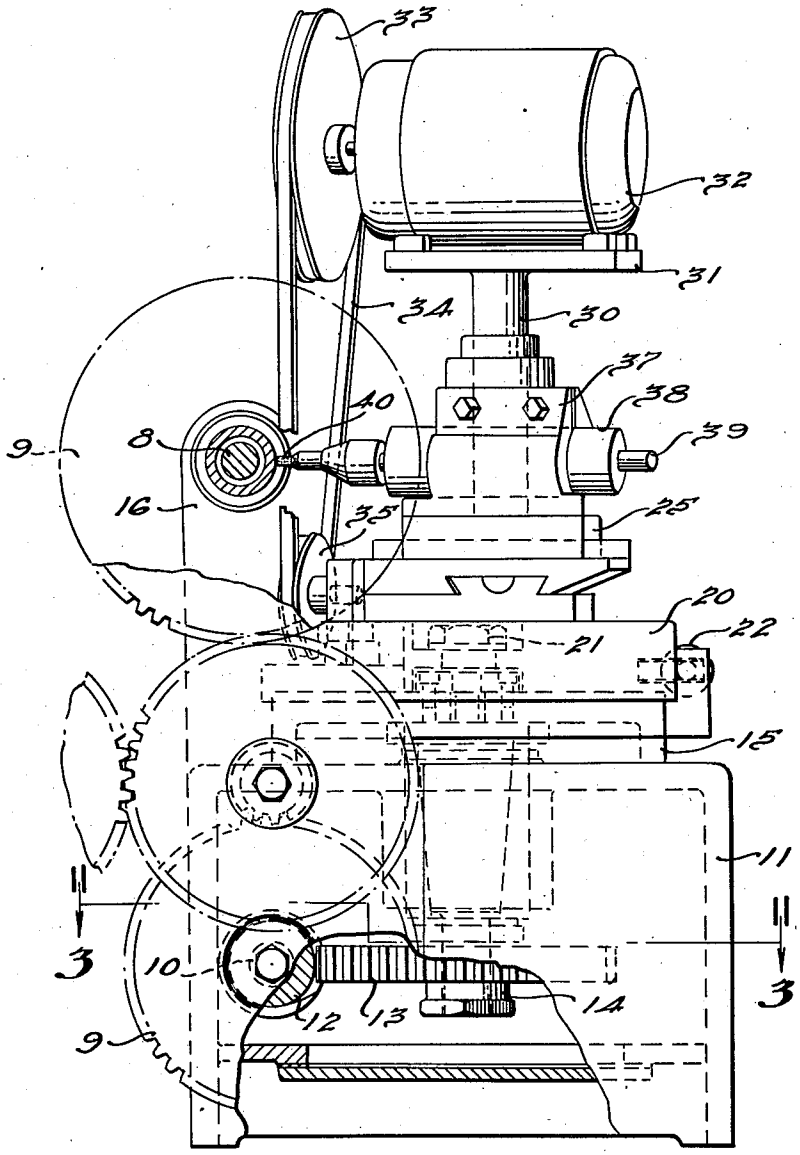
Dec. 28, 1943. G. R. SCOTT 2,337,776

THREAD POLISHING APPARATUS

Filed Nov. 3, 1941 2 Sheets-Sheet 1

FIG. 1.



INVENTOR
George R. Scott.
BY
Harness, Dickey & Pierce,
ATTORNEYS.

