Jan. 15, 1946. R. T. FENN 2,393,094

GAUGE FOR STEEP FACED THREADS

Filed March 28, 1944 2 Sheets-Sheet 1

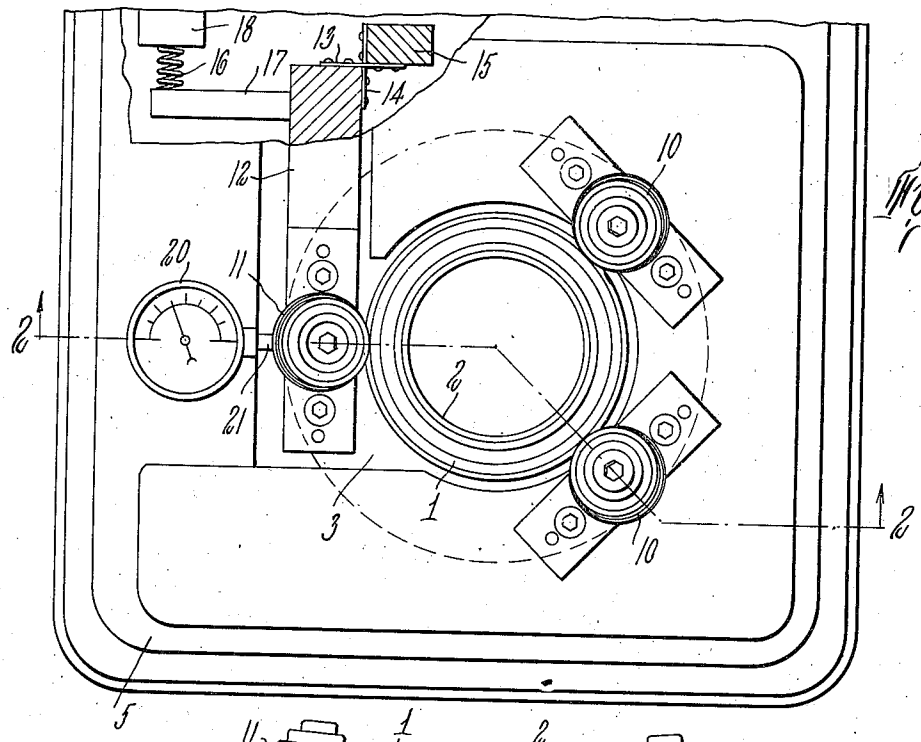


Fig. 1.

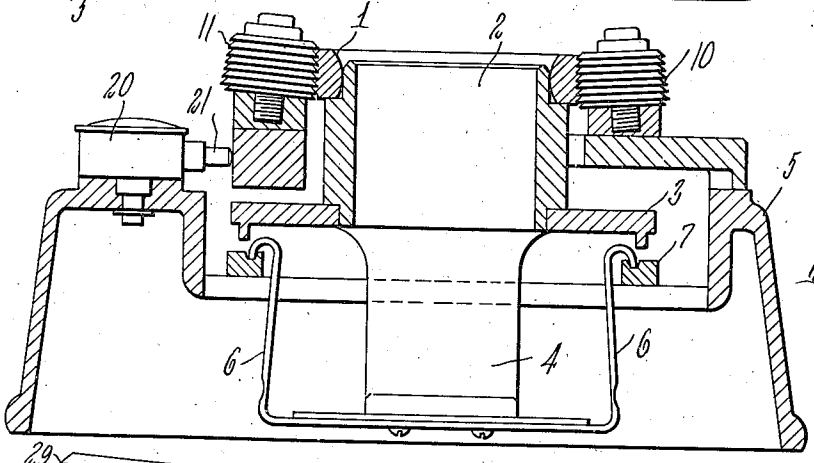


Fig. 2.

