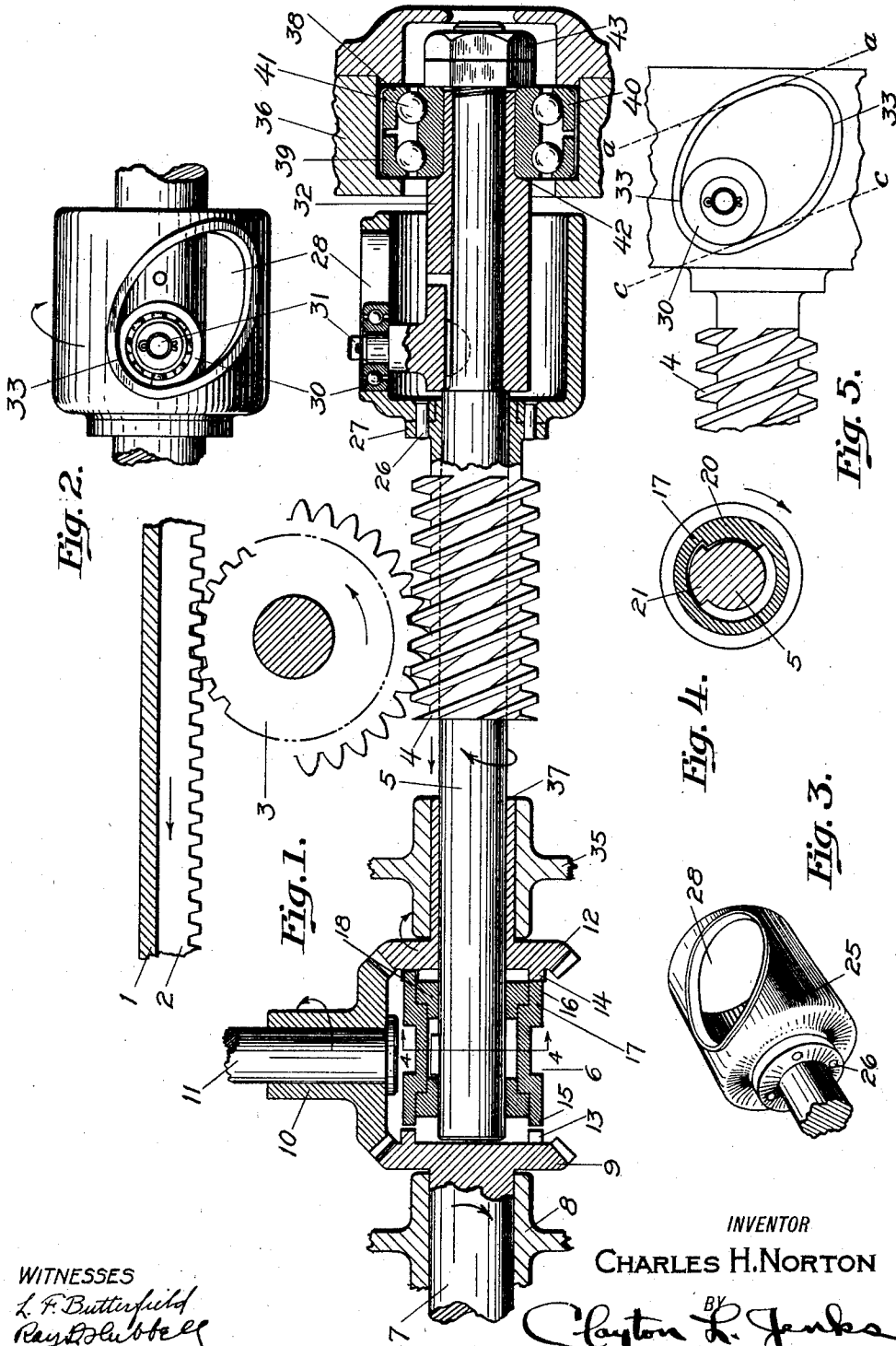


C. H. NORTON.
DRIVING AND REVERSING MECHANISM.
APPLICATION FILED MAR. 27, 1918.

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DRIVING AND REVERSING MECHANISM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, CHARLES H. NORTON, a citizen of the United States of America, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented certain new and useful Improvements in Driving and Reversing Mechanism, of which the following is a full, clear, and exact specification.

