Oct. 15, 1946. E. F. HOHWART 2,409,280

COMPARATOR

Filed May 28, 1943 2 Sheets-Sheet 1

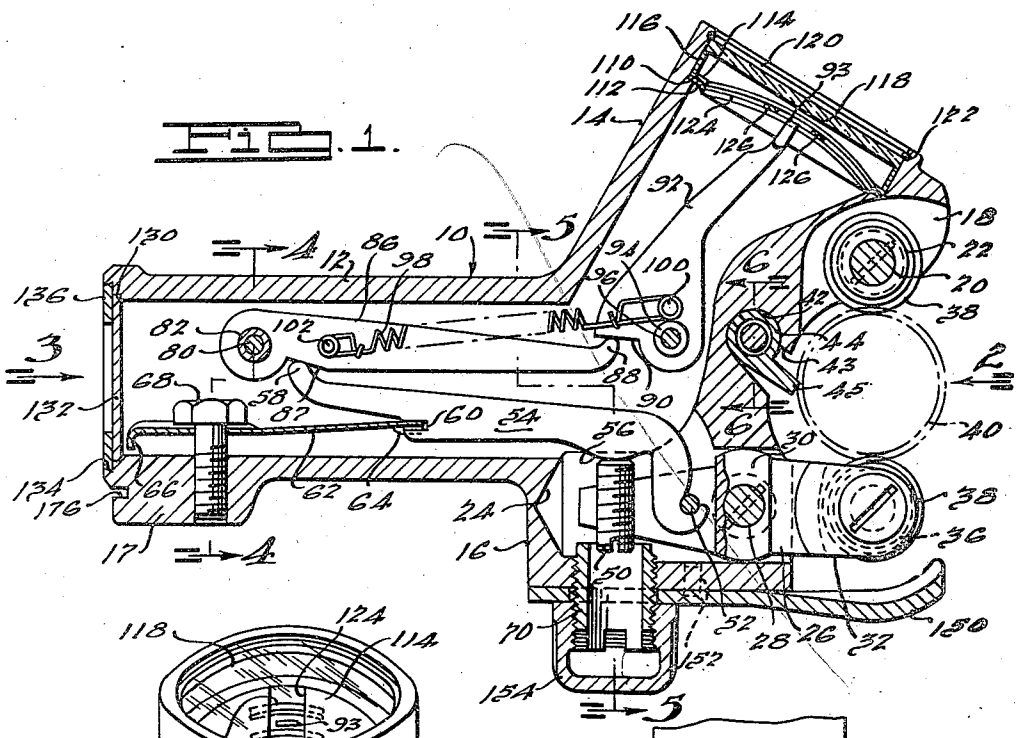


FIG. 1.

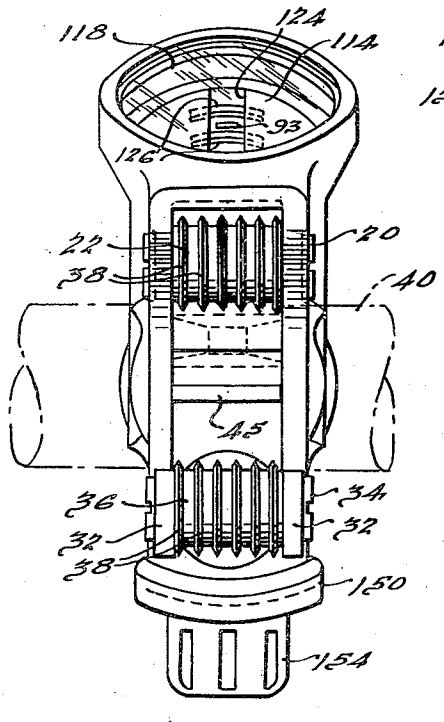


FIG. 2.

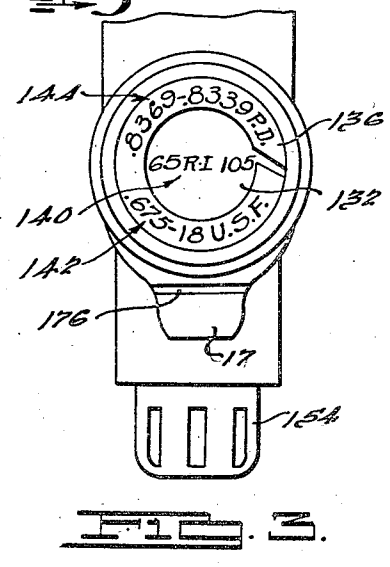


FIG. 3.

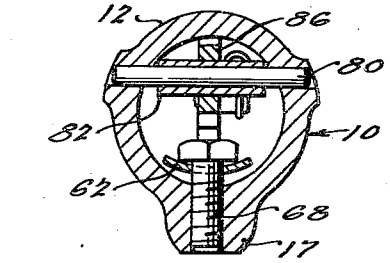
INVENTOR
Ernest F. Hohwart.
BY
Harness, Dickey & Pierce.
ATTORNEYS.

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Filed May 28, 1943 2 Sheets-Sheet 2

Fig. 4.



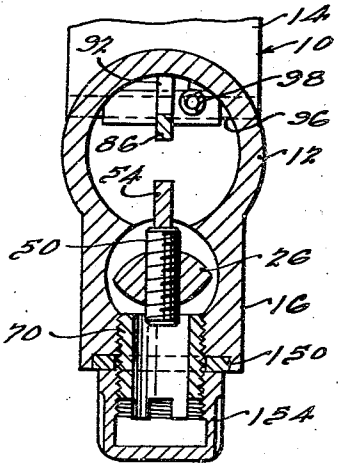


Fig. 5.

