Oct. 2, 1945. B. RUYSDAEL 2,386,145

DIVIDING MECHANISM

Filed Sept. 29, 1943 3 Sheets-Sheet 1

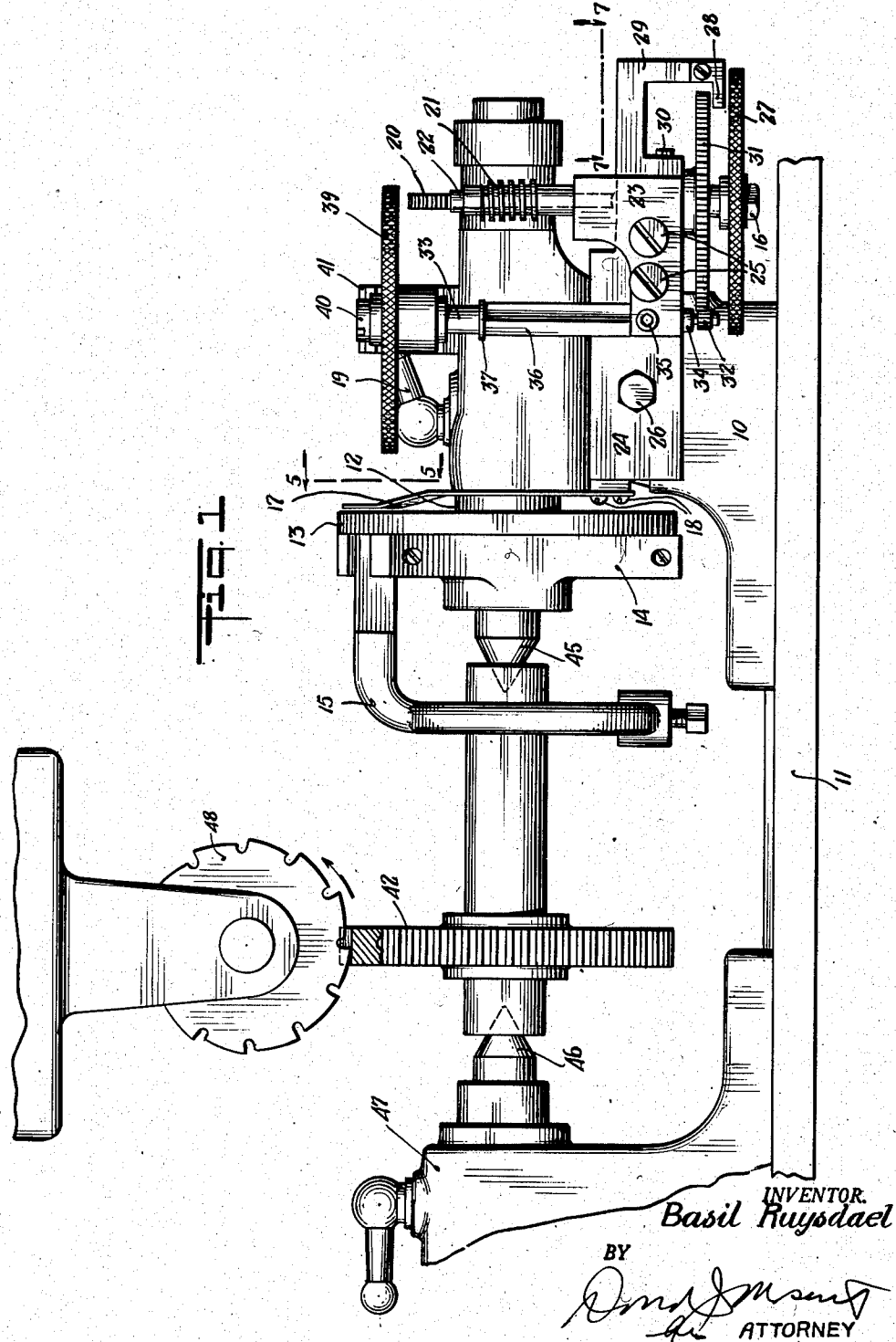


Fig. 1

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FIG. 3

