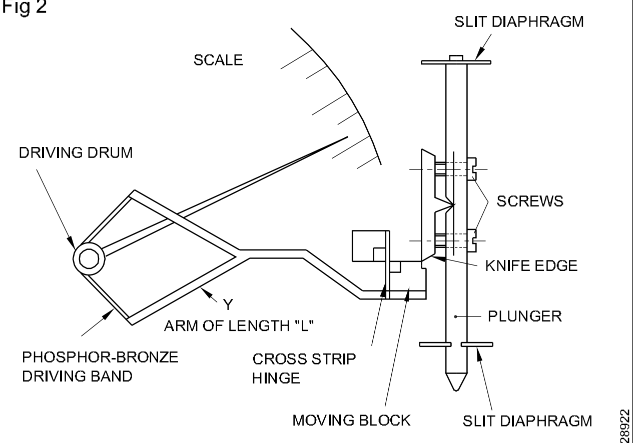
MOVEMENT OF JOHNSSON MICROCATOR

This is a simple and ingeneous design, giving a very high magnification up to 25000 times (0.02 μ ie. 0.00002 mm. least count) It is compact, robust and free from friction and backlash.

When the plunger moves up, the bell crank lever is tilted and the twisting strip elongates. The helix angle in the twisted strip reduces and this causes the pointer, which is fixed along the helix of the strip, to move to one side. This movement is then read on the scale fitted behind it. When the plunger moves down, the entire process of movement is reversed and the pointer moves to the opposite side and this reading is read against the scale.

Sigma comparator (Fig 2)

