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[54] MICROMETER WITH DIGITAL READING

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[52] **U.S. Cl.** **33/166,** 116/115
[51] **Int. Cl.** **G06m 1/00**
[58] **Field of Search** .... 33/166, 164 R; 116/115

[56] **References Cited**

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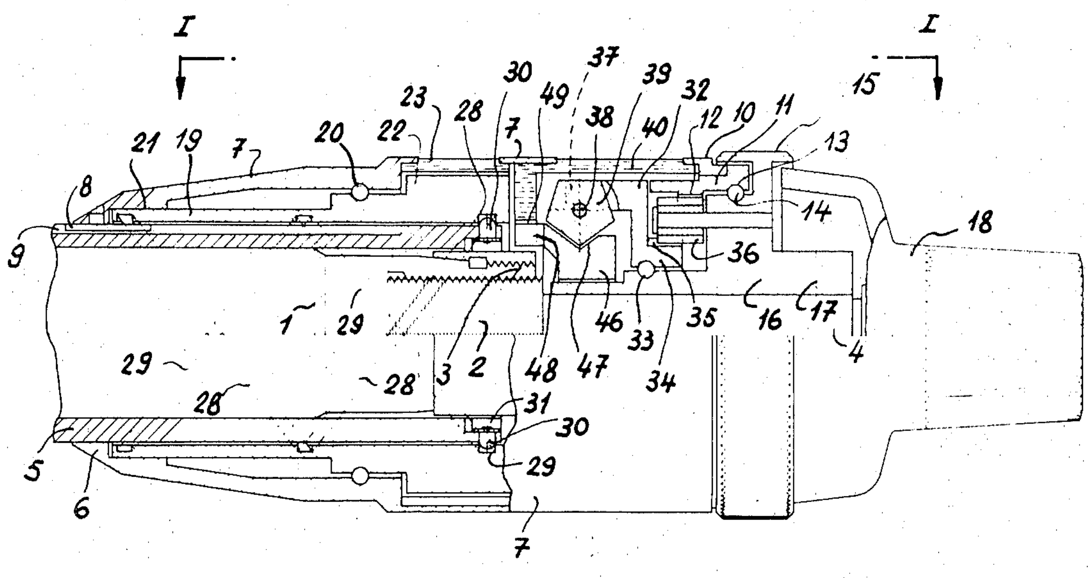
[57] **ABSTRACT**

This invention relates to a micrometer with digital reading comprising a micrometer screw, a body axially fixed to said micrometer screw and angularly fixed relative thereto, and prisms whose faces carry figures rotating in the body in front of a window made in said body.