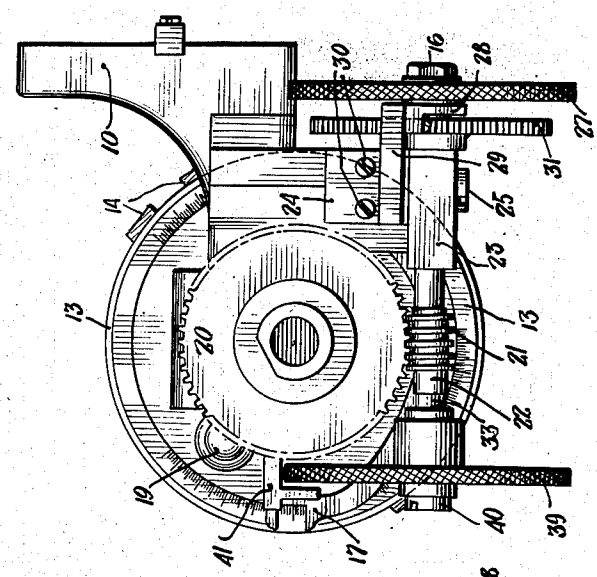
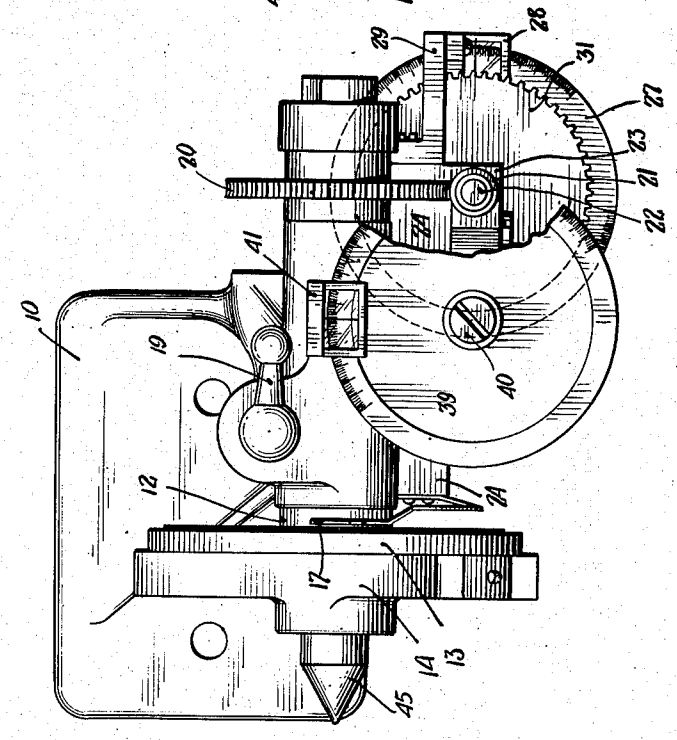


FIG. 2



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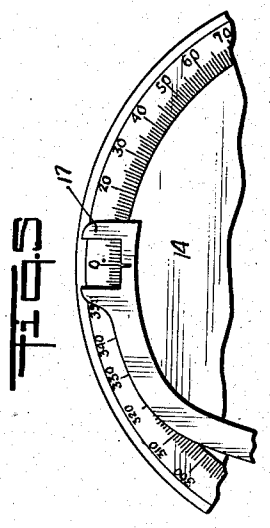