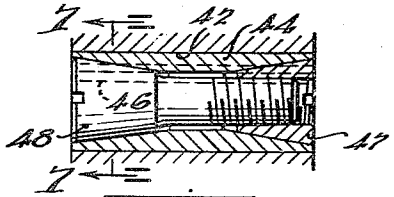


Fig. 6.

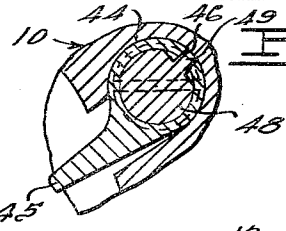


Fig. 7.

Fig. 8.

INVENTOR.

Ernest F. Hohwart.

BY

Harness, Dickey & Pierce.

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2,409,280

COMPARATOR

Ernest F. Hohwart, Detroit, Mich., assignor to N. A. Woodworth Company, Ferndale, Mich., a corporation of Michigan

Application May 28, 1943, Serial No. 488,845

11 Claims. (Cl. 33—199)

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This invention relates to gages and particularly to those of the type commonly known as comparators in which, instead of measuring a part to be gaged in decimal parts of an inch or other unit of linear measurement simply determines whether or not the part is within the limits of tolerance permitted in the size of such parts, the principal object being the provision of a device of this type that is simple in construction, efficient in operation, by means of which the relative size of parts to be gaged may be visually determined in a quick and easy manner, and one which is convenient to employ.

Objects of the invention include the provision of a comparator adapted for gaging the dimensions particularly of circularly sectioned pieces of work, and one that is particularly adaptable for ues in gaging screw threaded parts; the provision of a device of the type described that is capable of being employed either as a hand or as a bench type comparator; the provision of a device of the type described including a fixed and a movable gaging element, the movement of the movable gaging element being transmitted through motion multiplying mechanism to a pointer in a new and novel manner; the provision of a construction as above described in which suitable go and no-go indicating members are provided in association with the pointer members and may be readily varied in position with respect to each other and to the body of the device to accommodate the gaging of workpieces having different tolerances or the like; the provision of a device of the type described including a novel form of adjustment for accommodating the device for measuring workpieces of different sizes; the provision of a device of the type described including a single piece housing for enclosing the more delicate parts of the device, therefore rendering the device more rugged in character; and the provision of a device of the character described including a body portion having an opening therein and a closure for the opening further constituting an indicia carrying device for the same.

The above being among the objects of the present invention the same consists in certain novel details of construction and combinations of parts to be hereinafter described with reference to the accompanying drawings, and then claimed, having the above and other objects in view.

In the accompanying drawings which illustrate a suitable embodiment of the present invention and in which like numerals refer to like parts throughout the several different views,

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Fig. 1 is a vertical sectional view taken longitudinally through my improved comparator;

Fig. 2 is a front elevational view of the comparator shown in Fig. 1 taken looking in the direction of the arrow 2 thereof;

Fig. 3 is a rear end elevational view of the comparator shown in Fig. 1 taken looking in the direction of the arrow 3 in Fig. 1;

Fig. 4 is a transverse sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a fragmentary, transverse sectional view taken on the line 5—5 of Fig. 1;

Fig. 6 is a fragmentary, vertical sectional view taken on the line 6—6 of Fig. 1, illustrating in greater detail the details of construction of the stop for limiting the movement of the work between the gaging rollers;

Fig. 7 is a fragmentary, transverse sectional view taken on the line 7—7 of Fig. 6; and,

Fig. 8 is a side elevational view, reduced in size as compared to Fig. 1, showing the comparator of Fig. 1 mounted on a bench support forming a part of the present invention.

Referring now to the drawings it will be noted from Fig. 1 that the device comprises a main body portion indicated generally at 10 including a rearwardly (to the left as viewed in Fig. 1) portion 12 serving as a handle when the comparator is supported manually, and open at its rear end, a forwardly and upwardly inclined portion 14 open at its upper end and through which opening the pointer and the indicator bars are visible as will hereinafter be more fully explained, and a downwardly offset portion 16 at the forward end thereof. While the portions 12 and 14 may be of any desired cross-sectional configuration, in the embodiment shown they are substantially circular except that the extreme rear end of the portion 12 is provided with a downwardly projecting boss-like portion 17 the purpose of which will hereinafter be apparent. On its forward side the body portion is provided with a pair of forwardly and downwardly directed laterally spaced integral flanges or wall portions 18 between which extends and by means of which is supported a pin 20. In the broader aspects of the invention the pin 20 may be adjustable in position toward and from the free edges of the flanges 18 to accommodate the device to the gaging of workpieces of greater differences in sizes than would otherwise be possible, but for the purpose of illustration only each flange 18 is provided with a single hole for receiving the corresponding end of the pin 20 so that no such adjustment is provided in the construction shown. A gaging roller 22 is

rotatably mounted on the pin 20 between the flanges 18.