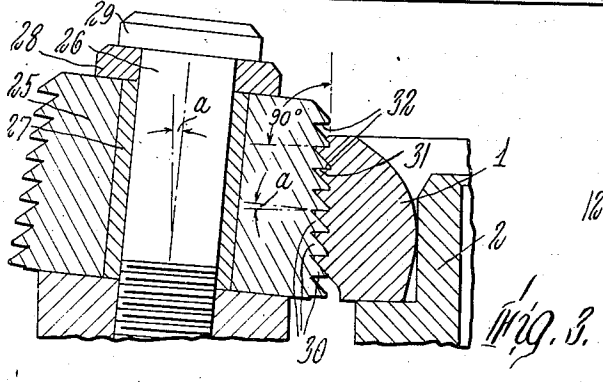


Fig. 3.

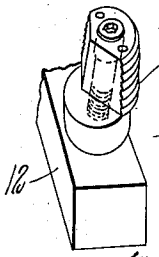


Fig. 4.

Inventor
Raymond T. Fenn
by Wright Brown Quinby & Clay
Attys.

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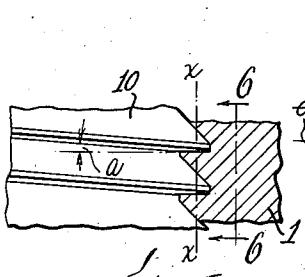


Fig. 5.

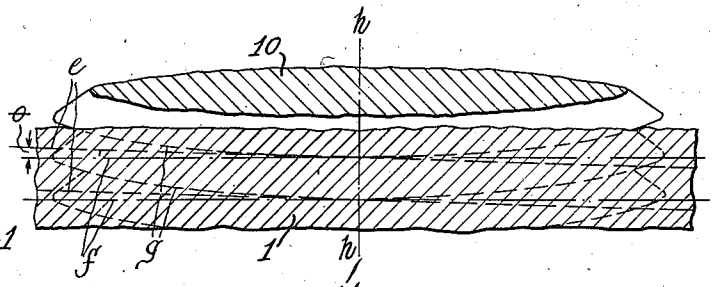


Fig. 6.

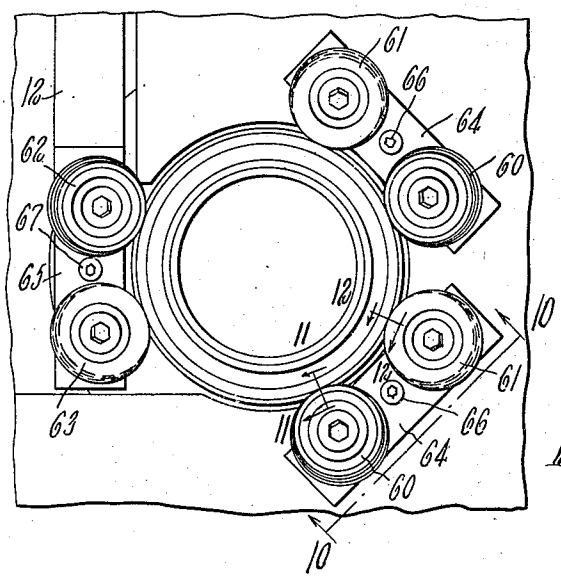


Fig. 9.

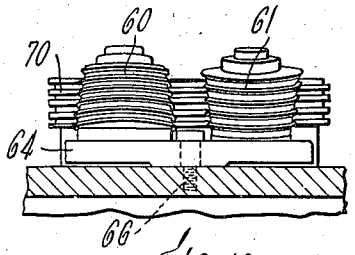


Fig. 10.

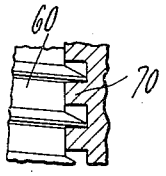


Fig. 11.

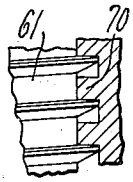


Fig. 12.

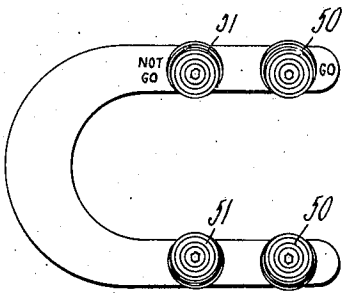


Fig. 7.

