Aug. 17, 1954 J. WALKER ET AL 2,686,370

APPARATUS FOR INDICATING A DEVIATION OF THE PROFILE OF AN ARTICLE FROM A STANDARD

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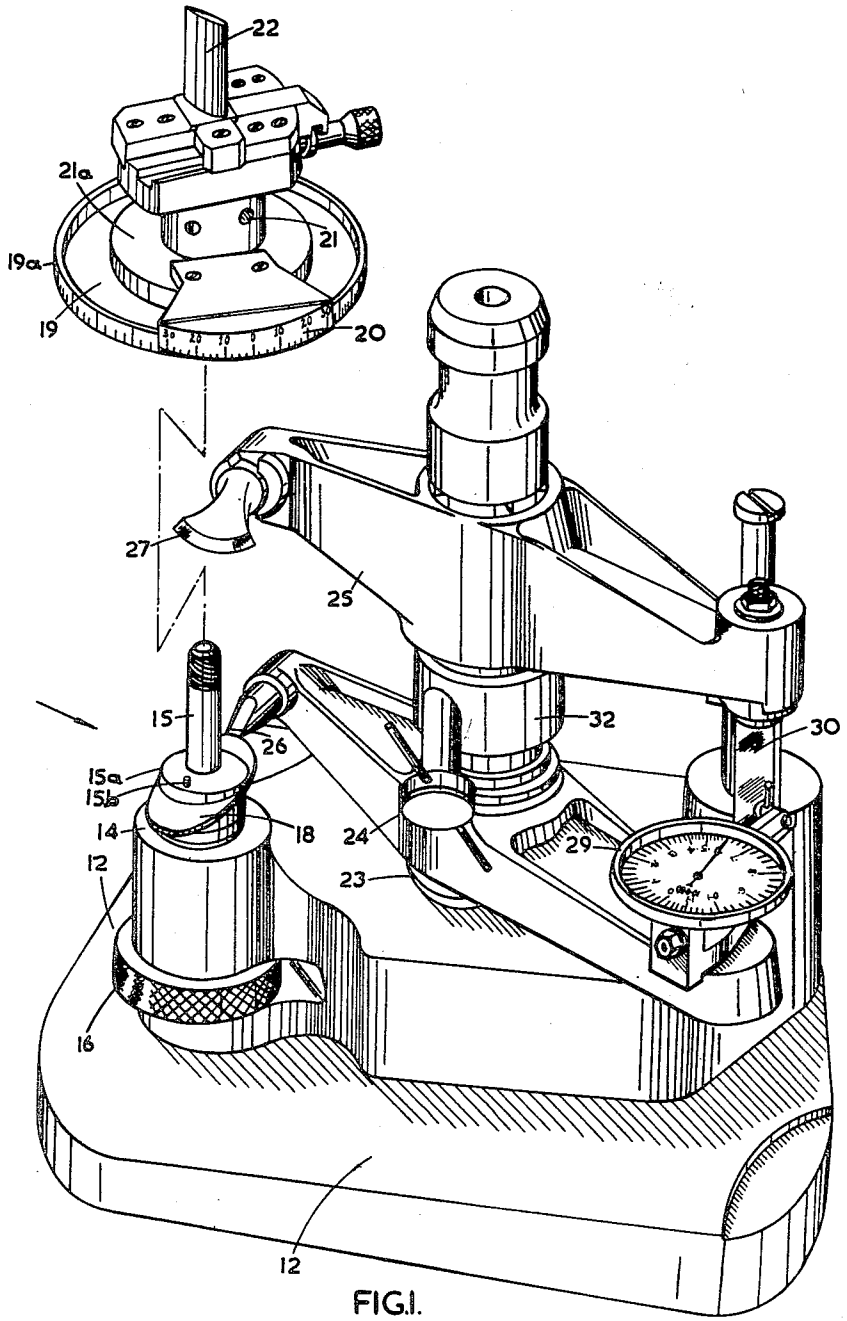


FIG.1.