My invention relates to a driving mechanism and has for an object the elimination of shocks incident to starting heavy bodies into motion and the provision of means permitting an increased rate of operation of a reciprocatory or periodically movable body.

A further object of my invention is to provide a gradual start for a massive reciprocating body at each reversal of direction without obtaining serious shocks, except such as may be incident to manipulation of the clutch mechanism and starting relatively light gearing into motion, and to utilize for this purpose a cam mechanism which rotates continuously between reversals.

With these and other objects in view, as will appear from the following disclosure, my invention resides in the combination of parts set forth in the following specification and covered by the claims appended hereto.

In the drawings, in which like reference numerals indicate like parts:

Figure 1 is a somewhat diagrammatic representation, partly in section, of a portion of a grinding machine embodying my invention;

Fig. 2 is an exterior elevation of the cam attachment constituting the driving mechanism;

Fig. 3 is a perspective view of the same part;

Fig. 4 is a section on the line 4—4 of Fig. 1, showing a clutch construction adapted to permit the shaft to remain at rest during a part revolution of the driving mechanism; and

Fig. 5 is a diagrammatic representation of the relation between the pitch of the worm and the shape of the cam path.

In the art of grinding, as well as in similar arts involving turning, forming or machining cylindrical surfaces, it is customary to mount the body to be treated upon a movable table and to cause the same to travel in opposite directions past the tool at frequent

intervals, the rate of cutting depending largely upon the speed with which the table may be moved. Hence, unless provisions are made to guard against such shock, it is impossible to drive the table at any considerable rate comparable with that theoretically permitted by the cutting capacity of the grinding wheel.

In the Patent #1,191,987 granted to me on July 25, 1916, I have provided a device for starting a grinding table gradually, this mechanism involving a worm which is made to serve as a rack bar without rotating during the starting of the table and thereafter to rotate and drive in a normal manner. In my present invention, relating to a similar type of driving and reversing mechanism, I have embodied provision for starting the worm into rotative motion and rotating it continuously during both the table starting operation and the normal forward drive, whereby I obtain a gradual acceleration of the driven parts from rest to full speed without serious shocks.

As a specific embodiment of one phase of my invention, I have illustrated in the drawings an arrangement applicable to a grinding machine, involving a grinding machine table 1, having a rack 2 thereon, connecting with a gear mounted on the same shaft with a worm wheel 3, which in turn meshes with a worm member 4 loosely mounted on the shaft 5. The shaft 5 is driven through the clutch mechanism 6 by means of a driving shaft 7. The driving shaft 7, mounted in suitable bearings, one of which is shown at 8, has a bevel gear 9 thereon meshing with the bevel gear 10 rotatably carried by the post 11. This bevel gear 10 in turn meshes with another bevel gear 12 on the shaft 5. On the inner faces of gears 9 and 12 are clutch teeth 13 and 14 adapted to mesh with clutch teeth 15 and 16 respectively of a clutch member 17 slidably mounted upon the shaft 5, and movable into engagement with one or the other of the clutch teeth on the bevel gears by any suitable means. This slidable clutch member 17 involves, as illustrated in Fig. 1 and Fig. 4, a hollow cylindrical body carried on two bearing members 18 slidably mounted on shaft 5, and has upon its inner surface a single tooth or key 20, which is adapted to engage a projecting lug 21 on the shaft 5. For a

purpose which will be hereafter explained, these teeth cover only a portion of the total circumference, the remaining space being left to permit the shaft 5 to remain idle, while the shaft 7 continues to rotate a part turn.

As illustrated in the drawings, the worm is loosely and rotatively mounted on the shaft 5 and is shorter than the space allotted to it, so that it may slide longitudinally and be freely rotatable thereon except as restrained by the driving mechanism. In order that the worm may be forced to rotate the worm wheel at a gradually increasing rate until its normal motion is attained, I provide a cam driving mechanism which starts the worm at substantially full speed and thereafter permits the worm to slide longitudinally on the shaft while rotating continuously, although not necessarily uniformly, with the driving shaft. While it is obvious that the worm need not be mounted on the driving shaft and the driving connections may be otherwise arranged, I prefer to utilize the compact and simple construction illustrated. In the present embodiment the worm carries a cam member 25 fixed thereto by suitable means such as the screw bolts 26 engaging an upturned flange 27 on an extended portion of the worm sleeve. Because of conveniences in manufacture and in the operation of the device, this cam member 25 may comprise a hollow cylindrical body concentrically spaced from the driving shaft 5 and provided with a double cam in the form of a large, obliquely disposed opening 28 in its peripheral wall. This cam member serves as a driver for the worm and an accelerator for the worm wheel, as will be hereinafter explained. In order to rotate the cam member and worm I provide a cam rider or driver, comprising in the present instance a roller 30, engaging the peripheral wall of the cam slot. This roller is suitably mounted on ball bearings on the post 31 carried by the cylindrical sleeve 32 keyed to the shaft 5.