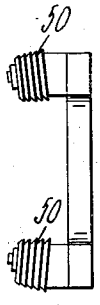


Fig. 8.

Inventor
Raymond T. Fenn
by Wright Brown Quinby & Clay
Attys.

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GAUGE FOR STEEP FACED THREADS

Raymond T. Fenn, Springfield, Vt., assignor to Bryant Chucking Grinder Company, Springfield, Vt., a corporation of Vermont

Application March 28, 1944, Serial No. 528,399

3 Claims. (Cl. 33—199)

When gauging threads, gauging anvils which mate the threads to be gauged are employed. When the work has a thread provided with a steep face, as, for example, a buttress thread where one face of the thread form is 90° or nearly 90° to the work axis, the tolerance with respect to this angle is extremely small, and it is extremely difficult to machine a conventional form of anvil to this form. Such a conventional form for outside gauging would be a segment of an internally threaded piece which consequently has a concave periphery for engagement with the convex periphery of the work piece. It is impracticable to grind the steep face of the thread form in an internally threaded hole to the close tolerances required for gauging.

In accordance with this invention, therefore, a different type of anvil is employed, this being provided with externally formed gauging elements. Thread rolls might be employed for such gauging, but this would require accurate angular positioning relative to each other of the rolls in order that the gauging points would be in phase with the lead of the thread of the work. This necessity makes this type of anvil undesirable, and to avoid this, instead of helically threaded rolls, in accordance with this invention, annularly grooves rolls are employed and they are spaced axially of the work, each one to its succeeding one by an amount equal to the lead of the thread between the points of contact of the several rolls determined by their angular spacing about the work. The use of annular grooved rolls, however, may give rise to a region of interference with the steep faces of the threads of the work because of the fact that the annularly grooved roll has no lead. If such a roll is tilted to the helix angle, this interference will be eliminated, but a full contact throughout the length of the roll will not be obtained since the axes of the work piece and roll do not then lie in a common plane. In order to obtain such a full length contact, in accordance with this invention, a conical roll is used, the conical roll being tilted toward the axis of the work so as to bring its small end into gauging position in line with the larger end parallel to a line through successive corresponding points in the thread periphery lengthwise of the work. This tilting of the conical roll causes the axes of the roll and the work piece to lie in substantially a common plane in which these axes are not parallel. Substantially where this plane intersects the peripheries of the work piece and the roll, the steep faces of the roll engage the steep faces of properly formed work threads throughout the axial length common to both piece and roll. The tilting of the gauge roll axis causes its steep gauging faces, which are perpendicular to its axis, to be inclined to planes perpendicular to the axis of the work, and as these gauge faces recede in opposite directions away from the common plane of the two axes, they also separate from the perpendicular work faces. Due to the lead of the threads, the steep faces of the work also are inclined to planes perpendicular to the work axis, this inclination being in amount the lead angle of the threads, and on one side of the common plane of the axes, this inclination is in the same direction as the inclination of the conical gauge roll steep faces. If this inclination of the gauge faces is slightly greater than that of the work faces, which is insured by making the roll taper slightly more than the helix angle, the permissible minimum difference being determined by the maximum diameter of the gauging roll, and being less with decrease in this maximum diameter, there will be no interference between the work and roll steep faces on this side of the common plane of the axes. On the opposite side of this common plane, the face inclinations of the work and gauge roll are in opposite directions and recede from each other so that no interference results on this side of the common plane.