Fig 2



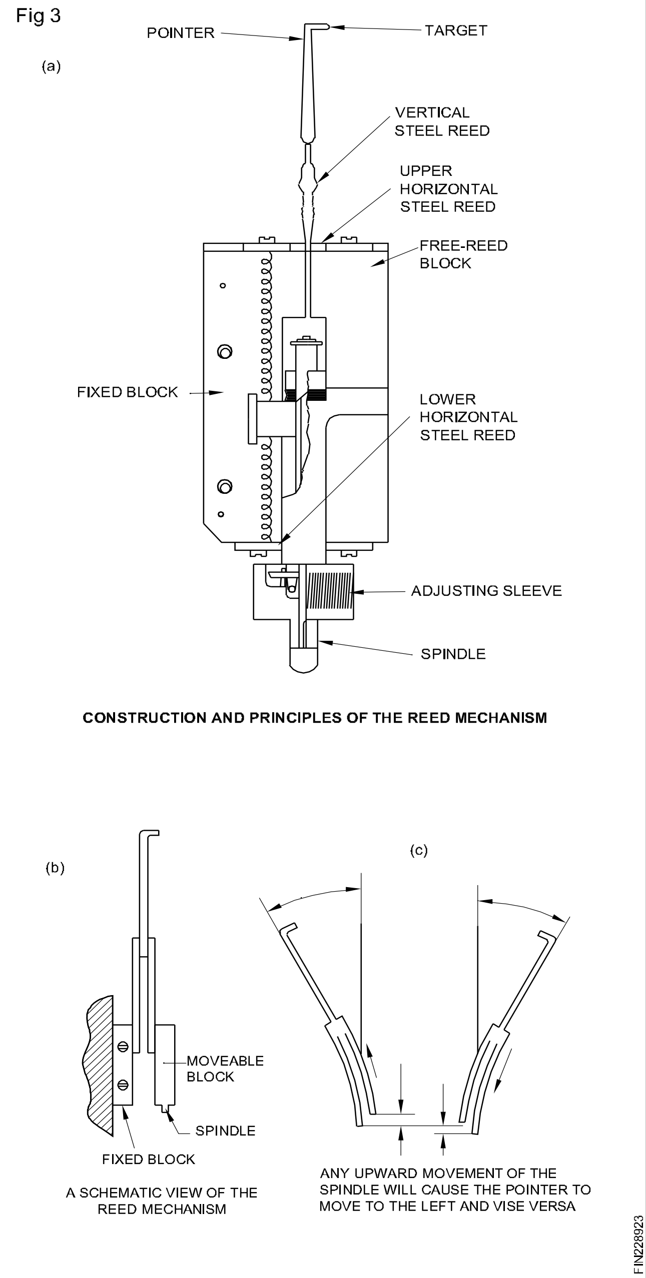
MOVEMENT OF SIGMA MECHANICAL COMPARATOR

This also gives a magnification of the same order as the microcator. When the plunger moves up, the knife edge resting on the sapphire bearing block also moves up, causing an imbalance to the hinged block which, in turn, causes the 'Y' arm to move down. The phospher-bronze band drives the drum and causes the pointer to move.

'Red' comparator

This design is also equally popular. Figures 3a, 3b and 3c explain the mechanism of this comparator.

Fig 3



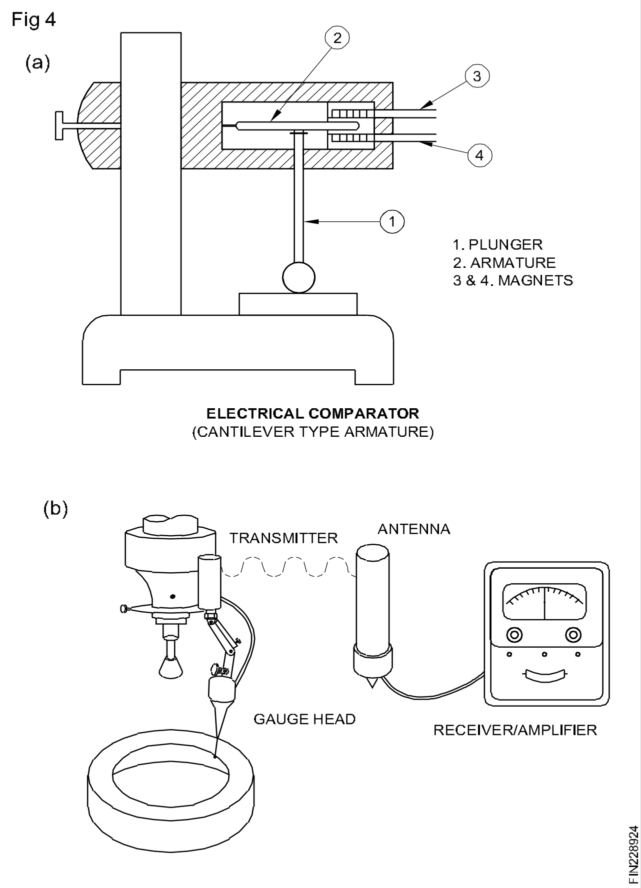
CONSTRUCTION AND PRINCIPLES OF THE REED MECHANISM

A SCHEMATIC VIEW OF THE REED MECHANISM

Electrical/Electronic comparator

These are power-amplified with a continuous analogue output. The electronic comparator offers advantages like widely adjustable magnification, electrical zero adjustment, adding or subtracting signals from a number of measuring heads, relay functions etc. (Figs 4a and 4b)