It is apparent that, in the construction so far described, if the worm were not longitudinally movable on the shaft 5 the driving roller 30 would drive the cam member 25 and rotate the worm synchronously with the shaft. To permit longitudinal movement of the worm and to utilize such movement for causing a gradual start of the grinding table, I make the cam slot 28 of a special shape. The initial portion 33 of the driving face of the slot is approximately parallel with the axis of the shaft, so that when the drive shaft 5 and roller 30 begin to rotate in the direction of the arrow shown in Fig. 2, the cam member 25 and worm 4 also turn in the same direction; but, due to the inertia of the stationary table 1, there is transmitted a reacting force through the worm wheel

teeth to the worm, and the worm tends to screw forward through the worm wheel teeth without turning the wheel, whereby the worm is forced to slide to the left on the shaft 5 and the roller 30 travels horizontally along the face of the cam slot.

Referring to Fig. 2 and Fig. 5, the latter representing a development of the cam, I have there shown the cam as being of a shape designed to prevent the worm sliding freely and to overcome the inertia of the worm wheel and table and to start them gradually. In accordance therewith, the initial portion 33 of the cam slot is substantially horizontal and produces no movement of the load. The curve of the cam gradually changes from this direction toward a helical line $a-a$ (Fig. 5) which is arranged at a suitable angle for driving the worm. I have found that the line $a-a$ should be substantially parallel with the driving face of the worm, although one may have to depart from the theoretically true form of the curve to take care of the exact conditions met with in the machine. Furthermore I so design the curve that the cam roller will stop at substantially the lower end of the slot and be ready to start back up the opposite face of the slot without any shock. As illustrated, the lower portion of the right hand curve is an arc of a circle corresponding with the shape of the roller, hence when the latter stops in its travel where the line $a-a$ is tangent to the curve, it is also in contact with the starting portion of the other half of the cam slot. The return path on the left hand wall of the slot is symmetrical with the portion described, the helical part of the curve in the tangent line $c-c$ being parallel with the line $a-a$.

The shaft 5 and associated parts are mounted on suitable supports 35 and 36, the part 35 having a suitable bearing sleeve 37 therein. The end thrust on the shaft 5 due to the reaction of the table load is taken care of by means of ball bearings of any suitable construction mounted in the support 36. These bearings may comprise rings 38 and 39, concentrically surrounding a ring 40 mounted on a reduced end of the cylindrical sleeve 32, these rings 38 and 39 being separated from ring 40 by the balls 41. A shoulder 42 on the member 32 and the nuts 43 prevent endwise movement of the parts.

Since the table and driving mechanism have considerable mass, I prefer to utilize the lost motion connection illustrated in Figs. 1 and 4, which permits the moving parts to continue for a short time under their own momentum after the clutch has been thrown for the reverse direction, whereby the table may come to rest gradually and without shock. This construction permits the shaft 5, the worm 4 and the cam member 25 to rotate together with the worm

wheel 3 after the power is disconnected, thereby causing the cam wheel 30 to remain stationary in its driving position in the cam slot 28, while the lug 21 on the shaft 5 moves around to meet the lug 20 on the clutch member which is now traveling in the reverse direction.

The operation of my device is obvious from the above disclosure. When the clutch is thrown and shaft 5 begins to rotate, the roller 30 is revolved about the shaft axis and therefore carries with it the cam member 25 and the worm 4. Due to the reacting pressure of the load transmitted through the worm wheel upon the worm, the worm at first slides on the shaft while rotating and its threads travel idly through the worm wheel teeth. As a result, the cam member 25, in addition to being revolved about the shaft's axis, is similarly moved horizontally. However, the roller 30 controls the position of this member, since it is forced to follow the cam represented by the upper half of the curve in Fig. 2 and Fig. 5, and such horizontal motion is thereby gradually retarded. As the roller climbs along the cam path, it causes the cam member 25 to rotate, momentarily, slightly faster than the shaft. This movement of the roller relative to the cam stops when the reacting force of the worm wheel tending to drive the worm longitudinally is balanced by the resultant force involved in the cam roller attempting to ride back down the cam path. By this means a reactive force is impressed upon the worm wheel, causing it to rotate at first slowly and at a gradually increasing rate until the normal speed is attained. When the clutch is reversed, the table and rotative parts keep moving under their own momentum until friction brings them to a stop. Then the mechanism will start in the opposite direction and bring the table gradually to full speed, the cam roller in this case riding along the left hand path of the cam slot and forcing the worm to slide toward the right.