An opening 24 is drilled into the downwardly projecting portion 16 of the main body portion 10 from the forward end of the main body and so that it intersects the hollow interior of the main body 10 as brought out in Fig. 1. Projecting into the opening 24 is a double armed lever indicated generally at 26 mounted for pivotal movement upon a pin 28 projecting diametrically through the opening 24 in axially parallel relation with respect to the pin 20 and suitably fixed against movement in the main body 10. The lever 26 is provided with a partially spherical central portion 30 of a diameter to closely fit the walls of the bore 24 and arranged with its center on the axis of the pin 28. The portion 30 thus has a relatively close fit with respect to the wall of the bore 24 so as to prevent the introduction of particles of foreign material into the interior of the main body portion 10 between the portion 30 and the walls of the bore 24 without restricting the pivotal movement of the lever 26 on the pin 28. The forward or outer end of the lever 26 is bifurcated or formed to provide a yoke 32 between the opposite arms of which, as best brought out in Fig. 2, extends and to which is fixed a pin 34 arranged with its axis parallel to the axes of the pins 20 and 28, and upon which is rotatably received a second gaging roller 36.

The gaging rollers 22 and 36 may be of any desired external conformation to accommodate them to the particular piece of work which is to be gaged by the comparator as will be readily appreciated by those skilled in the art. In other words where it is to be employed for gaging the diameter of a plain cylindrical piece of work or for gaging the thickness of a flat piece of material the rollers 22 and 36 may be plain cylindrical rollers. Where the comparator is to be employed for gaging the diameter of screw threaded parts, then the rollers 22 and 36 may be provided with circumferentially extending threads or ribs on their outer face complementary to the thread to be gaged. For the purpose of illustration it is assumed that the latter type of work is to be gaged by the comparator shown and for that reason the rollers 22 and 36 are each provided with a plurality of axially spaced circumferentially extending V-sectioned ribs 38 upon their outer surface, the ribs 38 being spaced from each other by a distance equal to the pitch, or multiples of the pitch, of the thread to be gaged thereby. The ribs 38 on one of the rollers are offset from the ribs on the other of the rollers axially of the rollers a distance equal to one-half of, or one and one-half times, the pitch of the threads to be gaged. In the particular case shown the ribs 38 are so spaced from one another as to engage the lands between every other pair of threads on the screw to be tested, this being merely a matter of choice. One, or even both of the gaging rollers 22 and 36 may be permitted to have a slight amount of free axial movement on their respective pins so as to insure proper engagement of the ribs 38 thereof between the threads of a workpiece being gaged.

It will be appreciated that the roller 36 is normally urged toward the roller 22 and in order to gage a screw or the like it is forced between the rollers. It will also be appreciated that in order to properly engage such a screw in its gaging position its axis will be required to be located in a plane substantially including the axes of the rollers 22 and 36. For this reason it is imperative that some means be provided for limiting the movement of a piece of work, herein assumed to be a screw such as indicated by dot-and-dash lines at 40 in Figs. 1 and 2, between the rollers 22 and 36 and for bringing its axis into parallelism with the axes of the rollers 22 and 36 at such time. Such means is best brought out in Figs. 1, 6, and 7 and is as follows. A cylindrical bore 42 is provided in the main body portion 10 vertically between the rolls 22 and 36 and with its axis parallel with the axis of the pin 20. The bore 42 is connected by a slot 43 which extends outwardly and downwardly therefrom, as viewed in Fig. 1, with the outer face of the main body portion 10 between the rolls 22 and 36. Relatively closely but rotatably received in the bore 42 is a cylindrical sleeve 44 having integrally formed therewith an outwardly projecting blade or tongue 45 the outer edge of which is parallel with the axis of the sleeve 44 and the axis of the pin 20 and it is of such size as to be capable of a limited amount of oscillating movement in the slot 43 upon oscillation of the sleeve 44. Swinging of the blade 45 in the slot 43 thus varies the distance between its outer edge and a plane including the axes of the rollers 22 and 36 and it, therefore, provides an adjustable stop for engaging work such as 40 projected between the rolls 22 and 36. The blade 45 not only serves to limit the movement of the work to a position in which its axis lies substantially in a plane including the axes of the rolls 22 and 36 but also to insure the axis of the work being parallel with the axes of the rolls 22 and 36.

In order to lock the blade 45 in an adjusted position corresponding to the diameter of a particular piece of work to be gaged the construction best brought out in Figs. 6 and 7 is provided. As illustrated in these figures it will be noted that the bore of the sleeve 44 is outwardly tapered at each end into frusto-conical formation and the sleeve 44 opposite the blade 45 is slotted over its length as at 46. In the righthand end of such bore as viewed in Fig. 6 is received a nut member 47 externally tapered into complementary relationship with respect to the corresponding tapered end of the bore of the sleeve 44. In the opposite end of the sleeve is received the head of a screw 48, also tapered into complementary conformation with the corresponding tapered end of the bore of the sleeve 44 and the body of which screw projects through the sleeve 44 and threads into the nut 47. As brought out in Fig. 7 the head of the screw 48 is provided with an integral radially projecting key portion 49 of substantially the same width as the slot 46 and which is received therein. The key 49 thus maintains the screw 48 from relative turning with respect to the sleeve 44 and tongue 45. It will thus be appreciated that by tightening up the nut 47 on the screw 48 the nut and the head of the screw are drawn toward one another and because of their tapered conformation serve to expand the sleeve 44 in the bore 42 and thus frictionally lock it in rotatably adjusted position. The screw and nut are provided with conventional screw driver slots therein so that when the blade 45 is adjusted to a desired position it may be maintained in such position by means of a screw driver engaging the slot in the head of the screw 48 while a screw driver is employed for tightening up the nut 47. Likewise by loosening up the nut 47 a screw driver acting through the screw 48 may rotate the screw and, therefore, the sleeve 44 and blade 45 to change its adjusted position upon which re-

tightening of the nut 47 will lock the assembly in such adjusted position. It will be noted from an inspection of Fig. 2 that the blade 45 is of substantially the same length as the rolls 22 and 36 and its outer edge being straight and parallel with the axes of the rolls provides an amply wide support for engagement with the work to serve its intended purpose.