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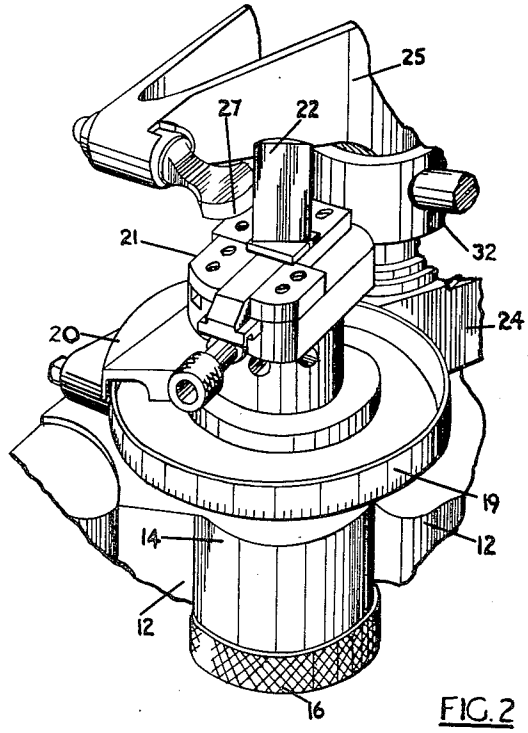


FIG. 2

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Patented Aug. 17, 1954

2,686,370

UNITED STATES PATENT OFFICE

2,686,370

APPARATUS FOR INDICATING A DEVIATION OF THE PROFILE OF AN ARTICLE FROM A STANDARD

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Application December 19, 1950, Serial No. 201,598

5 Claims. (Cl. 33—174)

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The invention relates to an apparatus for indicating a deviation of the profile of an article from a standard profile. It has particular reference (although not limited in this respect) to the checking of the profiles of turbine blades, cams, and the like.

Our main object is to provide an apparatus for the purpose which will be simple to use and which will enable the profile of the article very quickly and accurately to be checked, without there being any necessity for a high degree of skill on the part of the operator.

A further object is to provide an apparatus which includes coaxial, mutually-rotative supports for the article and the standard, and a pair of coaxial and independently pivoted gauge arms biassed for tracers thereof respectively to engage the article and the standard, the arms being so associated with an indicator that relative pivotal movement of the arms, consequent on a deviation of the profile of the article from the standard profile, will actuate the indicator.

These and other objects and advantages will be apparent, it is believed, from a consideration of the following description.

In the accompanying drawings:

Figure 1 is a perspective view of one form of apparatus according to the invention, but with the article and its support detached from its mounting, and with a graduated dial (for indicating the angular position of the article) detached from the said support; and

Figure 2 is a perspective view (to a larger scale), approximately in the direction of the arrow 2 of Figure 1, mainly of the standard and the article in assembled position on their mutually-rotative supports.

In the drawings, the stationary frame or base of the apparatus is shown at 12. It provides a tubular block 14 for the support of a vertical spindle 15 fast with an actuating member 16, shown as a knurled wheel. Located upon the spindle, above the tubular block 14, is first the standard 18, and above the standard the graduated dial 19. The latter coacts with a vernier scale indicator 20 fast with the support 21 for the article 22. The latter support is adjustable angularly on the spindle, in any usual manner, for setting up purposes.

The base also carries a vertical pillar (just appearing at 23 in Figure 1) on which are journalled the two arms 24, 25, the former carrying a round-nosed tracer 26 to engage the periphery of the standard 18, and the latter a tracer with an arcuate edge 27 to engage the article 22. Tension springs biassing the arms are not shown.

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The support 21 for the article 22, and the dial 19 are shown detached in Figure 1 so as not to obscure other parts, but their relative positions when assembled are shown in Figure 2. That is to say, the disc 19 rests, with its flange 19*a* uppermost, on a platform 15*a* which is fast with the spindle 15 (see Figure 1) and with a hole (not shown) engaged round a pin 15*b* of the platform; and the support 21 has a bottom flange 21*a* which rests on the upper side of the disc, with the indicator 29 outside the flange 19*a*.