FIG. 5

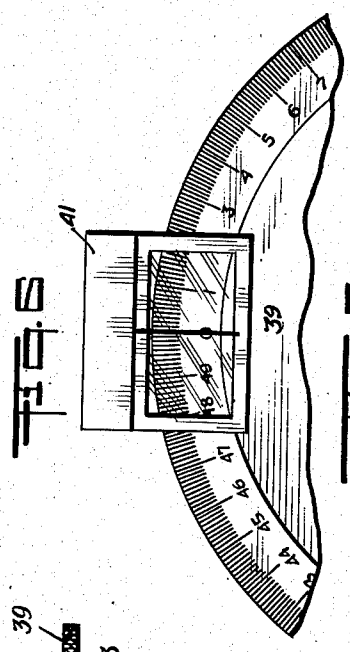


FIG. 6

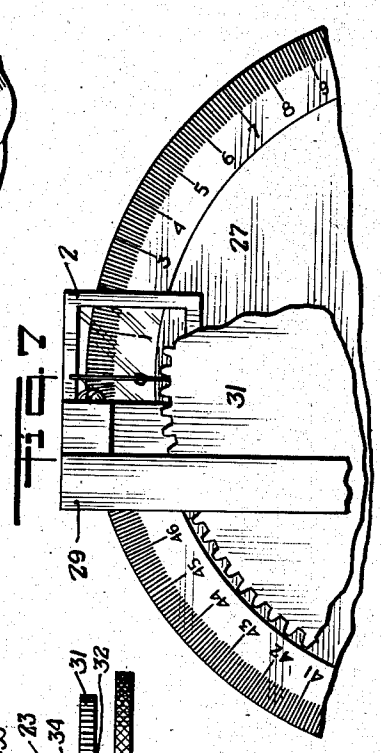


FIG. 7

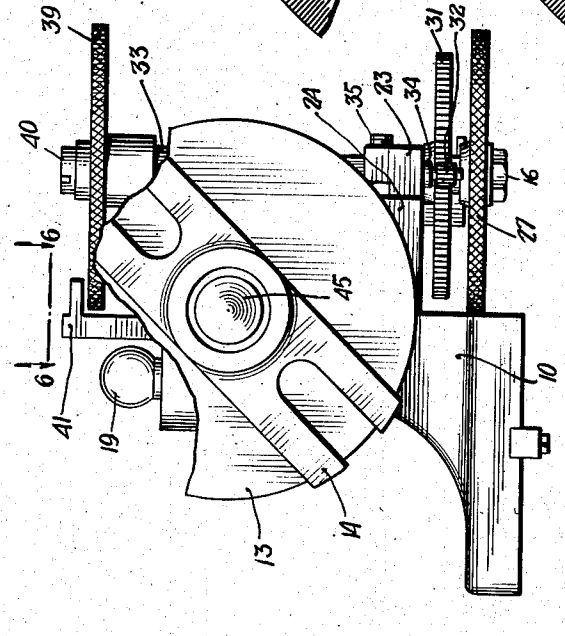


FIG. 4

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UNITED STATES PATENT OFFICE

2,386,145

DIVIDING MECHANISM

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Application September 29, 1943, Serial No. 504,513

3 Claims. (Cl. 90—56)

This invention generally relates to dividing mechanism and, more specifically, to dividing attachments adapted for use on milling machines, and the like, in the cutting of gears or similar operations, and commonly known as dividing or indexing heads.

The dividing heads heretofore generally employed are of more or less complicated and expensive construction and their use requires considerable practice and study on the part of the operator. By reason of their construction and the principles on which they are based, the range of operation of these devices is somewhat limited and, in many instances, complicated mathematical operations must be performed to set the mechanism for the desired number of divisions with considerable chances for error, as is well known to those skilled in the art.

It is, therefore, the general object of this invention to provide a dividing head of an entirely novel character which is simple and inexpensive so as to be within the reach of experimenters, and which embodies novel index means adapted to afford much greater ease of operation as compared with the devices of the prior art, while insuring absolute accuracy of divisions.

More specifically, it is a further and important object of the invention to provide a dividing head wherein all forms of holed or notched index plates or of index gears are dispensed with, and which has such a broad range of operation that any number of divisions may be obtained, as well as complicated vernier divisions.

The invention further aims at providing a dividing head of the character described, comprising only a limited number of parts, easily replaceable whenever necessary, the construction and the manner of operation of the device being such as to eliminate any possibility of cumulative error due to wear or slack.

These and other objects of the invention will become apparent in the following description of a preferred embodiment of the invention illustrated in the drawings, wherein:

Figure 1 is a side elevation of a dividing apparatus comprising the dividing head according to the invention, the device being shown applied to the table of a milling machine for a gear-cutting operation.

Figure 2 is a top plan view of the dividing head of Figure 1.

Figure 3 is an end view of the mechanism shown in Figure 2.

Figure 4 is a front elevation of the same mechanism.

Figure 5 is an enlarged view, on line 5—5 of Figure 1, showing a portion of the plate carried by the spindle of the dividing head and the graduations provided on said plate.

Figure 6 is a fragmentary enlarged view, on line 6—6 of Figure 4, of one of the index dials of the device.

Figure 7 is a similar fragmentary enlarged view, on line 7—7 of Figure 1, of the other, or main index dial of the device.

Referring now in detail to the drawings, wherein like characters of reference are employed to designate the similar parts in the various views, 10 indicates the base or support of the dividing mechanism adapted to be mounted on the table 11 of a milling machine. A horizontal spindle 12, rotatably mounted in base 10, and suitably held therein against axial displacement, carries, at one end, a plate 13 rigidly connected to the spindle for rotation therewith and a conventional driver 14 for a dog 15, for use when the workpiece is mounted between centers, as in the showing of Figure 1.