Fig 4



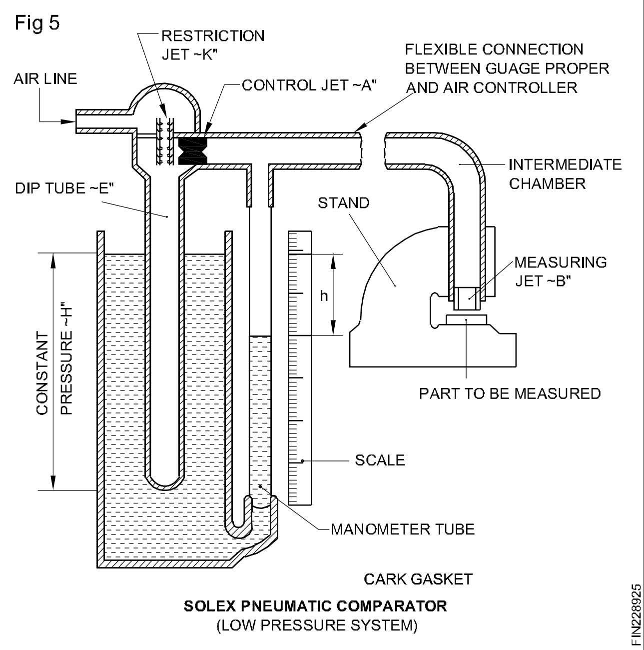
ELECTRICAL COMPARATOR
(CANTILEVER TYPE ARMATURE)

In Fig 4a, as the plunger (1) moves up, the armature (2) is lifted up, causing an imbalance in the electrical field created by the electromagnets (3 & 4). This causes an induced electromotive force in the circuits. These changes are amplified electronically to as much as 100000 times.

Fig 4b shows the electronic gauging system.

Pneumatic comparator (Fig 5)

Fig 5



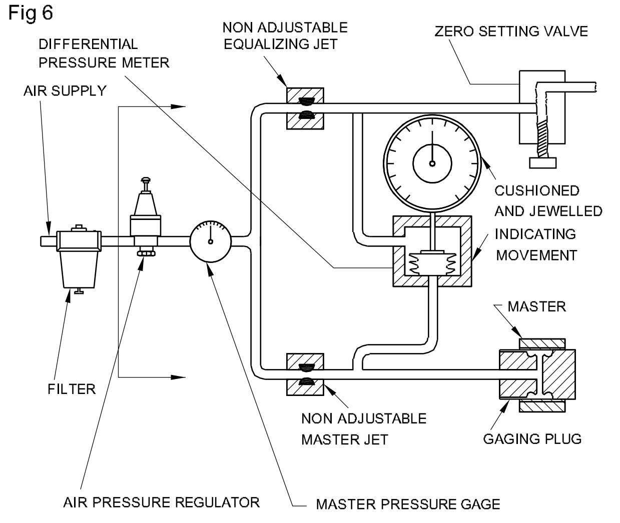
SOLEX PNEUMATIC COMPARATOR
(LOW PRESSURE SYSTEM)

This comparator is fast, rigid, accurate and suitable for use on the shop floor especially in mass production. As no mechanical contact exists between the gauge unit and the measured surface, these are used where other instruments are unsuitable. The air stream from the measuring jet also has a cleaning effect on the measuring surface.

In the figure, as the gap ‘d’ between the component and the jet ‘B’ decreases, the outflow of the air experiences some resistance to its free flow. This causes a back pressure in the air-line causing the liquid column inside the manometer tube to go down. When the distance ‘d’ increases, the liquid column in the manometer tube rises up. These variations ‘h’ are read from the scale fitted behind the manometer tube which correspond to the variations in ‘d’.

Fig 6 explains the pneumatic comparator wherein compressed air at 6 to 10 atmospheric pressure is made use of.

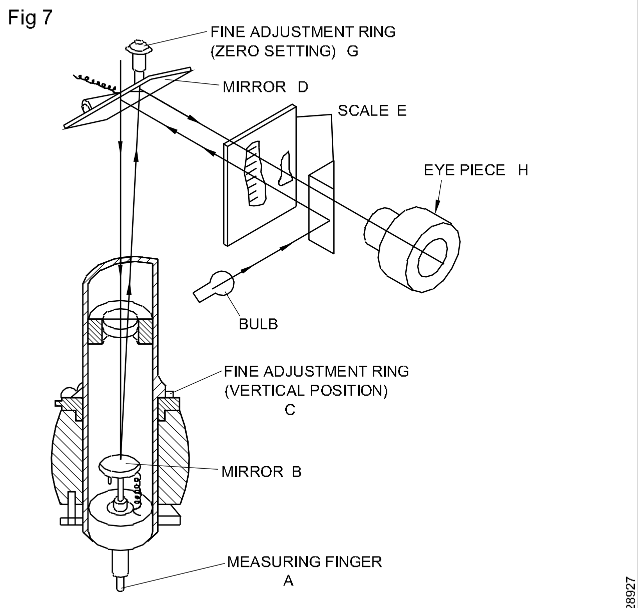
Fig 6



PNEUMATIC COMPARATOR
(HIGH PRESSURE SYSTEM)

