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J. G. KAVENY

2,372,088

LAPPING MACHINE

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2 Sheets-Sheet 1

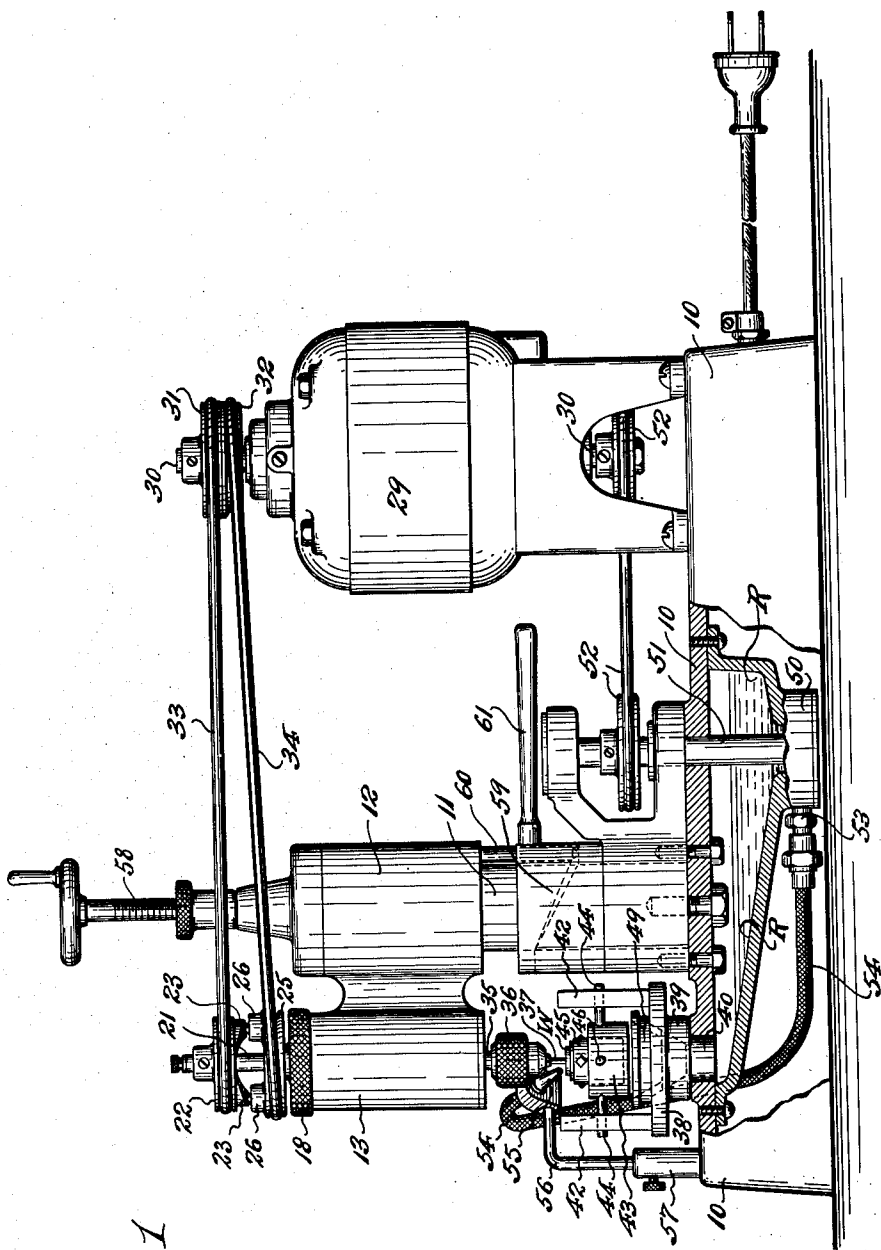


Fig. 1

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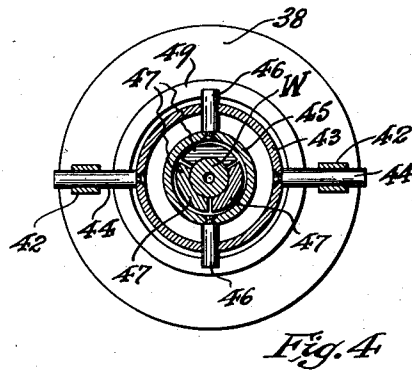
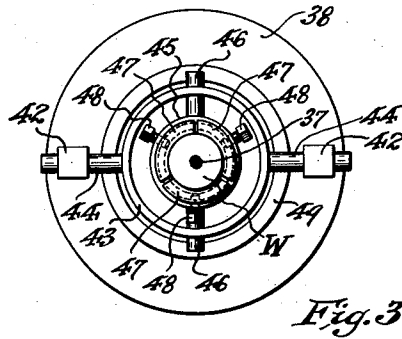
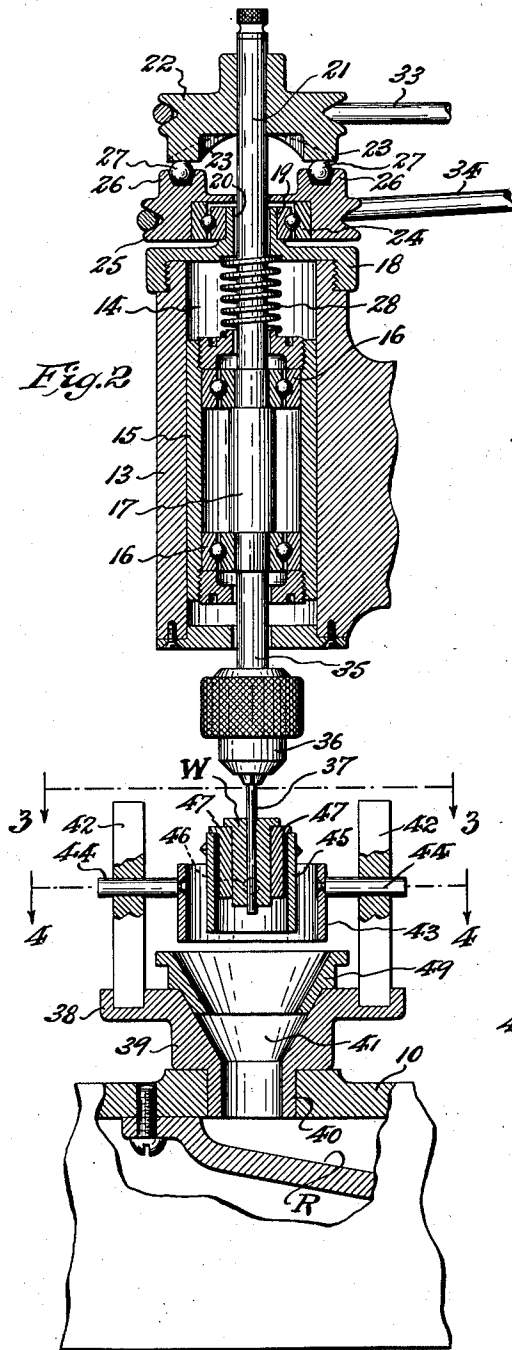
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,372,088

LAPPING MACHINE

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6 Claims. (Cl. 51—34)

This invention relates to improvements in lapping machines; and the invention has reference, more particularly, to an improved lapping machine for grinding and polishing the internal surfaces of the apertures in wire drawing and other dies, in bushings, and in other work pieces desired to be so treated.

The invention has for an object to provide a novel lapping machine adapted to impart combined rotary and reciprocating movement to a lapping tool or pin while the same is in contact with the work piece to be treated thereby, and to provide novel work holding means capable of universal tilting and lateral movements, whereby the work piece is held true to the lapping tool or pin at all times, so that the bearing of said lapping tool or pin, in operation upon the work piece surfaces, is uniformly applied to the entire area of said surfaces without risk of grooving or otherwise deforming the true symmetry of the work piece aperture.

