

The invention relates to a measuring pin for checking dimensions of a workpiece by means of a measuring device which is coupled to the measuring pin, in particular for determining two linear dimensions of a workpiece placed at right angles relative to each other by means of the same measuring device.

For the determination of linear dimensions in the micrometer- of millimeter range respectively, measuring devices are used which are very precise within a limited measuring range, for example mechanical measuring dials, electronic displacement gauges and the like. These measuring devices have proved themselves in particular in determining discrepancies in dimensions relative to a preset standard dimension, in determining the rotational accuracy of rotary workpieces, or in determining the position of a workpiece relative to a reference position. In many cases, however, the pin of the measuring device cannot be brought into direct contact with the object to be measured; therefore, a measuring pin is required which establishes the coupling between object and the measuring pin of the measuring device.

Generally known types of measuring pins operate unidirectionally linear, i.e. a linear change in dimension in a given direction (and in this direction only) is proportionally converted into an indication of the measuring means. For example, to measure dimensions, deviations in dimensions or a change in the dimensions of a workpiece in two different directions, the applied measuring device including the measuring pin had to be reset and newly aligned, or two measuring devices, which work independent of one another, were required.

This is reflected in requiring extra time for labour and/or financial investment.

The DE-OS 32 34 470 discloses a solution to registering, by means of a single one-dimensional path transmitter, a displacement of a measuring pin in the axial direction and a displacement of same in an axially vertical plane. Said construction uses a comparatively complicated system of lever hinges, linear ball guidance and ball-cone surfaces for converting the displacement of the measuring pin in the three spatial co-ordinates into one linear movement (of the measuring pin); if this is to be carried out with the required accuracy, then the manufacture and finishing of all the individual guiding members must be carried out at a considerable expense. This makes the device expensive and liable to breakdown.

It is the object of the present invention to avoid these disadvantages and to provide a simple measuring pin of robust construction, which allows measuring and detecting linear dimensions simultaneously in two directions which are vertical relative to one another at highest precision by means of a single measuring device.

This is achieved according to the invention by arranging a measuring pin according to claim 1 or 2.

Due to this type of arrangement, the effect of a measuring force onto a pin head in any direction always results in an identically or exactly opposite linear movement of the pin head in two directions which are vertical relative to one another, so that by way of a single measuring dial or other measuring device, the measuring probes of which can make contact at any surface of the pin head, a change in dimension can be measured, for example, both in the horizontal and the

vertical direction without having to change the measuring setup.

Preferred forms of embodiment and further developments of the inventive item are described in the dependent claims 3 to 5.

Below, an exemplary embodiment of the inventive item is described with reference to the enclosed drawings. The drawings show, in

- Fig. 1: a schematic side view of the measuring pin in its inoperative state;
- Fig. 2: a front view of the measuring pin according to Fig. 1, in the direction of arrow A;
- Fig. 3: a bottom view of the measuring pin according to Fig. 1, in the direction of arrow B;
- Fig. 4: a schematic side view of the measuring pin with a force P_1 or P_2 respectively applied to the probe head; and
- Fig. 5: a schematic side view of the measuring pin with a force P_3 or P_4 respectively applied to the probe head.

In the given example, the measuring pin, generally identified as 1, comprises of pin body 2 which is divided into a first section 3 and a second section 4. These two sections 3 and 4 are movable or displaceable relative to each other, as will be explained later.

The second section 4 is mounted to be fixed or of defined displaceability and arrestable relative to a workpiece to be measured; for this purpose, two fixing bores 4 can be provided, by which measuring-pin section 4 is anchored to a suitable, if appropriate adjustable holding means (not illustrated) of a measuring apparatus.

The first section 3 is movably connected to the second section 4 and carries a probe head 6, which in the given example is rigidly attached by means of a screw 7 to an extension 9 of the first section 3 of the pin body 2. Probe head 6 is composed of a cubic body with four measuring surfaces 10a - 10d. These measuring surfaces are processed plane and extend at an angle of exactly 90° relative to the respective adjacent measuring surfaces. Depending on application, at least two adjacent measuring surfaces (for example 10a and 10b) are exposed; in the given example, measuring surface 10c is also partly exposed, and measuring surface 10d also extensively exposed, i.e. loadable by a measuring force.