4 Claims, 3 Drawing Figures



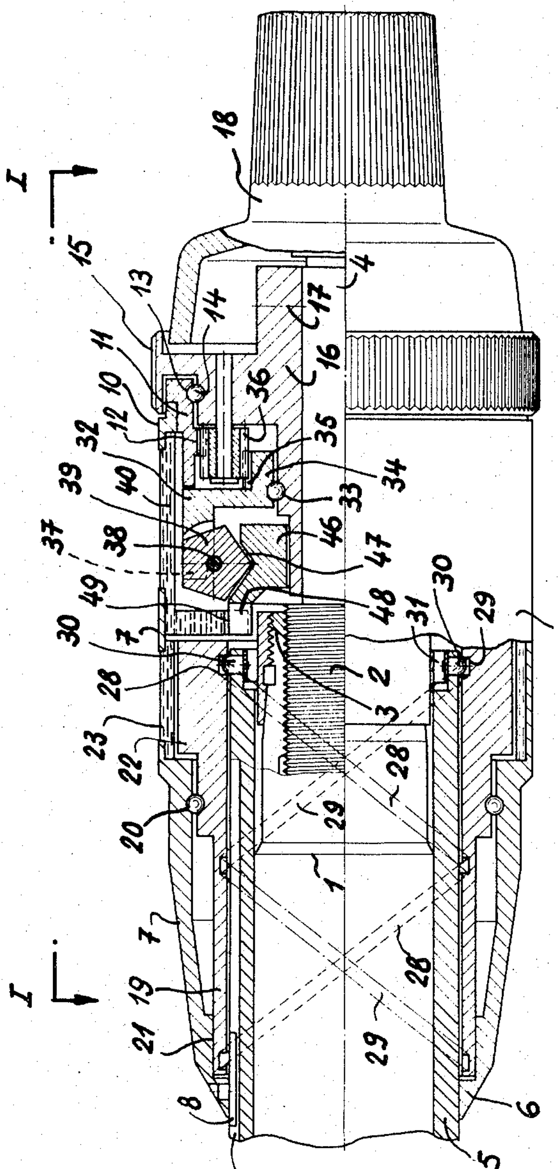


FIG. 1

FIG. 2

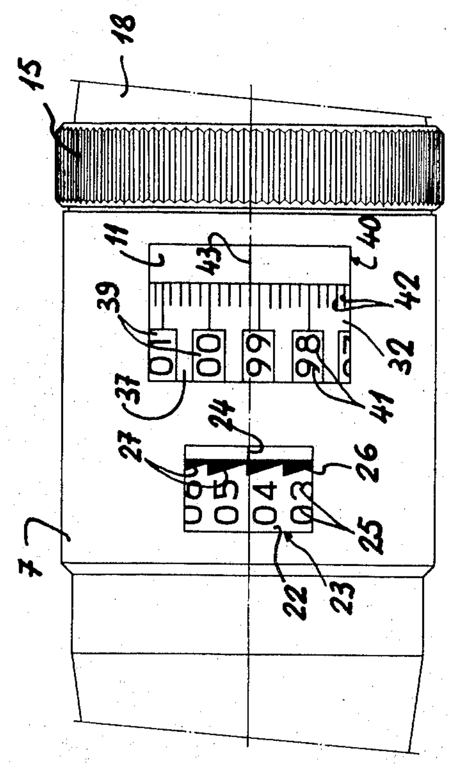
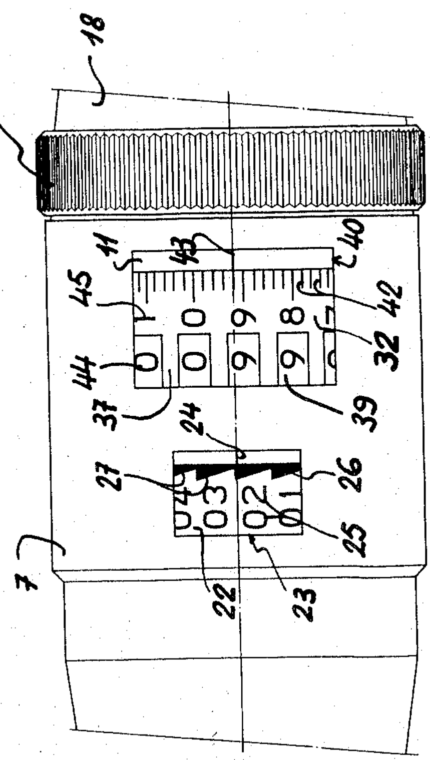


FIG. 3



MICROMETER WITH DIGITAL READING

The present invention relates to a micrometer with digital reading comprising a movable micrometer screw engaged in a fixed support and a body axially fixed to said micrometer screw, said body being angularly fixed relative to the micrometer screw and wherein the prisms whose faces carry the figures rotate individually in the body on axes tangential to an imaginary circle concentric to the axis of the micrometer screw, the assembly of prisms being rotated by the micrometer screw concentrically relative to the axis of said micrometer screw and moving in front of a window made in said body, the individual rotation of said prisms being assured by a cam which is angularly fixed and in engagement with said prisms.

Micrometers are already known wherein the individual rotation of the rotating prisms is assured by a cam fixed to the casing of the system and acting axially on the prisms, i.e. the cam is arranged on the side of the prisms and whereby the active surface or surface which is in engagement with the prisms is orientated towards said prisms according to a general direction parallel to the axis of the micrometer screw. However, this arrangement has serious disadvantages among which can be mentioned a large size in the axial direction and more particularly the fact that contact between the prisms and the cam can be interrupted if the member carrying the prisms has a slight axial play, which is substantially inevitable. In fact due to the fact that it is placed beside the prisms the cam cannot follow them if they move in the axial direction and as the interpenetration of the engaging surfaces is relatively poor the prisms can move away sufficiently from the cam to turn freely which completely falsifies the reading.