In accordance with my invention I have provided a mechanism for starting a periodically moving heavy body from rest to full speed, comprising a worm which is rotated constantly by a rotating cam-driving member, this constant rotation of the parts occurring during the interval between reversals of the clutch mechanism, whereby I am enabled to move the table of a grinding machine at two or three times the speed hitherto considered the maximum, without objectionable shock.

Having thus described my invention, what I claim as new and useful and desire to secure by Letters Patent is:

1. In a driving and reversing mechanism for a reciprocating load, means to start the load gradually and to move it in opposite

directions comprising a screw threaded member rotated continuously between reversals, a driven member meshing therewith and automatic means rotated continuously during the starting operation to impart a gradual acceleration of velocity to said member and thereafter drive it at a normal rate.

2. In a driving and reversing mechanism for a reciprocating load, a worm, a worm wheel driven thereby and driving means, comprising a driven cam member rotated continuously during the starting operation, to rotate the worm and move the worm wheel at a rate gradually increasing to a maximum and thereafter drive it continuously at said maximum rate.

3. In a driving and reversing mechanism for a reciprocating load, a rotatable worm, a worm wheel driven thereby and means comprising a single rotary cam member to accelerate the worm wheel at a gradually increasing rate until a normal motion is obtained and thereafter drive it at a uniform rate.

4. In a driving mechanism, a longitudinally movable, rotatable worm, a worm wheel driven thereby and means comprising a normally rotatable member having a cam path and a driver cooperating with said path to rotate the worm continuously while moving it longitudinally relative to the worm wheel and thereby start the load gradually and thereafter drive it at a uniform rate.

5. In a driving and reversing mechanism for a reciprocating load, a uniformly rotatable shaft, a worm axially and rotatably movable thereon and means, comprising a driver rotatable with the shaft and a cam member rotatable with the worm, to rotate the worm and simultaneously move it axially of the shaft to accelerate the load gradually to a normal driving rate.

6. In a driving and reversing mechanism, the combination of a rotatable shaft, a worm longitudinally movable thereon, a worm wheel driven thereby, a cam member attached to and rotatable with the worm, and a driver rotated by said shaft and engaging said cam to rotate the worm and permit a gradually decreasing longitudinal movement thereof during such rotation to accelerate a load gradually to a normal driving rate.

7. In a driving and reversing mechanism, a shaft, means to rotate the same uniformly in opposite directions, a worm axially and rotatably movable on the shaft, a worm wheel driven by the worm, a cam member rotatable with the worm and a rotated cam driver engaging the cam for rotating the worm constantly, said cam being of a shape adapted to permit a gradually decreasing axial movement of the worm on the shaft

in both directions during rotation of the worm.

8. In a driving and reversing mechanism, a shaft, means to rotate the same uniformly
5 in opposite directions, a worm mounted to move longitudinally and rotatably on the shaft, a worm wheel driven by the worm, a cam driving rider on and revoluble with the shaft, a cam member fixed to rotate with
10 the worm and having a double cam engaged by the rider, said cam being of a shape adapted to cause rotation of the worm and simultaneously permit an initial, gradually decreasing, longitudinal movement of the
15 cam member and worm for each direction of rotation of the shaft.

9. In a driving mechanism, a rotatable

shaft, a rotatable worm longitudinally movable thereon, a worm wheel driven by the worm, a cam roller revolvably carried by the
20 shaft, a cam member fixed to the worm and having an obliquely disposed cam slot engaged by the roller opposite walls of said slot, varying in direction gradually from
horizontal to substantially helical lines, 25 whereby revolution of the roller about the shaft axis rotates the cam member and causes it and the worm to travel longitudinally at a decreasing rate as the roller rides up a cam wall from the horizontal to the helical
30 position.

Signed at Worcester, Massachusetts, this
25th day of March, 1918.

CHARLES H. NORTON.