The movable coupling of the first section 3 to the second section 4 of pin body 2 is achieved by way of elastically deformable connecting members which extend at an angle of 45° relative to the measuring directions, i.e. relative to the measuring surfaces 10a - 10d. In the given example, two connecting members 11 and 12 are provided, which are part of pin body 2, which itself is made in one piece, i.e. sections 3 and 4 of pin head 2 are composed of one and the same body. The division into the two sections 3 and 4 is achieved in that several slots 13a - 13c and 14 are provided which separate the two sections 3 and 4 from one another.

Fig. 1 clearly shows that the pin body 2 has a lateral surface 15 which extends at an angle of 45° relative to the measuring surfaces 10a - 10d; this arrangement permits free access to measuring surface 10d. Parallel to this lateral surface 15, i.e. also at an angle of 45° , extends slot 13c a short distance away, for example in that a first connecting member 12 is formed;

this is the remaining material web in pin body 2 which connects first section 3 to second section 4.

Slot 13c runs via a slot 13b, which extends at right angles thereto (and which itself extends at an angle of 45° relative to the measuring surfaces 10a - 10d), into a slot 13a, which together with the latter slot 13b includes a right angle, thus extending parallel to slot 13c but at a certain distance therefrom. Finally, parallel to said slot 13a, at a short distance, is provided a slot 14, which extends up to the edge of pin head 2, so that a material web remains between it and slot 13a, which web forms the other connecting member 11.

As will be explained later, it is fundamental that webs 11 and 12, which serve as connecting members, extend at an angle of exactly 45° relative to the measuring surfaces 10a - 10d. On the other hand, it is not of decisive significance that the connecting members 11 and 12 are one-piece sections of the pin body 2; it is equally possible to construct sections 3 and 4 of pin body 2 as independent single parts and to interconnect them by way of two leaf springs (not illustrated). These will then take over the functions of webs 11 and 12, but it has to be ensured that the longitudinal extension of the leaf springs, in untensioned state, is at an angle of 45° relative to the measuring surfaces 10a - 10d.

If (according to Fig. 4) a force acts on the measuring surface 10a in the direction of the arrow P_1 , then it attempts to also move linearly in the direction of arrow P_1 . As the first section 3 of pin body 2, and thus probe head 6, is pivotably mounted to the second rigid section 4 of the probe body, probe head 6 is now caused to move in the direction of arrow P_1 and simultaneously in the direction of arrow P_2 . This is

because the first, movable section 3 is connected via the two webs 11 and 12, which extend at an angle of 45° relative to the measuring direction, to the second, rigid section 4. Thus, a type of pivot axes, around which the movable section 3 moves, is formed at their point of transition to the probe-body section 4, i.e. at points X and Y (Fig. 4).

Fig. 4 illustrates the maximum possible displacement position of probe head 6 under the effect of a force P_1 . It can be seen that the left-sided end of slots 14 and 13c is closed, whilst the left-sided end of slot 13a has increased relative to its breadth. By contact of the left-sided ends of the two webs 11 and 12 with the adjacent probe-body walls, a stop has been established which counters a further movement of section 3.

In practice, the maximum displacement path of probe head 6 relative to the rigid section 4 of pin body 2 is fractions of a millimeter, as an inventive pin head is generally used for precision measuring of a workpiece relative to a reference position, and not for absolute determination of a measurement. Therefore, the theoretical inaccuracy during the deformation of webs 11 and 12 is entirely insignificant as the displacement path is very small.

Exactly the same occurs when a measuring force is allowed to act on a measuring surface 10b in the direction of arrow P_2 . Although probe head 6 is theoretically inclined to deviate in the direction of the measuring force, it is forced to perform a diagonal movement between arrows P_1 and P_2 , as explained above. But it is thus achieved that a displacement of the probe head 6 in two directions which are vertical relative to one another (for example in the direction of arrow P_1 and in the direction of arrow P_2) can be

verified with only one measuring means, for example a measuring dial.