The inner end of the lever 26 is centrally slotted perpendicularly with respect to the axis of the pin 28 and adjacent its free end threadably receives therein centrally of such slot a screw 50. The slotted free ends of the inner arm of the lever 26 are normally urged toward one another so that they frictionally embrace opposite sides of the screw 50 and thus serve to frictionally lock it against inadvertent rotation therein in any of its axially adjusted positions. The axis of the screw 50 is perpendicular to the axis of the pin 28 and its axis is also perpendicular to a plane including the axis of the pin 28 and extending centrally of the inner arm of the lever 26.

A pin 52 is projected across the slot in the inner arm of the lever 26 in parallel relation with respect to the pin 28 and the screw 50. Engaged under the pin 52 is the hooked end of a lever or lever extension member 54 which extends upwardly from the pin 52 and then rearwardly over the upper end of the screw 50 within the hollow handle portion 12. Over the screw 50 the lever 54 is provided with a downwardly directed bearing or contact portion 56 bearing centrally on the upper end of the screw 50. The lever 54 extends well back into the hollow interior of the handle portion 12 from its point of contact with the screw 50 and is there provided with an upwardly turned curved contact end portion 58. It will be appreciated from the foregoing that the lever or extension member 54 in reality constitutes an extension of the lever 26 but is angularly adjustable through adjustment of the screw 50 in the lever 26 relative to the lever 26 about the axis of the pin 52, this angular adjustment being utilized for the purpose of accommodating a comparator for gaging different sized workpieces as will hereinafter be more readily appreciated. The curved surface 56 of the lever extension 54 in bearing against the end of the screw 50 provides a desired type of contact between the two permitting a gradual and uniform adjustment between them.

The lever extension 54 adjacent its rear or left-hand end as viewed in Fig. 1 and on the underside thereof is provided with a short and horizontally directed slot 60 therein. The forward end of a flat leaf spring 62 is more or less loosely received in the slot 60 and its side edges at its forward end are bent downwardly as at 64 on either side of the lever extension 54 to maintain the forward end of the spring against lateral displacement in the slot 60. The spring 62 extends to a point adjacent the rear end of the handle portion 12 of the main body 10 and such rear end of the spring 62 is downwardly flanged as at 66, the opposite corners of the lower edge of such flange 66 bearing against the inner wall of the handle portion 12. It may be noted that in Fig. 1 such flange 66 may appear to be hanging in the air but in view of the fact that the bore of the handle portion 12 is cylindrical in section it will be appreciated that the last mentioned condition actually exists.

A cap screw 68 projects down through the spring 62 a short distance forwardly of the flange 66 and threads into the projection of the handle portion 12 and acts to tension the spring 62 downwardly so as to urge the free ends of both the

lever extension 54 and the lever 26, which constitute a more or less rigid unit as above explained, in a downwardly direction so as to urge the roller 35 upwardly towards the roller 22. The amount of spring pressure thus exerted in pressing the roller 36 toward the roller 22 may be varied by threading the cap screw 68 upwardly or downwardly in the handle portion 12. In order to prevent inadvertent rotation of the screw 68 the spring 62 over the length of the head of the screw 68 is curved in cross-sectional configuration as illustrated in Fig. 4 so that the lower edges of diametrically opposite flats of the head of the screw 68 in engaging the concave surface of the spring 62 serve to prevent inadvertent rotation of the screw 68. To adjust the screw 68 it is merely necessary to turn it against the force of the spring which, because of its curved sides, is pressed downwardly by the camming action of the head of the screw 68 against it. Upon release of the turning force the curved sides of the spring automatically resiliently lock the screw in its adjusted position.

The downward movement of the lever extension 54 and lever 26 under the influence of the spring 62 is limited by contact of the inner end of the lever 26 with the upper end of a hollow screw 70 threaded upwardly through the lower portion 16 of the main body portion 10 approximately in axially concentric relation with respect to the screw 50, the bore of the screw 70 being sufficiently large to permit the lower end of the screw 50 to be freely received therein. The screw 70 thus serves as a means for adjusting the range of movement of the roller 36 with respect to the roller 22, it being appreciated, of course, that it is ordinarily desirable to permit the roller 36 to move toward the roller 22 by a distance only slightly smaller than the minimum tolerance dimension of a piece of work to be gaged by the device, and adjustment of the screw 70 may be made to correspond with such condition in any case. Any greater amount of movement of the roller 36 toward the roller 22 would simply multiply the wear of the various parts, and subject the parts to greater strain, entirely without advantage.

A pin 80 best shown in Figs. 1 and 4, is projected across the bore of the handle portion 12 above and to the rear of the free end 58 of the lever extension 54 and in parallel relation with respect to the pin 28. Upon the pin 80 is rotatably received a sleeve 82 which, as best brought out in Fig. 4, is of such length as to be confined against substantial end movement between the opposite side walls of the bore of the handle portion 12. The rear end of a forwardly extending lever 86 encircles the sleeve 82 midway between the opposite ends thereof and is rigidly fixed thereto as by means of soldering, brazing, welding or the like. The lever 86 is provided with a flat surface 87 against which the rounded rear end of the lever extension 54 is adapted to bear. The surface 87 lies approximately on a line joining the axes of the pins 80 and 28, this being desirable so as to result in the pressure exerted by the end 58 of the lever extension 54 on the lever 86 being at all times substantially perpendicular to lines radial to the pivotal axes of both.