Optical comparator (Fig 7)

Fig 7



OPTICAL SYSTEM OF COMPARATOR

These instruments employ the principle of reflection of light rays. Very large magnifications are attainable and the instrument is free from friction and backlash. Accuracy of measurements upto 1μ is possible with these comparators.

As the measuring plunger goes up, the light ray falling on mirror ‘B’ gets tilted and the tilted ray falls on mirror ‘D’ and gets reflected accordingly. This tilt in the light ray is read against the scale ‘E’ through the eyepiece ‘H’.

Digital dial indicator

Objectives: At the end of this lesson you shall be able to
- **define digital dial indicator.**

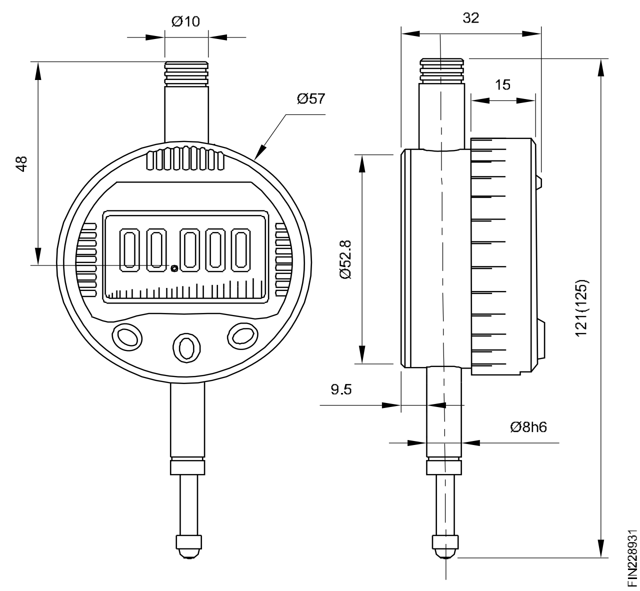
Digital dial indicator

With the advent of electronics, the clock face (dial) in some indicators are now a days replaced with digital displace (usually LCD's) and the dial readings are also replaced by linear encoders.

Digital indicators have some advantages over their analog predecessors, many models of digital indicator can record and transmit the data electronically through a computer, through an interface such as RS 232 or USB, this facilitates statistical process control (SPC), because a computer can record the measurement results in a tabular dataset (such as database table or spread sheet) and interpret them (by performimg statistical analysis on them). This obviates manual recordings of long columns of numbers, which not only reduce the risk of the operator by avoding errors (such as digit transpositions) but also really improves the productivity of the process by freeing the human efforts from time - consuming data recording and copying tasks.

Another advantages is that they can be switched between metric and british units by the press of a button, thus avoids the provision of separate unit conversion system.

Fig 1



Therefore the digital dial indicator is having more advantage over the ordinary dial indicator.