Kinematically exactly reversed conditions exist if the measuring pin is loaded with a measuring force in the direction of arrow P_3 or in the direction of arrow P_4 respectively; a situation of this type is illustrated in Fig. 5, again with maximum deflection of the movable section 3 relative to the rigid section 4 of the pin body 2. Here again, both a force in the direction of arrow P_3 and a force in the direction of arrow P_4 effect an identical displacement of probe head 6, which displacement can be determined, for example by means of a measuring dial. The only difference is that the displacement, compared to Fig. 4, is in the opposite direction.

The position of the contact point of the measuring means at measuring pin 1, for example the probing of the measuring probe of a measuring dial, is not critical as such as long as the surface is exactly plane at a defined angular position relative to the measuring directions. This suggests that the measuring probe be allowed to contact a measuring surface 10a...10d, which is not required for actual measuring, as those have the precision required for processing in any case. Another possibility lies in that head 8 of screw 7, which holds probe head 6, is constructed to be plane and that the measuring probe is set down thereat.

By way of the suggested inventive measuring pin, an instrument has been created which permits to check, by means of one single measuring means, two measuring directions which run vertical relative to one another, or to detect their change in position. For example, without constructive changes in the measuring setup, measurement discrepancies of a workpiece can be detected both in the horizontal and in the vertical

position. Another important possibility of application is to be seen in that a change in shape of a workpiece or the exact positioning of same can be detected by means of one single measuring means, for example the transition of the end-sided conical part of a helical drill into the cylindrical drill section.

Patent Claims



1: Measuring pin for checking dimensions of a workpiece by way of a measuring device which is coupled to the measuring pin (1), in particular for determining two linear dimensions of a workpiece placed at right angles relative to each other, by means of the same measuring device, characterised in that the measuring pin (1) is composed of a one-piece pin body (2), which is divided into two sections (3, 4) which are displaceable against each other, in which respect the first section (3) has attached to it a probe head (6) for abutment against the workpiece to be measured, which head is effectively connected to the measuring device and is formed by a cubic body, which is fixed to the first section (3), which has at least two freely disposed measuring surfaces (10a - 10d) including an angle of 90° , and whereby the second section (4) is connected to said first section (3) by way of elastically deformable connecting members (11, 12), which extend at an angle of 45° relative to the measuring surfaces (10a - 10d) of the probe head, whereby the one-piece pin body is divided into said first and second sections (3, 4) by way of slots (13a, 13b, 13c, 14) arranged in the pin body (2) at an angle of 45° relative to the measuring surfaces for the purpose of forming the connecting members.

2: Measuring pin for checking dimensions of a workpiece by way of a measuring device, which is coupled to a measuring pin (1), in particular for determining two linear dimensions of a workpiece, placed at right angles relative to each other,



characterised in that the measuring pin (1) is formed by a pin body (2), which is divided into two sections (3, 4) which are displaceable against each other, in which respect the first section (3) has attached to it a probe head (6) for abutment against the workpiece to be measured, which head is effectively connected to the measuring device and is formed by a cubic body, which is fixed to the first section (3), which has at least two freely disposed measuring surfaces (10a - 10d) including an angle of 90°, and whereby the two sections (3, 4) of the pin body (2) are formed by separate elements, and thereby the second section (4) is connected to the said first section (3) by way of two leaf-spring elements, which extend at an angle of 45° relative to the measuring surfaces (10a - 10d) of the probe head (6).

3: Measuring pin according to claim 1, characterised in that at least one connecting member (11) is formed between said first and second sections (3, 4) by way of a narrow material web of the pin body (2), disposed between two of the slots, which extend in parallel.

4: Measuring pin according to claim 1, characterised in that at least one connecting member (12) is formed between the said first and second sections (3, 4) by a narrow material web of the pin body (2), which is disposed between an outer edge (15) of the pin body (2), extending at an angle of 45° relative to the measuring surfaces (10a - 10d), and one of the slots (13c), which extends parallel to the outer edge (15).



5: Measuring pin according to one of the above claims, characterised in that the displacement movement of the two interconnected pin-head sections (3, 4) is limited.