The lever 86 extends forwardly within the bore of the handle 12 from the pin 80 to a point approximately above the screw 50 where it terminates in an upwardly curved end portion 88 which bears against a flat radially directed surface 90 of a lever 92 which extends therefrom upwardly

into the hollow interior of the body portion 14. The lever 92, similar to the lever 86, is fixed to a sleeve 94 which in turn is pivotally mounted on a pin 96 extending between the opposite sides of the housing 10 adjacent the junction of the portions 12 and 14 and in axially parallel relation with respect to the pin 28, it being similarly maintained in a central position in the housing portion 14 by engagement of the opposite ends of the sleeve 94 with the interior walls of the housing as indicated in Fig. 5. It will be noted that the surface 90 of the lever 92 is located relatively closely with respect to the axis of rotation of the lever 92 and that it lies approximately on a line joining the axes of the pins 96 and 80 when the lever is in approximately its mid-position of movement about the axis of the pin 96.

A coil spring 98 is tensioned between a pin 100 projecting laterally out from a side of the lever 92 immediately above the pin 96 and a pin 102 secured to and projecting laterally out from the lever 86 in forwardly spaced relation with respect to the pivotal axis of the latter. The spring 98 thus constantly urges the lever 92 in a counterclockwise direction of rotation as viewed in Fig. 1 and acting through its surface 90 against the end 88 of the lever 86 also has a tendency to rotate the lever 86 in a clockwise direction of rotation about the axis of the pin 80, as viewed in Fig. 1. To partially offset this latter condition it will be noted that the pin 102 is located below a line joining the axes of the pins 96 and 80 but nevertheless there is a sufficient force exerted by the spring 98 to not only maintain the surface 90 of the lever 92 in contact with the end 88 of the lever 86 but also to maintain the surface 87 continually in contact with the end 58 of the lever 54.

From the above description it will be appreciated that the connection between the lever 26 and the lever 92 constitutes a motion multiplying connection and while the amount of multiplication thus provided between the roller 36 and the free end of the lever 92 may be varied to meet the desires of the individual designer, it may be stated that with the particular proportions of parts illustrated a thousandth of an inch of movement of the roller 36 toward or away from the roller 22 is accompanied by approximately $\frac{1}{32}$ of an inch of movement of the free end of the lever 92.

In order to provide means whereby movement of the free end of the pointer lever 92 may be utilized to indicate whether a part to be gaged is within the desired limits of tolerance, the following mechanism is provided. As best brought out in Fig. 1 the outer end of the hollow interior of the body extension 14 is enlarged so as to provide an interior shoulder 110. Received in the open end of the extension 14 against the shoulder 110 is a relatively thin and preferably metallic plate 112 which is curved outwardly in a plane perpendicular to the axis of the pin 96 on a radius struck from the axis of the pin 96 as indicated. The member or plate 112 is also curved transversely of the direction of curvature shown in Fig. 1 as indicated to some extent in Fig. 2 and, where the open end of the extension 14 of the body is circular the outer surface of the member 110 may be partially spherical.

Seated over and against the marginal edges of the plate 112 is a complementary curved thin sheet metal face plate 114 having an outwardly turned peripheral flanged edge 116 relatively closely received within the outer end of the extension 14. The central portion of the face plate 114 does not lie in actual contact with the plate 112 but is slightly spaced therefrom as indicated in Fig. 1. A transparent plate 118 which may be either flat or which may be curved to magnify the face plate and associated parts therethrough and which may be of glass but is preferably formed from suitable transparent plastic material is received in the open end of the body portion 14 against the outer edges of the flange 116 of the face plate 114 and is removably secured in position by means of a split spring ring 120 received in a groove 122 formed in the inner wall of the body extension 14 immediately above the outer face of the window 118.

The member 112 and the face plate 114 are both centrally slotted as at 124 in line with the path of travel of the free end or pointer end 93 of the pointer lever 92 therebelow, the pointer 93 projecting into the slot 124 of the member 112 but short of the space between the plate 112 and the face plate 114. Received between the plate 112 and the face plate 114 and extending across the slot 124 therein are a pair of bars 126. These bars 126 are preferably formed from resilient material and preferably from spring metal and are relatively narrow and of no greater thickness than the thickness of the space between the plate 112 and the face plate 114. They are originally straight so that in assembling them between the plate member 112 and the face plate 114 they are bent into curved conformation and are, therefore, frictionally held in position between these members. By removing the ring 120 and window 118 any suitable instrument such as a pencil may be employed to shift the members 126 longitudinally of the slot 124 to bring them to their desired position in the length of the slot 124.