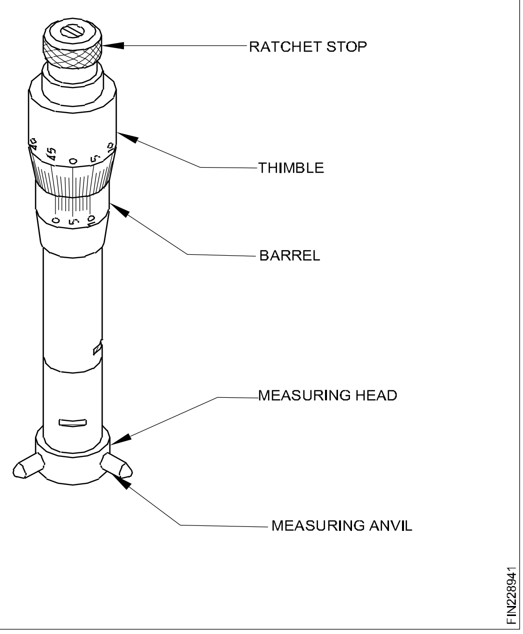
The digital dial indicator accuracy is 0.001mm in metric and 0.0001 inch in british.

Measurement of quality in cylindrical bore using three point internal micrometer

Objectives: This shall help you to
- **state the uses of a three-point internal micrometer**
- **identify the parts of a three-point internal micrometer**
- **state the features of the three-point internal micrometer.**

The three-point internal micrometers (Fig 1) are useful for:

Fig 1



- Measuring the diameters of through and blind holes.
- Checking cylindricity and roundness of bores.

The commonly used three-point internal micrometers have a least count of 0.005 mm.

Parts

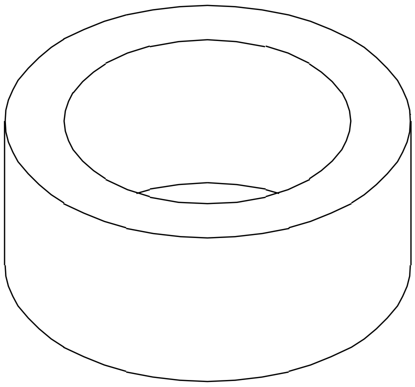
- Measuring head consisting of three measuring anvils
- Ratchet stop
- Thimble
- Barrel

This micrometer has a cone spindle which advances when the thimble is rotated clockwise. The movement of the cone spindle makes the measuring anvils to move forward and backward uniformly. The three measuring anvils facilitate self-alignment of the instrument within the bore.

Three-point internal micrometers are available in different sizes permitting measurement within a range.

The ratchet stop permits uniform pressure between the anvils and the work-surface being measured.

Fig 2



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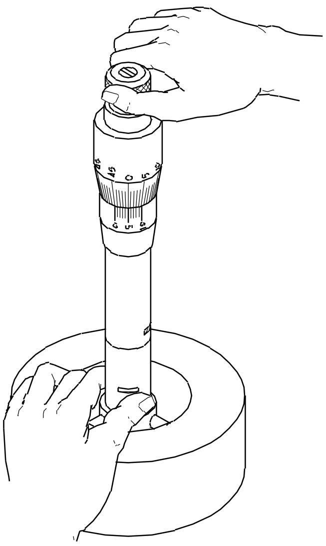
These micrometers are provided with one or more zero setting rings. (Fig 2)

Fig 3



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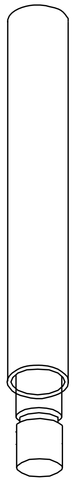
Before taking measurement, the zero setting has to be checked using setting ring. (Fig 3)

The position of the anvils can be reset by loosening the barrel using a screwdriver provided for this purpose.

Depending on the depth of the bore the length of the micrometer cab be varied using an extension rod. (Fig 4)

Fig 4



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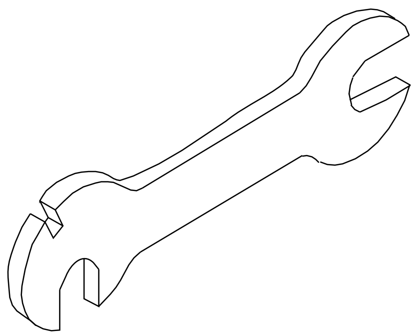
A spanner is provided for changing the extension rods. (Fig 5)

These instruments are available in various sizes for different uses.

They are also available in analogue or digital read-outs.

Fig 5



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