In instances where it is desired to check the profile of a peripheral face of an article (e. g., of a cross-section of a turbine blade, as shown in the drawings, or of a radially-operating cam—the article being held with its longitudinal axis parallel to the axis of rotation of the coacting support, i. e., of the spindle 15), the apparatus has the pivotal axis of the arms 24, 25 (i. e., the aforesaid vertical pillar) arranged to be parallel to the spindle 15. On the other hand, if it is the profile of a substantially radial face (e. g., of an axially-operating cam) which is to be checked, then the apparatus would have the pivotal axis of the arms 24, 25 arranged at a right angle to the axis of rotation of the supports for the standard and article. The apparatus can be designed either for one of these forms of checking, or obviously it may be adjustable so as to be capable of dealing with both of them.

In the drawings the arms are shown as being supported between their ends. They carry the tracers at adjacent ends, and the other ends are arranged to actuate a known form of indicator 29. In this case it is desirable for the effective lengths of the arms on both sides of their support to be equal so as to enable a direct-reading indicator (e. g., a dial-type of indicator calibrated, say, in ten-thousandths of an inch) to be employed. The indicator is mounted on the lower arm, and the upper arm carries a rigid strip 30 to coact with the operative end of the indicator plunger.

We may provide for one or both arms to be adjustable longitudinally of the aforesaid vertical pillar whereby to enable the profile at different zones of the article to be checked. Thus, for the checking of a parallel-sided article as shown, the associated arm 25 may be slid along the said pillar and be held in a desired vertical position by means of a locking sleeve 32, for gauging a selected zone of the periphery. In other instances, for example, where the article and standard are

conical, we can arrange for both of the arms to be slid along the said pillar, whilst preserving their spacing, for checking different zones.

For the checking of the profile of a thin article (e. g., for checking the cross-sectional profile of a turbine blade as shown), there would sometimes be difficulty in closely following a master turbine blade acting as the standard. Therefore, as shown, the standard 18 is, in such a case, preferably formed to have a periphery of a shape such as would be generated by the path of a point on a line passing through the point of contact of a roller with a blade of the correct contour, and through the centre of the roller, whilst the latter is being rolled round the periphery of the said blade of correct contour. Thus the said point may be at the centre of the roller, or to one side or the other of the centre. In this way the artificial standard is made to be materially thicker than the article to be checked (being somewhat kidney-shaped in the case of a turbine blade) and is easier to produce within the desired limits of accuracy. Also a standard so formed is much more robust than a master blade, and the coacting tracer 26 will move more easily round it, particularly at the ends corresponding to the leading and trailing edges of the blade, than round a master blade. It will be understood that the centres of the arcuate edge of the tracer 27 and of the radiussed end of the tracer 26 are arranged so as to coincide when the profile of the blade 22 conforms to the profile represented by the artificial standard 18.

The opposite ends of the lower and upper arms carry, respectively, a dial-type indicator and a coacting contact strip, and these ends of the arms are also associated with springs biassing the tracers into intimate contact with the respective profiles. Obviously, if desired the half arms carrying the tracers could alternatively be arranged also to support the indicating means, all acting at the same radius from the axis of the said pillar so as to give a direct reading on the indicator dial of any profile errors.

By adjusting the upper arm axially of the shaft and supporting it at a chosen checking position by means of the clamping sleeve 32, the blade can be checked at any position from root to tip.

When a blade having the same profile but a different stagger angle is to be tested, the support 21 can be twisted relatively to the graduated dial 19 and be set by means of the vernier and dial scales to bring the blade into correct relationship with the standard.

The form of the apparatus just described is only suitable for checking turbine blades having parallel leading and trailing edges and of a constant stagger angle from root to tip. However we contemplate adapting the apparatus for the checking of blades having non-parallel leading and trailing edges, and with or without constant stagger angle, by providing a number of artificial standards of different form corresponding to different sections of the blade from root to tip, or by providing a composite artificial standard, and in such cases we would provide for moving and supporting both upper and lower arms along the shaft so that the respective tracers could engage the correct standard (or portion thereof, as appropriate) and the corresponding portion of the test blade.