With the above described construction, in actual practice when it is desired to set the comparator for engaging a particular piece of work, two master pieces of work are made up one of which is at the minimum tolerated size and the other of which is at the maximum tolerated size. The blade 45 is first adjusted so as to cause the rollers to engage the work substantially on a diametrical plane thereof. Then if insertion of the smaller piece of work does not move the pointer end of the lever 92 to approximately or near its mid-position under the slot 124 of the face plate 114 the screw 50 is adjusted until this condition prevails. The upper lefthand bar 126, as viewed in Fig. 1, is then moved in the direction of the length of the slot 124 until its width, meaning its dimension longitudinally of the slot 124, is in substantial alignment with the face, meaning the outer end or edge of the pointer 93. The small piece of work is then removed and the piece of a maximum tolerance replaces it, under which conditions the pointer 93 will move to the right from the first position above referred to, upon which the righthand bar member 126 will be shifted to the left, as viewed in Fig. 1, until its width is in alignment with the face of the pointer 93. The two bars 126 thus indicate, in their relative relation with respect to the pointer 93, the minimum and maximum sizes which are acceptable for the piece of work to be tested. The screw 70 is then adjusted so that when the work is removed from between the rollers 22 and 36 the pointer 93 will stop short of the end of the slot 124 and preferably somewhere between the lefthand bar 126 and the lefthand end of the slot 124. The screw 70, there-

fore, serves to limit the range of movement of the pointer 93 in one direction as will be readily appreciated.

The lefthand open end of the handle portion 12 of the main body 10 is interiorly stepped as at 130 and receives therein a closure disc 132. Outside of the step 130 it is again stepped as at 134, this time with a re-entrant angle and within this second step is received a split spring ring 136. The closure 132 may thus be readily removed for adjustment of the screw 68, or for assembly or disassembly of various parts of this end of the main body 10. Advantage is taken of this construction to provide a simple means for identifying both the device and the particular size of the object for which it may be adjusted to gage at any particular time. In other words, the symbol number such as indicated at 140 in Fig. 3, or other identifying information, may be centrally placed on the closure 132 so as to be visible within the split ring 136, and then the outer face of the split ring 136 may carry indicia such as indicated at 142 indicating the particular size and other characteristics of the parts to be gaged, in the particular case shown the diameter of the screw and the number of threads per inch, and other indicia such as 144 indicating the tolerances permitted for the pitch diameter of such screw.

In order to prevent possible damage to the comparator through striking the roller 36 or the lever 26 with some foreign object, as for instance when placing the comparator upon a bench or the like, a guard 150 is arranged in protecting relation with respect to the outer end of the lever 26 and the roller 36 carried thereby and it projects both forwardly beyond and laterally beyond the outer end of the lever 26 and the roller 36 carried thereby. Its outer end is preferably curved upwardly both in a forwardly and laterally direction as clearly brought out in Figs. 1 and 2 to afford maximum protection. The guard 150 comprises a piece of suitably formed sheet metal secured against, and preferably inset into as brought out in Fig. 5, the lower face of the portion 16 of the body 10 by means of screws 152 passing through the guard 150 and threading into the lower face of such portion 16. Additionally, the guard 150 is provided with an opening therein through which the range adjustment screw 70 passes. A blind nut 154 is threaded on the lower end of the range adjustment screw 70 and against the guard 150 and not only serves to lock the range adjustment screw 70 in its adjusted position but also serves to seal the bore thereof against the passage of foreign material into the body of the comparator and aids in securing the guard 150 to the lower face of the portion 16.

In operation, the work is simply thrust between the rollers 22 and 36 and firmly against the outer ends of the blade 45 whereupon the position of the pointer 93 with respect to the bars 126 gives a quick and accurate visual indication of whether the dimension of the workpiece being gaged falls within the minimum and maximum tolerated sizes therefor. No unusual care is required in fitting the workpiece between the rollers 22 and 36 as firm pressure on the workpiece centrally thereof and toward the blade 45 will insure its proper positioning for the gaging operation and, because of the relatively large amount of movement of the pointer 93 corresponding with relatively small tolerances for a workpiece, the accuracy in size of the workpiece is visually indicated in a readily observable manner.

Where the device is adjusted to gage a workpiece of one particular size and it is desired to readjust it to accommodate a workpiece of a different size, then adjustment of the screw 50 is required in addition to the adjustments last described as will be readily appreciated. Ordinarily the device, particularly in its smaller sizes, that is, for gaging parts one inch or smaller in diameter, may be adjusted to gage workpieces varying in diameter by one-eighth of an inch, for instance, above or below a mean diameter which the device is designed to gage, but the degree of adjustment in this respect may be increased or decreased by simple changes or variations in the proportions of parts shown as will be readily appreciated by those skilled in the art.

The device above described, particularly in its smaller sizes, that is sizes adapted to gage workpieces of approximately one inch or less in diameter, is relatively light and may be handled manually as a comparator without undue tiring effect on the operator because of its weight. However, even in such cases and particularly in the larger sizes it is often desirable to mount the device as a bench type comparator and in such case it may be mounted upon a base which may be mounted, or secured if desired, upon a bench or other suitable surface, thus permitting the operator to employ both hands in applying and removing workpieces to be gaged.

In Fig. 8 is illustrated a bench type of support for the comparator above described and to which the comparator may be readily applied and from which it may be readily removed. Referring to Fig. 8 it will be noted that the bench type support comprises a preferably relatively heavy main body portion or base 160 preferably having a flat lower face adapted to be received directly upon a bench or the like and if desired suitably secured thereto as by screws or the like (not shown). The rear portion of the base 160 is extended upwardly as at 162 to provide a pair of laterally spaced wing-like portions between which is formed a seat 163 at least partially complementary in cross-sectional configuration to the cross-sectional configuration of the handle portion 12, in the particular embodiment shown by way of illustration, therefore, semi-cylindrical. The rear portion of the seat 163, however, is cut away as at 164 for reception of the projection 17 and preferably with clearance therefor. Forwardly of the seat 163 the base 160 is provided with an upwardly facing boss or projection 166 which is provided with a vertical bore 168 of a size to loosely receive the hollow nut or dust cap 154 therein. The engagement of the dust cap 154 in the bore 168 not only serves to prevent relative rotation of the comparator in the seat 163 formed between the wings 162 but also holds it against relative movement in a forward and rearward direction. In order to hold the comparator down on the seat 163 formed between the wings 162 a flat spring 170 is secured at its lower end to the lower portion of the rear face of the base 160 by means of a screw 172. The spring 170 projects upwardly from the screw 172 and its upper end is forwardly bent at 174 and is received in a slot 176 formed in the rear face of the projection 17 for reception thereof. The spring 170 thus prevents the rear end of the comparator from being lifted and as it is tensioned toward a forward direction it tends to force the comparator forwardly and to force the forward edge of the dust cap 154 against the forward edge of the bore 168. It has been found that this provides an effective means for securing the comparator in the bench support and