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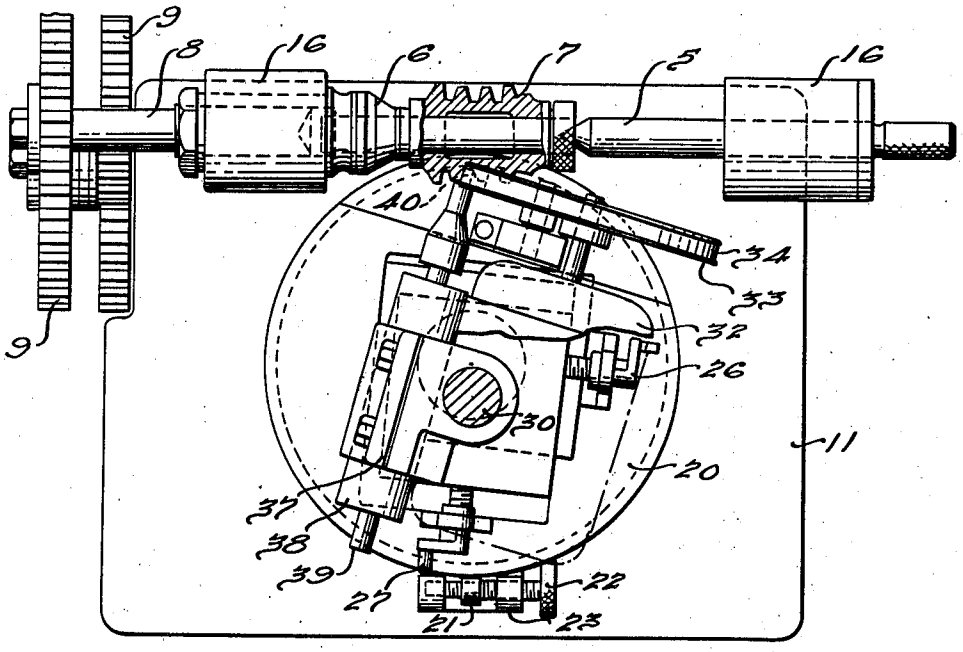


FIG. 2.

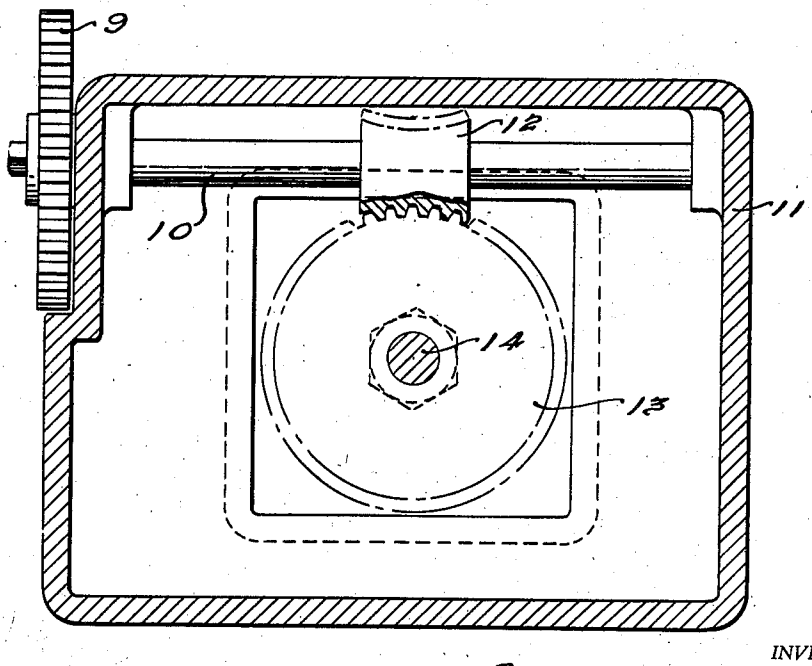


FIG. 3.

INVENTOR
George R. Scott.
BY Harness, Dickey & Pierce
ATTORNEYS.

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2,337,776

UNITED STATES PATENT OFFICE

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THREAD POLISHING APPARATUS

George R. Scott, Detroit, Mich.

Application November 3, 1941, Serial No. 417,647

4 Claims. (Cl. 51—142)

The present invention relates to apparatus for polishing worms for use in worm gearing. More particularly, the present apparatus relates to a polishing head assembly adapted to be mounted as a unit on a hobbing machine for the purpose of polishing the thread flanks of a worm of the hour-glass, globoidal or area contact type.