Where the taper of the grooved roll is sufficiently more than the helix angle of the thread, as hereinbefore specified, interference on the steep face of the thread and rolls is eliminated, and this taper may be larger than this limit so long as it is not sufficiently great to cause interference on the inclined faces of the threads. A slight excess of the taper of the roll over the lead angle is necessary to insure that contact between the gauging anvils and steep thread faces occurs in the plane containing the axes of the work piece and anvil, this excess providing for clearance elsewhere and to allow for inaccuracies in that plane to effect the gauging action to at least slightly outside of the tolerance limits desired for the gauge indication. As the inclined faces of the threads and gauging ridges recede rapidly from each other from the points of maximum contact, no interference on these faces is to be expected, provided these inclined faces are not too steep, and the angle of taper and tilt does not greatly exceed the lead angle of the threads. In all cases the direction of taper, that is toward the smaller diameter end, of the gauging anvils is in the direction from the inclined toward the steep faces of each thread valley. For this reason a single

set of anvils cannot be used to gauge square threaded work in one operation, since one steep face only can be gauged at one time. In order to gauge both faces, the work would have to be gauged first while facing in one direction to test one steep face and then reversed end for end to test the opposite steep face, but as will be more fully pointed out, by the use of two sets of anvils the anvils of the two sets oppositely facing, square threads may be gauged by a single operation.

For a more complete understanding of this invention, reference may be had to the accompany ing drawings, in which

Figure 1 is a top plan view, partly broken away and in section, of an external buttress thread gauge embodying this invention.

Figure 2 is a sectional view on line 2—2 of Figure 1.

Figure 3 is a view somewhat similar to a portion of Figure 2 to a larger scale and showing one of the gauging anvils in central section.

Figure 4 is a fragmentary perspective view showing a modified construction of gauging anvil.

Figure 5 is a fragmentary view to a larger scale showing the anvil in elevation and the work in section.

Figure 6 is a detail sectional view on line 6—6 of Figure 5.

Figures 7 and 8 are side and end elevations, respectively, of a snap gauge for buttress threads.

Figure 9 is a view similar to a portion of Figure 1, but showing a gauge for use with square or substantially square threads.

Figures 10, 11 and 12 are detail sectional views on the correspondingly numbered section lines of Figure 9, Figures 11 and 12 being drawn to a larger scale.

Referring to the drawings, a work piece provided with buttress threads is shown at 1, this being illustrated as engaged with a tubular holder 2 supported on a platform 3, this platform having a depending portion 4 supported from the bed 5 as by spring elements 6, the upper ends of which are outwardly turned and engaged in slots in stationary members 7 which form a part of the bed 5. These springs 6 permit some lateral motion of the work to bring it into or out of contact with a pair of fixed gauging anvils 10 carried by the bed 5. This support also permits a sufficient vertical adjustment of the work so that its threads may be brought into proper relation to the gauging elements of the anvils. A movable gauging anvil 11 is shown as supported on an arm 12 pivoted as by pairs of cross springs 13 and 14 on a stationary supporting post 15. The movable anvil 11 may be pressed toward the fixed anvils as by a spring 16 reacting between an arm 17 secured to the arm 12 and a fixed abutment 18, and the position of the gauging element when in gauging position may be shown by a position indicator at 20 having a stem 21 against which the arm 12 contacts, the position indicator 20 being supported in fixed position by the bed 5, as shown in Figure 2. This general arrangement of fixed and movable anvils with the indicator controlled by the position of the movable anvil is not my invention, which is concerned with the gauging elements per se and their relation to each other.