at the same time when it is desired to remove it therefrom the forward end of the comparator may be simply lifted upwardly and the comparator withdrawn from the support. In applying the comparator to the support the rear end of the comparator is depressed and the boss 17 is guided downwardly into the pocket 164 until the end 174 of the spring 170 is received in the slot 176 upon which the forward end of the comparator is pressed downwardly and the dust cap 154 forced into position in the bore 168.

Having thus described my invention, what I claim by Letters Patent is:

1. In a device of the type described, in combination, a hollow housing, a gage member rotatably mounted on said housing exteriorly thereof, a lever pivotally mounted between its ends on said housing with one end thereof positioned interiorly of said housing and the opposite end thereof exteriorly of said housing, a gage member rotatably supported by said outer end of said lever about an axis parallel to the axis of rotation of the first mentioned gage member, a face plate disposed over an opening in said housing, indicia operatively associated with said face plate, a pointer member pivotally mounted within said housing and having a pointer end arranged for sweeping movement relative to said face plate, motion multiplying means interconnecting the first mentioned lever with said pointer member, and means constantly urging said lever in a pivotal direction to diminish the distance between said gage members, said motion multiplying means including a lever extension, a screw threaded through the inner end of said lever with its axis approximately perpendicular to the centerline of the inner end of said lever and approximately in a plane perpendicular to the pivotal axis of said lever, said lever extension being pivotally connected to said lever on that side of said screw nearest the pivotal axis of said lever and bearing against an end of said screw whereby to be angularly adjustable with respect to said lever by adjustment of said screw, and spring means constantly urging said lever extension into contact with said screw.

2. In a device of the type described, in combination, a hollow housing, a gage member rotatably mounted on said housing exteriorly thereof, a lever pivotally mounted between its ends on said housing with one end thereof positioned interiorly of said housing and the opposite end thereof exteriorly of said housing, a gage member rotatably supported by said outer end of said lever about an axis parallel to the axis of rotation of the first mentioned gage member, a face plate disposed over an opening in said housing, indicia operatively associated with said face plate, a pointer member pivotally mounted within said housing and having a pointer end arranged for sweeping movement relative to said face plate, motion multiplying means interconnecting the first mentioned lever with said pointer member, means constantly urging said lever in a pivotal direction to diminish the distance between said gage members, a screw threadably mounted on the inner end of said lever cooperating with said motion multiplying means for varying the relation of said lever with respect thereto, and a screw element threaded through said housing and into abutting relation to the inner end of said lever for limiting pivotal movement of said lever in one direction, said screw element being hollow and substantially aligned with said screw whereby adjustment of said screw may be effected through said screw element.

3. In a device of the type described, in combination, a hollow housing, a gage member rotatably mounted on said housing exteriorly thereof, a lever pivotally mounted between its ends on said housing with one end thereof positioned interiorly of said housing and the opposite end thereof exteriorly of said housing, a gage member rotatably supported by said outer end of said lever about an axis parallel to the axis of rotation of the first mentioned gage member, a face plate disposed over an opening in said housing, indicia operatively associated with said face plate, a pointer member pivotally mounted within said housing and having a pointer end arranged for sweeping movement relative to said face plate, motion multiplying means interconnecting the first mentioned lever with said pointer member, means constantly urging said lever in a pivotal direction to diminish the distance between said gage members, a screw threadably mounted on the inner end of said lever cooperating with said motion multiplying means for varying the relation of said lever with respect thereto, a screw element threaded through said housing and into abutting relation to the inner end of said lever for limiting pivotal movement of said lever in one direction, said screw element being hollow and substantially aligned with said screw whereby adjustment of said screw may be effected through said screw element, and a blind nut on the outer end of said screw element sealing the hollow interior thereof to the passage of foreign material to the interior of said housing and locking said screw element in threadably adjusted position in said housing.

4. In a device of the type described, in combination, a hollow housing, a gage member rotatably mounted on said housing exteriorly thereof, a lever pivotally mounted between its ends on said housing with one end thereof positioned interiorly of said housing and the opposite end thereof exteriorly of said housing, a gage member rotatably supported by said outer end of said lever about an axis parallel to the axis of rotation of the first mentioned gage member, a face plate disposed over an opening in said housing, indicia operatively associated with said face plate, a pointer member pivotally mounted within said housing and having a pointer end arranged for sweeping movement relative to said face plate, motion multiplying means interconnecting the first mentioned lever with said pointer member, means constantly urging said lever in a pivotal direction to diminish the distance between said gage members, a stop screw threaded through said housing into engaging relation with respect to said lever for limiting movement of said lever in the last-mentioned direction, lock means for said screw, and a guard member secured to said housing by said lock means and extending therefrom into protective relation to the outer end of said lever and said gage member carried thereby.