It is recognized that in gearing of this general type the worm generally possesses greater strength than the wheel with which it is meshed. Consequently, failures from over-loading are in the vast majority of cases failures of the wheel rather than the worm. This situation is different from that encountered in conventional worm gearing where practically all failures of the gear set arise as a result of failure of the worm. Consequently, in conventional worm gearing, in order to obtain maximum strength of the gear set, it is conventional practice to harden and grind the worm thread in order to increase its strength. This grinding operation serves to provide the thread of the worm with the desired smooth finish.

In the manufacture of worms of the type with which the present application is concerned, the strength of the worm is sufficiently great so that hardening is unnecessary. Grinding operations are unnecessary because the worm as finally cut is not distorted as a result of heat treatment. Consequently, in gearing of this type, it is in many cases desirable to improve the finish of the thread flanks of the worm in order that these thread flanks will be smooth. This is desirable inasmuch as the cutting operation does not in most cases produce thread flanks having as smooth a surface as may be desired. Consequently, polishing apparatus of the type herein disclosed has particular and peculiar advantages in gearing of the type with which the present invention is concerned.

Many other and further objects, advantages, and features of the present invention will become clearly apparent from the following description when considered in connection with the accompanying drawings.

In the drawings:

Figure 1 is a side elevational view with parts broken away showing a polishing assembly embodying the improvements of the present invention mounted in position on a more or less conventional hobbing machine.

Figure 2 is a top plan view with parts broken away illustrating in further detail the apparatus shown in Figure 1.

Figure 3 is a transverse sectional view taken substantially along the line 3—3 of Figure 1 illustrating in detail the drive mechanism for the hobbing machine table.

In order to appreciate the nature of the action of the apparatus hereinafter described, attention is directed to Cone Patents No. 1,822,800 and No. 1,885,686 in which an area contact worm and gear of the type with which the present invention is concerned are shown and described in detail. It will be readily appreciated that in this type of gearing, the worm is generated in such a manner that a plane passing through the axis of the worm intersects the flanks of the thread of the worm to form straight line intersections. These lines of intersection, when extended, all lie tangent to a common circle herein referred to as the "base circle" and it should be borne in mind in this connection that the term base circle as used in connection with worm gearing of this type is not to be confused with the term base circle as used in connection with conventional involute gearing.

While it will be readily appreciated that a full-sized machine designed and intended for the sole purpose of polishing worms may conveniently be constructed embodying the improvements of the present invention, the specific embodiment of the invention illustrated in the drawings and described in detail below consists merely of a more or less unitary, self-contained assembly which may be attached to or detached from the table of a hobbing machine and inasmuch as the hobbing machine with which this device is adapted to be associated is substantially conventional in construction, it is not believed necessary to illustrate the details thereof.

As is conventional in hobbing machines, a pair of centers 5 and 6 are provided between which is mounted a workpiece or worm 7 which has been cut to a thread of substantially the finally desired form. As has been pointed out above, this worm is of the area contact type in which a plane passing through the axis of the worm intersects the thread flanks of the teeth to form straight line intersections and in which the extension of these lines of intersection in a plane passing through the axis of rotation of the worm all lie tangent to a common base circle whose axis coincides with the axis of the worm wheel with which the worm is adapted to mesh.

The centers 5 and 6 and the workpiece 7 together comprise a work spindle which is driven by means of a shaft 8 and through change speed gearing 9 drive a shaft 10 journalled for rotation in the base housing 11 of the hobbing machine.

Inasmuch as the interconnecting drive of the work spindle and table of a hobbing machine is conventional construction, it is not believed necessary in this application to describe this structure in detail.

A worm 12 is carried by the shaft 10 and meshes with a worm wheel 13 carried on a shaft 14 which shaft 14 carries at its upper end a conventional circular work table 15 of a hobbing machine. In this construction, it will be readily appreciated that as the work spindle is rotated by means of a suitable source of power, the work table 15 will be rotated in timed relation thereto and, by means of the change speed mechanism, the ratio between the rotation of the work spindle and the work table may be maintained the same as the ratio between the worm and the worm wheel with which the worm is adapted to mesh.