An attempt to eliminate this shortcoming led to the dissociation of the cam from the casing in such a way as to be able to move it parallel to the axis of the micrometer screw to compensate the axial play of the member carrying the prisms. However, this requires the use of shims to axially position the cam which significantly complicates the assembly of the system because it is necessary to accurately adjust the cams and in addition the tolerance of the member carrying the prisms can subsequently vary which requires new adjustments while there is still a danger of loss of contact between prisms and cam.

The micrometer according to the invention has for its object the elimination of said shortcomings. It is characterised in that it comprises a radially revolving cam angularly fixed to the body concentric to the axis of the micrometer screw and arranged between the prisms with which it is in engagement according to a radial direction relative to the axis of the micrometer screw.

The attached drawing shows as an example an embodiment of the object of the invention.

FIG. **1** is a partial longitudinal section of the main embodiment;

FIG. **2** is a view along I—I of FIG. **1**;

FIG. **3** represents the modified embodiment viewed in part from above.

The micrometer shown in FIGS. **1** and **2** comprises in known manner a guidance tube **1** wherein is centered in engagement a micrometer screw **2**, the engagement of the micrometer screw **2** in the guidance tube **1** being controlled by a tolerance compensation system **3** which is also known and will not be described in detail here. The micrometer screw **2** is extended by a rear pin **4** and a front pin, not shown, and controlling the movable feeler or feelers of the instrument.

On he guidance tube **1** is fixed a coaxial tubular support **5** whereon is slidingly mounted the front portion **6** of a sleeve **7** comprising a guidance shoe **8** engaged in a longitudinal groove **9** made along the tubular support **5** parallel to the axis thereof. Therefore the sleeve **7** can slide along support **1** while remaining angularly fixed thereto. The rear portion **10** of sleeve **7** is fixed, for example, driven onto a ring **11** carrying an internal toothing **12.** Ring **11** has a roller path **13** wherein are located balls **14** via which a control drum **15** is mounted rotatably on said ring **11** and therefore on sleeve **7.** This control drum **15** comprises a hub **16** engaged on the rear pin **4** of the micrometer screw **2,** said hub **16** being fixed to said pin **4** by a screw shown schematically by the broken line **17.** The free end of the pin **4** is engaged in a control ratchet **18** contiguous with drum **15,** said control ratchet not being described in greater detail because it can be made in any adequate or known manner. Thus on rotating ratchet **18** or control drum **15** the micrometer screw **2** is also turned and moves axially in the guidance tube **1.** Simultaneously drum **15** which is fixed to pin **4** moves axially and drives sleeve **7** to which it is axially fixed as a result of the coupling of ring **11** and balls **14.** Thus, with any axial movement of the micrometer screw **2** corresponds an identical and simultaneous axial movement of sleeve **7** which however remains angularly fixed.

On hub **16** of control drum **15** is rotatably mounted a ring **32** which is axially fixed to said hub **16,** the mounting of ring **32** on hub **16** being assured by a ball race schematically represented at **33.** Ring **32** has a hub **34** with peripheral teeth **35.** On drum **15** is rotatably mounted a pinion **36** out-of-centre relative to the axis of drum **15** and meshing on the one hand with the teeth **12** of ring **11** which is fixed to sleeve **7** and on the other with the peripheral teeth **35** of the hub of ring **32.** This system serves as a planetary gearing and when drum **15** is rotated pinion **36** is on the one hand rotated on its axis in the reverse direction due to its engagement with teeth **12** which are fixed and on the other it drives the rotary ring **32** via its teeth **35** in the same direction as drum **15** but at a different rotational speed. However, this arrangement is not limitative and the drive of the rotary ring **32** by drum **15** can be direct and if desired the rotation speeds can be identical.

The rotary ring **32** has in known manner a series of lateral arms **37** forming a type of cage and between which are mounted rotatably on shafts **38** prisms **39** with five faces. The prisms **39** are arranged concentrically relative to the pin **4** and their axes are respectively tangential to an imaginary circle concentric to pin **4.** It should be noted that although in the example described the prisms **39** each have five faces it is possible to use prisms having a different number of faces, for example, four or six faces. The rotary ring **32** as well as the prisms **39** move in front of a window **40** arranged in the wall of sleeve **7.** Window **4** has dimensions such that it is possible for the corresponding faces of several prisms **39** to appear simultaneously.