The invention has for another object to provide a novel work holding means for lapping machines comprising a suitable work gripping means supported by gimbals capable of both tilting movement about its pivotal points and shifting movement in the directions of the axes of its pivotal points, whereby the supported work piece is permitted combined universal tilting and lateral shifting movements relative to the axis of the lapping tool or pin operatively engaging the same, so that the work piece will automatically, freely and constantly adjust itself to said lapping tool or pin for uniform engagement of its treated surfaces thereby.

Other objects of this invention, not at this time more particularly enumerated, will be understood from the following detailed description of the same.

An illustrative embodiment of this invention is shown in the accompanying drawings, in which:

Fig. 1 is an elevational view, in part section, of a lapping machine made according to this invention; Fig. 2 is a fragmentary vertical sectional view of the lapping tool or pin actuating means and the cooperating work holding means, said view being drawn on an enlarged scale; Fig. 3 is a fragmentary horizontal section, taken on line 3—3 in Fig. 2; and Fig. 4 is another horizontal section, taken on line 4—4 in Fig. 2.

Similar characters of reference are employed in the above described views, to indicate corresponding parts.

Referring to the drawings, an illustrative form of lapping machine therein shown comprises a

hollow base 10, upon the platform of which is fixed an upstanding carrier post 11. Suitably mounted on said carrier post 11, for vertical movement thereon, is the supporting bracket 12 of the machine head 13, whereby the latter is disposed in overhanging relation to the platform of the base 10. Said head 13 is provided with an axially extending cylinder chamber 14, and slidably supported in said cylinder chamber, for vertical reciprocatory movement therein, is a bearing piston 15. Rotatably mounted in anti-friction bearings 16, with which said bearing piston 15 is provided, is a spindle 17. Said spindle 17 is so related to the bearing piston 15 as to reciprocate therewith while being nevertheless free to rotate therein.

Suitably affixed to the upper end of said head 13 is a cap 18 having a hub 19 axially aligned with the cylinder chamber 14; said hub having an axial passage 20 extending therethrough. The spindle 17 is provided with an upwardly projecting section 21 which projects through the hub passage 20 for external extension above the cap 18. Fixed on the free end portion of the spindle section 21 is a driven pulley 22 for rotating the spindle. Connected with the underside of said driven pulley, to rotate therewith, is a spindle reciprocating cam member 23. Mounted on said cap hub 19, and preferably supported by anti-friction bearing means 24 so as to freely rotate thereon, is a second driven pulley 25. Connected with the upper side of said driven pulley 25 are thrust members 26 to bear upon and cooperate with the cam member 23; said thrust members being preferably provided with anti-friction ball or like means 27 to contact the operative surfaces of said cam member 23. Compression spring means 28 is arranged about the spindle section 21 between the upper end of the bearing piston 15 and the underside of the cap 18. Said spring means exerts a yieldable downward thrust upon the bearing piston 15, and through it upon the spindle 17, whereby to yieldably thrust the cam member 23 into operative engagement with the thrust members 26.

Said spindle driving pulley 23 and said thrust member driving pulley 25 are driven at differential speeds, from any suitable source of power. Preferably, however, a power source in the form of an electric motor 29 is mounted, in convenient location, upon the base 10, and fixed on one end of the motor shaft 30 are the respective drive pulleys 31 and 32; one to drive the spindle driving pulley 23 through an interconnecting transmission belt 33, and the other to drive the thrust

member driving pulley 25 through an interconnecting transmission belt 34. The said spindle driving pulley 23 and thrust member driving pulley 25 are driven at differential speeds, whereby one, preferably the former, is driven at a somewhat faster speed, than the other, viz. the latter. Due to this arrangement, the spindle, and the lapping tool or pin actuated thereby as will subsequently appear, may be driven at high R. P. M., while, at the same time, the thrust member may be driven at lower R. P. M., whereby to cyclically permit the high points of the cam member 23 to overtake the thrust members 26 so as to ride thereover, and thus impart to the spindle and lapping tool or pin suitably timed reciprocal axial movement in addition to the rotary movement thereof. One arrangement to accomplish this end is to provide drive pulleys 31 and 32 of equal diameter, respectively in driving relation to a thrust member driving pulley 25 of larger diameter than that of the spindle driving pulley 23.