As is conventional in hobbing machines of this general character, the centers 5 and 6 are mounted for rotation in suitable supports 16 which may be mounted on suitable ways (not shown) in order to adjust the position of the workpiece with respect to the axis of rotation of the work table 15 in order that during the polishing operation the center distance between the axis of rotation of the worm and the axis of rotation of the table 15 may be adjusted to coincide with the center distance between the axis of rotation of the worm and the theoretical rotation of the worm wheel with which the worm is ultimately adapted to mesh.

The apparatus of the present invention includes a supporting base 20 which is rotatably anchored to the table 15 of the hobbing machine by any suitable means such, for example, as the cap screw 21 and is preferably mounted in such a way that it may be rotated with respect to the table about an axis which coincides with the axis of rotation of the work table 15. This base member 20 has integrally formed thereon a projection 21 which is engaged by means of an adjusting screw 22 rotatably received in a suitable boss 23 projecting from the table 15. It will be apparent from this construction that the relative rotative position of the base member 20 with respect to the work table 15 may be very accurately and precisely adjusted by means of the screw 22.

A main supporting base 25 is interconnected to the base member 20 by means of a pair of dovetail slides arranged at right angles to each other and the position of these slides may be accurately adjusted and controlled by means of feed screws 26 and 27 in order that the supporting base 25 may be adjusted to any desired position with respect to the work table 20. The supporting base has projecting upwardly therefrom a supporting column or pedestal 30 which at its upper end is provided with a platform 31 on which is mounted a suitable electric motor 32 having a pulley 33 adapted to carry a polishing belt 34. The polishing belt 34 passes over an idler pulley 35 mounted for rotation on a suitable stub shaft carried by the supporting base 25.

A suitable fixture 37 serves to mount a housing 38 adjacent the column 30. The housing 38 carries a conventional bearing assembly for rotatably mounting a spindle 39 which has a relatively small cylindrical tip 40 over which the polishing belt 34 passes. This tip 40 is, as stated above, cylindrical in form and is of sufficiently small diameter so that it may easily enter between the threads of the worm. Due to the fact that the spindle 39 is freely rotatable, this cylindrical tip provides an idler pulley which serves the purpose of forcing the polishing belt 34 into intimate engagement with the thread flank of the worm being finished.

The operation of the device is substantially as follows. The worm or workpiece 7 is mounted between centers 5 and 6 and the supports 16 are adjusted so that the axis of rotation of the workpiece is spaced from the axis of rotation of the work table 15 exactly the same distance as the axis of the worm would be spaced from the axis of the worm wheel with which the worm is adapted to mesh. When this condition is obtained, it will be readily appreciated that a plane passing through the axis of the worm and perpendicular to the axis of the work table will intersect the thread flanks of the worm to provide straight line intersections. These lines of intersection, when extended in this plane, will all lie tangent to a common circle whose center coincides with the axis of the work table which circle is referred to herein as the base circle.

The adjusting screws 26 and 27, controlling the respective slides, are then adjusted so that the left hand side of the spindle tip 40, as viewed in Figure 2, will lie along a line which is also tangent to this base circle.

The motor 32 may then be started which serves to drive the polishing belt 44 over the spindle tip 40 and the hobbing machine may then be started which will rotate the table 15 in precisely timed relation to the workpiece 7. The screw 22 may then be adjusted to vary the relative rotative position of the base 20 with respect to the work table 15 thereby bringing the surface of the polishing belt into contact with the thread flank of the worm being polished.

It will be appreciated that adjustment of the screw 22 merely varies the relative rotative position of the polishing assembly with respect to the work table 15 of the hobbing machine without altering the adjustment of the polishing spindle from its position. This is a particularly important feature because it will be appreciated that the operating surface of the polishing spindle must lie along a line tangent to the base circle in order that the polishing action will at all times tend to generate the desired form on the flanks of the thread of the worm being polished.