5. In a device of the type described, in combination, a hollow housing, a gage member rotatably mounted on said housing exteriorly thereof, a lever pivotally mounted between its ends on said housing with one end thereof positioned interiorly of said housing and the opposite end thereof exteriorly of said housing, a gage member rotatably supported by said outer end of said lever about an axis parallel to the axis of rotation of the first mentioned gage member, a face plate disposed over an opening in said housing, a second plate

below said face plate and spaced over its central portion therefrom, said plates having aligned slots therein, an indicator bar located between said plates in bridging relation with respect to said slots, a pointer member pivotally mounted within said housing and having a pointer end arranged for sweeping movement longitudinally of said slots immediately therebelow, motion multiplying means interconnecting the first mentioned lever with said pointer member, and means constantly urging said lever in a pivotal direction to diminish the distance between said gage members.

6. In a device of the type described, in combination, a hollow housing, a gage member rotatably mounted on said housing exteriorly thereof, a lever pivotally mounted between its ends on said housing with one end thereof positioned interiorly of said housing and the opposite end thereof exteriorly of said housing, a gage member rotatably supported by said outer end of said lever about an axis parallel to the axis of rotation of the first mentioned gage member, a face plate disposed over an opening in said housing, said face plate being of curved cross-sectional conformation and being centrally slotted, a second plate below said face plate and having a central portion curved in conformance with said face plate and spaced therefrom, said second plate being slotted in alignment with the slot in said face plate, a pair of indicator bars received and frictionally retained between said plates in bridging relation with respect to said slots, a pointer member pivotally mounted within said housing and having a pointer end arranged for sweeping movement longitudinally of and immediately below said slots, motion multiplying means interconnecting the first mentioned lever with said pointer member, and means constantly urging said lever in a pivotal direction to diminish the distance between said gage members.

7. In a device of the type described, a housing having an opening therein, a pair of plates closing said opening, said plates being centrally slotted with said slots in alignment with each other, the central portions of said plates being spaced from each other, and a pair of indicator bars received between and frictionally held by said plates in bridging relation with respect to said slots.

8. In a device of the type described, a housing having an opening therein, a pair of plates closing said opening, said plates being centrally slotted with said slots in alignment with each other, the central portions of said plates being spaced from each other, and being curved in cross-sectional configuration in planes at right angles to each other, and a pair of indicator bars received between said plates within the spaced portions thereof and in bridging relation to said slots, said indicator bars being resilient and being maintained in flexed condition by said plates whereby to be frictionally held against inadvertent movement relative to said slots.

9. In a device of the type described, in combination, a hollow housing, a gage member rotatably mounted on said housing exteriorly thereof, said housing having a cylindrical opening therethrough, a lever projecting through said opening and pivotally mounted between its ends within said opening on an axis intersecting the axis of said opening and with its inner end projecting into the hollow interior of said housing and its

outer end projecting outwardly beyond said housing, a gage member rotatably supported by said outer end of said lever about an axis parallel to the axis of rotation of the first mentioned gage member, a face plate disposed over an opening in said housing, indicia operatively associated with said face plate, a pointer member pivotally mounted within said housing and having a pointer end arranged for sweeping movement relative to said face plate, motion multiplying means interconnecting the first mentioned lever with said pointer member, means constantly urging said lever in a pivotal direction to diminish the distance between said gage members, and means for sealing said cylindrical opening against the passage of foreign material around said lever comprising a spherical enlargement on said lever having a center lying on the pivotal axis of said lever and with its peripheral surface in substantial engagement with the bore of said opening.

10. In a device of the type described, in combination, a support, a gaging roller rotatably carried thereby, a second gaging roller carried by said support in laterally spaced relation with respect to the first mentioned gaging roller and in axially parallel relation with respect thereto, and means for limiting movement of a workpiece to be gaged projected between said rollers comprising a blade having an outer edge arranged in parallelism with the axes of said rollers and having a sleeve fixed thereto, said support having a bore therein arranged with its axis parallel to the axes of said rollers and rotatably receiving said sleeve therein, said support being slotted from said bore outwardly thereof to that face thereof adjacent and between said rollers and said blade being oscillatably received in and projecting from said slot, said sleeve being slotted from one end thereof to the other end thereof, and means cooperating with the bore of said sleeve operable to radially expand said sleeve into locking relationship with respect to said bore in said support.

11. In a device of the type described, in combination, a support, a gaging roller rotatably carried thereby, a second gaging roller carried by said support in laterally spaced relation with respect to the first mentioned gaging roller and in axially parallel relation with respect thereto, and means for limiting movement of a workpiece to be gaged projected between said rollers comprising a blade having an outer edge arranged in parallelism with the axes of said rollers and having a sleeve fixed thereto, said support having a bore therein arranged with its axis parallel to the axes of said rollers and rotatably receiving said sleeve therein, said support being slotted from said bore outwardly thereof to that face thereof adjacent and between said rollers and said blade being oscillatably received in and projecting from said slot, said sleeve being slotted from one end thereof to the other end thereof, the opposite ends of the bore of said sleeve being outwardly tapered, a screw having a tapered head received in one end of said bore of said sleeve, and a tapered nut received in the opposite end of the bore of said sleeve and threadably receiving said screw therein, whereby relative tightening of said screw and nut serve to radially expand said sleeve into locking relation with respect to said bore in said support.

ERNEST F. HOHWART.