The spindle 17 is provided with a downwardly projecting section 35 which extends downwardly beyond the lower end of the head 13. Affixed on said spindle section 35 is a suitable chuck 36 for mounting and driving a lapping tool or pin 37.

The means for holding a work piece to be lapped by the lapping tool or pin 37 is mounted on a table 38 having a hub portion 39 supported on the base 10; said hub portion having an extension 40 of reduced diameter to project through the wall of said base 10. Said table 38 is disposed in axial alignment with the spindle 17 and lapping tool or pin 37 affixed thereto, and said table is provided with a funnel-like passage 41 extending therethrough to communicate with a cutting compound catch-basin or reservoir R which is suitably mounted within the base interior and beneath its platform.

The novel work holding means according to this invention is provided by a pair of laterally spaced upstanding posts 42 affixed to the table 38, between which the work is hung in gimbals, comprising an outer gimbal ring 43 having oppositely extending, diametrically aligned trunnion arms 44 both pivotally and slidably engaged through said posts. Within said outer gimbal ring 43 is mounted an inner gimbal ring 45 having oppositely extending, diametrically aligned trunnion arms 46 both pivotally and slidably engaged through the walls of said outer gimbal ring 43 on an axis at right angles to the pivotal axis of the latter. Said inner gimbal ring 45 is adapted to receive the work piece W desired to be treated, and is provided with means to grip and hold the work in fixed relation thereto. In a preferred form thereof, as shown, the work gripping means comprises a plurality of separable gripper jaws 47 substantially conformable to the contours of the work piece to be engaged, and set-screws 48, or other suitable means, carried by the inner gimbal ring 45, and manipulatable to force the gripper jaws 47 into holding engagement with the work piece. It will be understood, that, optionally, the gripper jaws 47 may be omitted, and the work piece itself engaged and gripped merely by the set screws 48 or the like alone.

If desired, a separable cutting compound catch funnel extension 49 may be mounted in the top of the table 38 beneath the work holding means and the work piece supported by the latter.

Means is provided for supplying a suitable cut-

ting compound to and for bathing the lapping tool or pin and work piece surfaces operatively engaged thereby when the machine is in operation. To this end a suitable cutting compound circulating pump means 50 is provided in the bottom portion of the catch-basin or reservoir 42, the drive shaft 51 of which is driven by a belt and pulley transmission 52 from the lower end of the motor shaft 30, or by any other suitable means. To the discharge outlet 53 of said pump means 50 is coupled a suitable conduit 54, which is led therefrom upwardly through the base 10 to terminate in a discharge nozzle 55 directed toward the lapping tool or pin 37 and the work piece W undergoing treatment thereby. Said conduit and its discharge nozzle is suitably supported in such position by a supporting bracket means 56 adjustably affixed in an upstanding socket member 57 with which the base 10 is provided. It will be obvious, that the cutting compound discharged upon the lapping tool or pin and the work piece will drain therefrom, and will be caught by the funnel portions with which the table 38 is provided, so as to drain back into the catch-basin or reservoir R for recirculation therefrom.

Means (not fully shown) is provided for vertically adjusting the head 13 whereby to operatively position the lapping tool or pin relative to the work piece, such means including the manipulatable adjusting or jack screw 58. Means is also provided for quickly lifting the head 13 to withdraw the lapping tool or pin from the work piece, the same comprising a rotatable lift cam 59 mounted on the carrier post 11, with which is engaged a thrust pin 60 dependent from the head bracket 12; said lift cam 59 having, in extension therefrom, a suitable hand lever 61 for operatively rotating the same.