On each of the faces of prisms **39** are marked two FIGS. **41** (FIG. **2**) corresponding to fractions of the units of the scale chosen to indicate the measurements performed by the instrument, for example, tenths and one hundredths of units while the rotary ring **32** carries lines **42** corresponding to fractions of the figures indicated on prisms **39** for example thousandths of units. The fixed ring **11** has a reference line **43.** As illustrated on the variant of FIG. **3** the faces of each of the prisms **39** may only have a single FIG. **44** corresponding to a fraction of the unit of the scale, whereas FIGS. **45** corresponding to another fraction of said units, for example, hundredths of units can be marked on ring **32** which also carries lines **42** serving as a reference for the fractions of FIGS. **45.**

On hub **16** is mounted so as to slide freely with a certain radial play thereon a disc **46** whose rim is shaped in such a way to form a radially revolving cam **47** concentric to pin **4.** This disc **46** is placed in the circular surface formed by the system of prisms **39** and cam **47** is in engagement with said prisms which it acts upon radially relative to pin **4.** The dimensions of disc **46** are such that there is a certain play between cam **47** and prisms **39.** Disc **46** has a lateral arm **48** which is slidingly engaged in a stop member **49** integral with sleeve **7** whereby said assembly is provided to prevent rotation of disc **46** and consequently cam **47** while leaving the possibility of moving axially and radially relative to pin **4** and prisms **39.**

Thus when rotary ring **32** is rotated it drives prisms **39** which slide along the radial cam **47** which remains fixed. Prisms **39** thus follow the profile of radial cam **47** which has the effect of making them rotate. Depending on the rotation ratio selected for the rotary ring **32** and prisms **39** the number of prisms **39** and the number of faces thereof as well as the unit chosen it is possible to cause to pass in front of window **40** and in front of reference **43** the successive figures corresponding to the fractions of the unit chosen to indicate the displacements of the micrometer screw **2.** Therefore to each turn of the micrometer screw **2** corresponds a sequence of figures indicating for example tenths and hundredths of units the lines **42** of ring **32** supplying in this case an indication of thousandths of units. Taking account of the possibilities of varying the rotation ratios between the pin **4,** ring **32** and prisms **39** and due to the fact that the number of prisms **39** and the number of their faces can be selected randomly the system is obviously applicable to all desired unit divisions, as well as to metric measurements and measurements in inches.

The control of the rotation of the prisms **39** on their shafts **38** by means of the radial cam **47** offers numerous important advantages compared with the known systems.

In fact the cam described is radial, i.e. it is arranged between the prisms and its active surface or contact surface with the prisms is oriented towards the same in a general direction which is perpendicular to the axis of the pin. This results in a considerable space saving in the axial direction. Moreover due to the fact that the cam is radial and arranged between the prisms its active or contact surface with the prisms cannot move away from the same so as to permit them to rotate freely. Moreover as described hereinbefore the radial cam can be made to float, i.e. it can slide freely in the axial direction and have a certain radial play so that it is able to follow all the axial movements of the prisms and even adapt to any possible inequalities in their radial position. Thus, auto-centering occurs and there is a total elimination of the danger of dislodging the prisms. Finally, for a given size the radial cam can have its diameter greatly reduced which permits a further increase in the dimension of the prisms whose faces can carry larger figures facilitating the reading thereof.

In addition to the described system for the digital reading of fractions of the units of the chosen scale the micrometer has a construction permitting the digital reading of units of a scale chosen to indicate the measuring range of the instrument. Although this construction does not form part of the invention it will be briefly described hereinafter to improve the general understanding and with reference to the attached drawing.

This construction comprises mounted rotatably in sleeve **7** a tubular member **19** which is coaxial to the tubular support **5** and which is axially fixed to said sleeve **7.** The axial mounting and guidance of the rotation of tubular member **19** in sleeve **7** is assured by a ball race fixed to sleeve **7** and schematically represented at **20** and by a bearing **21.** One portion **22** of member **19** is arranged beneath a window **23** placed in the wall of sleeve **7** beside window **40** and relative to which is marked a reference line **24** (FIGS. **2** and **3**).

On the periphery of portion **22** of tubular member **19** which faces window **23** are aligned one above the other all the successive FIGS. **25** (FIGS. **2** and **3**) of the units of the scale chosen to indicate the measuring range of the instrument. Window **23** of sleeve **7** has dimensions such that at least three of the FIGS. **25** are visible simultaneously in order to avoid ambiguities of reading during the passage from one figure to the next.