As shown in detail in Figure 5, the rear face of plate 13 is provided with degree graduations that are readable against an indicator member 17 supported by the base 10, as at 18; lock handle 19 actuates a conventional mechanism in base 10 for locking the spindle in any desired angular position during operation of the device.

A worm gear 20, suitably connected to spindle 12 for rotation therewith, meshes with a single thread worm 21 provided on a shaft 22 rotatable in a supporting member 23 and having a portion projecting downwardly from said member; as worm gear 20 has seventy-two teeth, a complete revolution of shaft 22 and worm 21 results in a rotation of five degrees of the worm gear and therefore of the spindle 12. Member 23 is carried by a support 24, to which it is suitably fastened, as by means of screws 25, support 24 being in turn bolted to base 10, as shown at 26.

A disk 27, which may be designated as the main index dial of the dividing head by reason of its function, is fastened to the aforementioned downwardly projecting portion of shaft 22, as shown at 16, for rotation with said shaft and is provided, on its upper face, with a scale consisting of five hundred uniformly spaced divisions, every tenth division being marked with a longer line and a numeral as shown in Figure 7; an indicator member 28 secured to a bracket 29 carried by member 23, as at 30, is provided for the dial. Since to one complete revolution of shaft 22

carrying index dial 27 there corresponds a five degree rotation of spindle 12 and plate 13, it will be apparent that the rotation of the dial through an angle defined by ten of the divisions indicated by the longer lines will determine a rotation of spindle 12 and plate 13 through an angle of one-tenth of one degree, and a rotation of shaft 22 through an angle defined by two adjacent divisions therefore will result in a rotation of the spindle of one hundredth of a degree. It is therefore evident that a rotation of the spindle through one-hundredth of a degree, which is accurate enough for ordinary gear work, can be easily controlled by means of the index dial 27.

Greater accuracy in indexing the spindle is, however, attainable by means of the device that will now be described. A gear 31 mounted on shaft 22 meshes with a pinion 32 secured to the lower end of a second vertical shaft 33 which is rotatable in a bushing 34 mounted in member 23 and held against rotation therein as by means of set screw 35; a portion of shaft 33, having a shoulder 37, extends upwardly from member 23 for rotation within a hollow member or sleeve 36 interposed between the upper face of member 23 and shoulder 37 to prevent axial displacement of shaft 33 and to insure proper meshing of gear 31 and pinion 32. As shown in Figure 2, gear 31 is of smaller diameter than index dial 27 so as not to interfere with the reading of the graduations of this dial.

A second index dial 39, similar to index dial 27 and likewise provided with a scale consisting of five hundred uniformly spaced divisions and longer lines to mark every tenth division, is suitably secured to the upper end of shaft 33, as at 40, the divisions being readable against an indicator member 41 carried by the base 10. As the ratio of the gear coupling 31—32 has been made 10 to 1 in the embodiment illustrated, it will be apparent that the rotation of index dial 39 through an angle defined by two adjacent divisions will result in a rotation of spindle 12 of one-thousandth of a degree, and that such an angular movement, which is sufficient for practically perfect indexing accuracy, can be easily controlled by means of index dial 39.

With a low power magnifying glass, that can be conveniently mounted on indicator member 41, movements of dial 39 of a half graduation can be easily checked, thereby controlling the rotation of spindle 12 even through an angle of half a thousandth of a degree.

The manner of operation of the dividing head will be apparent from the foregoing description. The work piece may be mounted on the milling machine in any suitable manner, as in the showing of Figure 1, which illustrates the cutting of a gear blank 42, mounted between center 45 of spindle 12 and center 46 of a conventional tailstock 47, by means of a cutter 48. The operator determines the angular interval between two successive divisions in relation to the total number of divisions desired, which will represent the initial setting of the dividing mechanism, and manipulates the main index dial 27 and the index dial 39 thereby rotating spindle 12 until the desired angle has been obtained; the main index dial may be set within one degree of the desired angle and the second dial moved on to the thousandths of degree required. Should the setting be inadvertently passed, the spindle can be rotated back a degree, or so, and the mechanism reset to take up any slack.