It will be noted that each of the gauging elements as shown in Figures 1, 2 and 3, is a tapered roll 25 which is held on a central support as by a screw 26, the upper end of which is inclined toward the central axis of the work. As shown the gauging anvil 25 is provided with a central bushing 27 through which the screw 26 extends and a washer 28 is placed between its upper end and the head 29 of the screw. The inclination of the axis of each of the anvils toward the axis of the work piece is such as to bring into parallelism the adjacent generating elements of the two surfaces of revolution generally defined by the roll and by the threaded surface of the work, the extent of angularity of the mounting being equal to that of the taper when gauging straight threads or equal to the sum or difference of the tapers for the roll and tapered threads when gauging tapered threads, and in order that there shall be no interference between the steep faces 31 of the work and the corresponding steep faces 32 of the anvil, this angle must be at least as much as the helix angle of the work threads being gauged. The engagement between the steep thread faces of the work and the corresponding faces of the anvil is shown best in Figure 6. The lines *e—e* represent the steep thread faces, being at angles θ, representing the lead angles, to the lines *f—f* perpendicular to the work axis *h—h*. The curved lines *g—g* show the apices of the flat gauging faces of the gauging anvil ribs which are shown as elliptical lines since they are arcs of circles viewed nearly edgewise at the angle of tilt, but they are nonsymmetrical with relation to the thread faces *e—e* since, as these gauging faces are peripheral ribs instead of threads, they have no lead. The smaller the amount of tilt of the anvils is made, approaching the lead angle, the flatter these curves become, approaching the lines *f—f*, but anything less than the lead angle brings the lines *g—g* below the lines *e—e* to the left of the axis *h—h*, representing interference between the anvils and the work which, of course, would render the gauge inoperative for correct gauging. It will be noted that if the steep face of the work thread is 90° to the work axis, this tilting of the anvils causes the steep faces of the anvils to be less than 90° by the amount of tilt. Thus assuming that the angle of tilt *a* is 6°, the angle of the steep faces of the gauging elements will be 84° for gauging work threads of 90°. This decrease of the angle of the steep thread faces for the anvils which is illustrated clearly in Figure 5 makes it possible to grind these steep faces accurately. If the steep faces of the work are at less than a 90° angle, all the more decrease in angle is provided for the anvil steep faces.

It will be noted from an inspection of Figure 2, that the two anvils there shown are spaced axially by an amount equal to the lead of the thread between the gauging points of contact. Thus the right hand fixed anvil shown in Figure 2 is shown as mounted somewhat lower than the movable anvil 11. The third anvil is similarly axially offset from the others in accordance with the lead between these points of contact.

In Figure 4 a modification is shown in which instead of employing a complete conical gauging anvil, the anvil comprises a segment slightly less than one-third of the complete circumference. This permits one roll to be cut into three segments, each of which may be used where three anvils are to be employed for gauging a single piece as will usually be provided.

In Figures 7 and 8 the invention is shown as embodied in a snap gauge, the gauging anvils 50 being formed and spaced to pass work within the maximum tolerance limits, and the anvils 51 being formed and spaced to pass work just below minimum tolerance limits, the anvils 50 thus being "go" anvils and the anvils 51 being "not go" anvils.

It will be noted that a set of anvils for gauging work having steep faces on one side cannot at the same time gauge steep faces on the opposite sides of the threads. Thus, if it be desired to gauge square or nearly square threads, anvils shaped to gauge one steep face and with clearance for the other steep face may be used, and provided the threads to be gauged are symmetrical, the work may be subjected to two gauging operations with the work facing in opposite directions. Square or nearly square threads may be gauged in a single operation, however, by employing two sets of oppositely facing anvils, one set for each steep face, in which case opposite thread faces need not be symmetrical if the anvils are shaped to the particular faces to be gauged thereby.