What we claim as our invention and desire to secure by Letters Patent of the United States is:

1. An apparatus for indicating a deviation of the profile of an article from a standard profile, including coaxial, mutually-rotative supports for the article and the standard, means for relatively orientating the article and standard about their common axis of rotation, a pair of coaxial, independently pivoted gauge arms, said arms relatively movable along their common pivotal axis, tracers fast with said arms to respectively engage the article and the standard, and a dial-type indicator carried by one of said arms, said indicator having an operating plunger coacting with the other said arm so that relative pivotal movement of said arms, consequent on a deviation of the profile of the article from the standard profile, will actuate the indicator.

2. An apparatus for indicating a deviation of the profile of an article from the profile of a standard, comprising a stationary base, a spindle journalled in said base, said spindle supporting the standard and the article in an adjustably fixed angular relation, two gauging arms independently journalled between their ends for movement about an axis parallel to that of said spindle, said gauging arms relatively adjustable along said axis, adjacent ends of said arms adapted to respectively engage the profiles of the article and standard, and a dial-type indicator carried by one of said arms, said indicator having an operating plunger coacting with the other said arm so that relative pivotal movement of said arms, consequent on a deviation of the profile of the article from the standard profile, will actuate the indicator.

3. An apparatus for indicating a deviation of the profile of an article from the profile of a standard, comprising a stationary base, a spindle journalled in said base, means for locating the standard and the article in angular adjusted relation on said spindle consisting of indicating elements in the form of a vernier scale indicator to coact with a graduated dial, one of said elements being rotatively fast with respect to the standard and the other being rotatively fast with respect to the article, means for adjusting said elements angularly, two gauging arms independently journalled between their ends for movement about an axis parallel to that of said spindle, said gauging arms relatively adjustable along said axis, adjacent ends of said arms adapted to respectively engage the profiles of the article and standard, and a dial-type indicator carried by one of said arms, said indicator having an operating plunger coacting with the other said arm so that relative pivotal movement of said arms, consequent on a deviation of the profile of the article from the standard profile, will actuate the indicator.

4. An apparatus for indicating a deviation of the profile of an article from the profile of a standard having its periphery shaped as if generated by the path of a point on a line passing through the position of contact of a roller with an article of correct contour and through the centre of the roller, comprising a stationary base, a vertical spindle journalled in said base, means for mounting on said spindle the standard and the article in an adjustably fixed angular relation, a stationary pillar parallel to said spindle, two gauging arms independently journalled between their ends upon said pillar, said gauging arms relatively adjustable axially of said pillar, one of adjacent ends of said arms carrying a round-nosed tracer to engage the standard with substantial point contact and the other of said

adjacent ends carrying a tracer which is arcuate about the said point to engage the article, and a dial-type indicator carried by one of said arms, said indicator having an operating plunger coacting with the other said arm so that relative pivotal movement of said arms, consequent on a deviation of the profile of the article from the standard profile, will actuate the indicator.

5. An apparatus for indicating a deviation of the profile of an article from the profile of a standard having its periphery shaped as if generated by the path of a point on a line passing through the position of contact of a roller with an article of correct contour and through the centre of the roller, comprising a stationary base providing a vertical tubular block and a pillar parallel to said block, a spindle fast with an actuating member journalled in said block, means for locating on said spindle the standard and a graduated dial fixed angularly with respect to the standard, other means for locating on said spindle the article and a vernier scale indicator fixed angularly with respect to the article, said indicator adapted to coact with said graduated dial, two gauging arms independently journalled between their ends upon said pillar, adjacent ends of said arms carrying tracers to respectively engage the profiles of the article and standard, that tracer to engage the standard being a round-nosed tracer, and that tracer to engage the profile of the article being a tracer which is arcuate about the said point, and the other ends of said gauging arms carrying coacting indicator elements in the form of a dial type of indicator having a movable plunger on one of the arms, and a coacting abutment on the other to engage the operative end of said plunger.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,652,435	Goodrich	Dec. 13, 1927
2,202,638	Praeg	May 28, 1940
2,407,490	Gregg	Sept. 10, 1946
2,433,421	Bowness	Dec. 30, 1947
2,623,293	Nebesar	Dec. 30, 1952
2,624,949	Schieman	Jan. 13, 1953

FOREIGN PATENTS

Number	Country	Date
591,197	Great Britain	Aug. 11, 1947
616,759	Great Britain	Jan. 26, 1949