The spindle is then locked by means of lock handle 19 and the first division is effected, the spindle being then rotated, of course, by the same angular amount as many times as necessary to obtain the desired number of divisions. As the train moves always in the same direction during the dividing operation, there is no objectionable slack or backlash to the train, and no vibration affects the setting due to the fact that the spindle is firmly locked in the proper angular position after each setting.

The angular interval required for any given number of divisions is determined by means of tables that show, at a glance, in degrees and thousandths of degree, the angular interval between any two successive divisions and the total angular displacement of the spindle in any phase of the dividing operation. If, for instance, 38 divisions are desired, the tables will show an angular interval between any two successive divisions of 9.474° (which will be the initial setting of the dividing head) and a total angular displacement for, say, the fourteenth division of 132.632°; the setting can be in this manner continuously checked during the dividing operation as the total angular displacement of the spindle is readable, at any time, on the index dials. Obviously, the angular values given in the tables cannot always be absolutely correct as the third decimal figure must, in some instances, be approximated; however, the error is insignificant and compensated back and forth in the tables, to avoid the possibility of cumulative error, so that it does not affect in any way the accuracy of the divisions.

The foregoing description clearly illustrates the advantages of the novel dividing mechanism as compared with the devices of the prior art. The dividing head is of simple and inexpensive construction, it comprises only a limited number of parts, easily assembled and disassembled for replacement of any part as might be required due to wear or other causes; cumulative errors due to wear or slack are entirely eliminated.

The adoption of index dials graduated in degrees and decimals of degrees, and the arrangement of the parts, permit of great accuracy of divisions and of an extremely broad range of operation; furthermore, the operation of the mechanism is rendered so simple and easy that anyone can use the device provided he is capable of reading the graduations on the index dials.

While I have described the invention substantially with reference to a preferred embodiment thereof, it will be understood that many modifications may be made in the structure described in the specification and illustrated in the drawings without departing from the spirit of the invention or exceeding the scope of the claims.

I claim:

1. A dividing mechanism comprising a base, a horizontal spindle rotatably mounted in said base, a plate and a worm wheel fastened to said spindle for rotation therewith, a scale on said plate, a vertical shaft rotatably supported externally of the base and having a worm meshing with the worm wheel fastened to the spindle, said worm and worm wheel being so proportioned as to determine a rotation of the spindle through an angle of five degrees for each revolution of the shaft, a second vertical shaft rotatably supported externally of the base, constantly meshing gear means for driving the first-mentioned shaft at the reduced rate of one to ten relative to said second shaft upon rotation of this latter, discs fastened to the shafts oper-

able to rotate the same, and scales on said discs, said scales cooperating with the scale on the plate fastened to the spindle to indicate the amount of angular displacement imparted to the spindle through the rotation of the shafts.

2. A dividing mechanism comprising a base, a horizontal spindle rotatably mounted in said base, a plate and a worm wheel fastened to said spindle for rotation therewith, a scale on said plate, supporting means removably carried by the base externally thereof, a shaft rotatably mounted on said supporting means and having a worm meshing externally of the base with the worm wheel fastened to the spindle, said worm and worm wheel being so proportioned as to determine a rotation of the spindle through an angle of five degrees for each revolution of the shaft, a second shaft rotatably carried by said supporting means, constantly meshing gear means for driving the first-mentioned shaft at the reduced rate of one to ten relative to said second shaft upon rotation of this latter, discs fastened to the shafts operable to rotate the same, scales on said discs, said scales cooperating with the scale on the plate fastened to the spindle to indicate the amount of angular displacement imparted to the spindle through the rotation of the shafts, and means independent of the discs for locking the spindle in any angular position.

3. A dividing mechanism comprising a base, a horizontal spindle rotatably mounted in said base, a plate and a worm wheel fastened to said spindle for rotation therewith, a scale on said plate, a vertical shaft rotatably supported externally of the base and having a worm meshing with the worm wheel fastened to the spindle, said worm and worm wheel being so proportioned as to determine a rotation of the spindle through a specific part of a revolution for each revolution of the shaft, a second vertical shaft rotatably supported externally of the base, constantly meshing gear means for driving the first-mentioned shaft at a fixed reduced rate relative to said second shaft upon rotation of this latter, discs fastened to the shafts operable to rotate the same, and scales on said discs, said scales cooperating with the scale on the plate fastened to the spindle to indicate the amount of angular displacements imparted to the spindle through the rotation of the shafts.

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