It will be appreciated that the apparatus herein shown and described, when operated as described above, will merely serve to polish one thread flank of one thread of a worm. In order to polish the opposite thread flank of the worm, the workpiece may be removed from the centers 5 and 6 and turned end-for-end in order to expose the opposite thread flank for polishing. Similarly, if it is desired to employ the present apparatus for polishing a worm of two or more threads, suitable adjustments of the polishing assembly may be made which will bring the polishing spindle into proper position with respect to the flank of each of the threads to be polished.

While it will be appreciated that the invention herein shown and described merely illustrates one form of construction embodying the improvements of the present invention, many other and further modifications thereof may be made therein within the scope of the invention as defined in the subjoined claims.

What is claimed is:

1. Apparatus for polishing the thread flank of an area contact type of worm, including a spindle for rotatably mounting said worm, a rotatable

supporting table mounted for rotation about an axis coinciding with the axis of rotation of the worm wheel with which said worm is adapted to mesh, a polishing belt mounted on said supporting table, said belt having a width generally the same as the depth of the thread of the worm being polished, means mounted on said table for continuously driving said belt, and means mounted on said table for urging said belt into engagement with the thread flank of said worm, said last mentioned means comprising a rotatable cylindrical spindle having a diameter sufficiently small to enter freely between the threads of said worm.

2. Apparatus for polishing the thread flank of an area contact type of worm, including a spindle for rotatably mounting said worm, a rotatable supporting table mounted for rotation about an axis coinciding with the axis of rotation of the worm wheel with which said worm is adapted to mesh, a polishing belt mounted on said supporting table, said belt having a width generally the same as the depth of the thread of the worm being polished, means mounted on said table for continuously driving said belt, means mounted on said table for urging said belt into engagement with the thread flank of said worm, said last mentioned means comprising a rotatable cylindrical spindle having a diameter sufficiently small to enter freely between the threads of said worm and disposed to engage the inside of said belt in line contact, and means for adjusting the position of said spindle whereby said polishing belt will engage the thread flank of said worm along a straight line tangent to a circle whose center coincides with the axis of rotation of said supporting table.

3. Apparatus for polishing the thread of an area contact type of worm, including a spindle for rotatably mounting said worm for rotation about its axis, a rotatable supporting table mounted for rotation about an axis coinciding with the axis of rotation of the worm wheel with which said worm is adapted to mesh, means for rotating said worm spindle and table in timed relation with each other in accordance with the ratio of said worm and worm wheel with which said worm is adapted to mesh, polishing apparatus mounted on said supporting table for bodily movement therewith adapted to engage and polish the flank of the thread of said worm, adjustable means interconnecting said polishing apparatus with said supporting table whereby to vary the relative rotative position of said polishing apparatus with respect to said supporting table, said polishing apparatus including a spindle having a cylindrical end portion adapted to enter between the threads of the worm being polished and disposed in a plane passing through the axis of the work and a polishing belt passing over said spindle in engagement therewith whereby said spindle may serve to force said polishing belt into engagement with the thread flank of said worm.

4. Apparatus for polishing the thread of an area contact type of worm, including a spindle for rotatably mounting said worm for rotation about its axis, a rotatable supporting table mounted for rotation about an axis coinciding with the axis of rotation of the worm wheel with which said worm is adapted to mesh, means for rotating said worm spindle and table in timed relation with each other in accordance with the ratio of said worm and worm wheel with which said worm is adapted to mesh, polishing apparatus mounted on said supporting table for bodily movement therewith adapted to engage and polish the flank of the thread of said worm, adjustable means interconnecting said polishing apparatus with said supporting table whereby to vary the relative rotative position of said polishing apparatus with respect to said supporting table, said polishing apparatus including a spindle having a cylindrical end portion adapted to enter between the threads of the worm being polished and disposed in a plane passing through the axis of the worm, a polishing belt passing over said spindle in engagement therewith whereby said spindle may serve to force said polishing belt into engagement with the thread flank of said worm, and adjustable means for varying the position of said spindle in order that the engagement of said polishing belt with the thread flank of said worm will constitute a straight line which in extension will intersect the axis of said worm and will lie tangent to a circle whose center coincides with the axis of rotation of said supporting table.

GEORGE R. SCOTT.