A gauge for gauging square or nearly square threads in a single operation with two sets of anvils is shown in Figures 9 to 12, inclusive. Referring to these figures, two sets of stationary anvils **60** and **61** are employed and one set of movable anvils **62** and **63**. Each of the sets of anvils is carried by one end portion of a lever **64** or **65** fulcrumed centrally at **66** and **67**, respectively. The two anvils of each set are reversely disposed, that is, one of the anvils **60** is mounted with its small end upward as shown at the left hand in Figure 10 and its axis is inclined upwardly and inwardly, while the other anvil **61** at the right as shown in Figure 10, is arranged with its larger end upwardly and its axis inclined upwardly and outwardly. The anvils **60** engage the upper steep faces of the square threads **70** of the work as shown in Figure 11, while the anvils **61** engage on the lower faces of these threads **70** as shown in Figure 12, the gauging ribs of each of these anvils being cut away on the side opposite to the steep gauging faces to clear the oppositely disposed steep faces of the threads. The anvils of each set are offset axially of the work in accordance with the lead advance between them determined by their angular relationship as in the case of the gauge provided with the single set of anvils shown in Figures 1 to 4 and 8. Since these two sets of anvils are pivoted for free equalizing motion from and toward the work, and the anvils for gauging each side of the work thread are symmetrically disposed, the anvils cooperate with each other to produce a true gauging action. The peripheral edges of the gauging ribs of the anvils may be formed to engage the work at the roots of the threads, and the side faces of the anvils between the gauging ribs may be formed to engage the outer faces of the threads, so that between the two sets of anvils gauging of substantially the entire thread faces is produced. The anvils **62** and **63** are mounted on the equalizing lever **65** carried by the movable arm **12** of the gauge in place of the single gauging element shown in Figures 1 and 2, and the gauging action may be produced similarly as by means of a position indicator as shown in Figures 1 and 2.

While as shown the anvils are arranged for gauging external straight work, similar anvils may be used for gauging internal work or taper threaded work, if desired. In gauging internal work, the curvature of the work and of the anvils is in the same direction, so the anvils should be of as small diameter as is practicable in order that they may be given sufficient motion for free gauging action without interference. In gauging taper threads the inclination of the anvil axes will be modified to suit the taper of the work so as to bring the gauging portions of each anvil from end to end into the same relation to standard work threads.

It also will be evident from the foregoing description of certain embodiments of the invention that other changes and modifications might be made without departing from the spirit or scope of this invention as defined by the appended claims.

I claim:

1. A gauge for threads having at least one steep face, said gauge including a plurality of relatively movable gauging anvils, each of said anvils including at least a portion of an annularly grooved roll tapered at an angle greater than the lead angle of the threads to be gauged, each of said grooves having one face for engagement with the steep face of the threads and said anvils being offset axially of the work relative to each other by amounts equal to the thread lead for the angular distance by which said anvils are spaced about the axis of the work, said roll portions being tilted to bring the line of gauging action parallel to a line through successively corresponding points of the thread peripheries lengthwise of the work substantially in a plane containing the axes of the threaded work and of the tapered roll.

2. A gauge for threads having at least one steep face, said gauge incluing a plurality of relatively movable gauging anvils, each of said anvils including a fixed peripheral segmental portion of an annularly grooved roll tapered at an angle greater than the lead angle of the threads to be gauged, each of said grooves having one face for engagement with a steep face of the threads and said anvils being offset axially of the work relative to each other by amounts equal to the thread lead for the angular distances by which said anvils are spaced about the axis of the work, the axes of said roll portions being tilted to the work axis at the taper angle to bring the line of gauging action parallel to the thread peripheries lengthwise of the work substantially in a plane containing the axes of the threaded work and of the tapered roll.

3. A gauge for threads having opposed steep thread faces, said gauge including a pair of sets of relatively movable gauging anvils, each of said anvils including at least an arcuate portion of an annularly grooved roll tapered at an angle greater than the lead of the threads, the anvils of the two sets being disposed with their smaller diameter ends facing in opposite directions and inclined toward the work to engage correctly shaped work threads equally from end to end of the gauging portions of said anvils, each of said anvils having one wall of each groove shaped to engage one side wall of a work thread and the opposite wall free from engagement with the opposite wall of the work thread valley, anvils of the two sets engaging opposite steep faces of the work threads and positioned alternately about a central axis in pairs including an anvil of each set, and a pivoted lever to which the anvils of each pair are secured permitting said anvils of the two sets to automatically adjust themselves to the threads of the work when said anvils are moved relatively into gauging relation to such work, the anvils of each set being offset axially of the work relative to each other by amounts equal to the thread lead for the angular distances by which said anvils are spaced about the axis of the work.

RAYMOND T. FENN.