Beside the FIGS. **25** the periphery of portion **22** of tubular member **19** has a marking **26** (FIGS. **2** and **3**) constituted by a succession of marks **27** in saw tooth form arranged so as to indicate the measuring range corresponding to each unit figure, i.e. all the values between **1** unit figure and the next unit figure. Thus, with reference to FIG. **2** it can be seen that reference **24** is adjacent to the top of saw tooth **27** corresponding to FIG. 04, which indicates that the measurement performed by the instrument is slightly below five units, i.e. one is in the four unit range or in other words four units plus a certain number of fractions of a unit. The reference **26** thus facilitates the reading of the ranges corresponding to FIGS. **25.**

The inner wall of tubular member **19** is hollowed out by two diametrically opposed helical grooves **28** and **29** and whereof the pitch is equal to the measuring range of the instrument. In each of the helical grooves **28** and **29** is introduced a tenon **30** which is axially and angularly fixed relative to tubular member **19,** said tenons **30** being diametrically opposed and respectively fixed on an elastic ring **31** located in tubular support **5** whereby each of the tenons **30** traverse the wall of said tubular support **5** to become located respectively in the helical grooves **28** and **29.**

As indicated hereinbefore sleeve **7** is axially fixed to micrometer screw **2** and follows the movements thereof whilst remaining angularly fixed. However, tenons **30** are axially and angularly fixed and tubular member **19** is axially fixed to sleeve **7** while being angularly free because it is rotatably mounted in said sleeve **7.** Moreover tenons **30** are engaged in helical grooves **28** and **29** of tubular member **19.** It follows that on axially displacing sleeve **7** tubular member **19** also moves axially. However, tenons **30** are engaged in helical grooves **28** and **29** of tubular member **19** and can only permit the axial displacement of tubular member **19** when they slide along the helical grooves **28** and **29.** As tenons **30** are fixed their sliding in the helical grooves has the effect of rotating tubular member **19** about its axis. The pitch of helical grooves **28** and **29** being equal to the measuring range of the instrument, the tubular member **19** performs a complete revolution about its axis for a displacement of sleeve **7** and micrometer screw **2** equal to the measuring range of the instrument. All the FIGS. **25** of the units of the scale chosen to indicate the measuring range of the instrument which are aligned like reference **26** in the periphery of portion **22** of tubular member **19** thus pass in front of window **23** and permit a digital reading of the units of the scale.

Thus the indication of the units with the aid of tubular member **19** combined with that of the fractions of units given by prisms **29** and pin **32** permit a digital reading of the measurements performed by the instrument and as a result of the relative position of the two indicating systems the digital reading takes place in the normal reading direction, namely from left to right for the units and their fractions. However it is obvious that the indication of the fractions of unit with the aid of pin **32** and prisms **39** controlled by the radial cam can be combined with any other system for reading units.

What we claim is:

1. A micrometer with digital reading comprising:

a. a movable micrometer screw threadedly engaged in a fixed support;

b. a body axially fixed to said micrometer screw, said body angularly fixed to said support;

c. a bushing coaxial to said micrometer screw and rotatably arranged in said body, said bushing movable with said micrometer screw;

d. a plurality of indicator prisms whose faces carry a plurality of digits, each of said indicator prisms rotatably mounted on a shaft secured to said bushing tangentially to an imaginary circle concentric to the axis of the micrometer screw;

e. a window disposed in said body and exposing some of said indicator prisms to view; and

f. a radial cam mounted under all the indicator prisms, said radial cam angularly fixed to the body and arranged therein concentrically to the axis of the micrometer screw, said radial cam engaging said prisms according to a radial direction relative to the axis of the micrometer screw, whereby said indicator prisms are rotated upon their shafts as said bushing is rotated.

2. A micrometer according to claim **1**, wherein the radial cam is slidably mounted with a certain radial play on a support member coaxially connected to the micrometer screw.

3. A micrometer according to claim **1**, whrein the radial cam is slidably mounted with a certain axial play on a support member coaxially connected to the micrometer screw.

4. A micrometer according to claim **1**, wherein the radial cam is slidably mounted with a certain radial and axial play on a support member coaxially connected to the micrometer screw.

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