The apparatus is especially well adapted for lapping cylindrical apertures of dies, bushings and other work pieces, and the work holding means is of particular advantage in lapping work pieces of small size having cylindrical apertures of small diameter. It will be obvious, however, that the apparatus and work holder means may be suitably sized to treat large work pieces having apertures of cylindrical, conico-cylindrical, or of other cross-sectional shapes.

When the work piece W is mounted in the work holder and the lapping tool or pin 37 entered in the aperture of said work piece, operation of the machine will both rotate and reciprocate the lapping tool or pin 37 in the work piece aperture while constantly bathing the engaging surfaces of the tool or pin and work piece aperture with a suitable cutting or abrasive compound, such e. g. as pulverulent abrasive material suspended in kerosene or other suitable liquid as a vehicle and lubricant therefor. By reason of the fact that the work holder is capable of universal tilting and lateral movements, the work piece is held true to the moving lapping tool or pin so that the latter bears upon the engaged work piece surfaces evenly over the entire area thereof without risk of undue pressure at any point, and consequently eliminating possibility of grooving or otherwise deforming the true symmetry of the aperture contours. These advantages are due to the fact that the outer gimbal ring 43 may tilt about one diametric axis while the inner gimbal ring 45 may tilt about another diametric axis at right angles thereto, thus permitting a tilting yield of the work in any direction. At the same time the outer gimbal ring

is capable of lineal sliding movements back and forth in the direction of its pivotal axis, and also the inner gimbal ring is likewise capable of lineal sliding movements back and forth in the direction of its pivotal axis and thus at right angles to said lineal movements of the outer ring. By reason of these factors the work piece is capable of compound tilting and lineal lateral movements in all directions, and consequently will automatically, freely and constantly adjust itself to the lapping tool or pin surfaces for uniform engagement therewith, so that all risk of binding on the tool or pin or shifting out of alignment therewith is avoided.

I am aware that various changes could be made in the apparatus of this invention without departing from the scope of the invention as defined by the following claims. It is therefore intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a lapping machine, work holding means for supporting work subject to operative engagement by a moving lapping tool and in self-adjusting relation thereto comprising a support, an outer gimbal ring having oppositely extending diametrically aligned trunnion arms pivotally engaged in said support, an inner gimbal ring having oppositely extending diametrically aligned trunnion arms pivotally engaged in said outer gimbal ring on an axis at right angles to the pivotal axis of the latter, and means carried by said inner gimbal ring for gripping the work.

2. In a lapping machine, a lapping tool, means to impart combined rotary and reciprocal movements to said tool, and work holding means for supporting work subject to operative engagement by said lapping tool and in self-adjusting relation thereto comprising a support, an outer gimbal ring having oppositely extending diametrically aligned trunnion arms pivotally engaged in said support, an inner gimbal ring having oppositely extending diametrically aligned trunnion arms pivotally engaged in said outer gimbal ring on an axis at right angles to the pivotal axis of the latter, and means carried by said inner gimbal ring for gripping the work.

3. In a lapping machine, work holding means for supporting work subject to operative engagement by a moving lapping tool and in self-adjusting relation thereto comprising a support, an outer gimbal ring having oppositely extending diametrically aligned trunnion arms both piv-

otally and slidably engaged in said support, an inner gimbal ring having oppositely extending diametrically aligned trunnion arms both pivotally and slidably engaged through the walls of said outer gimbal ring on an axis at right angles to the pivotal axis of the latter, and means carried by said inner gimbal ring for gripping the work.

4. In a lapping machine, a lapping tool, means to impart combined rotary and reciprocable movements to said tool, and a work holding means for supporting work subject to operative engagement by said lapping tool and in self-adjusting relation thereto comprising a support, an outer gimbal ring having oppositely extending diametrically aligned trunnion arms both pivotally and slidably engaged in said support, an inner gimbal ring having oppositely extending diametrically aligned trunnion arms both pivotally and slidably engaged through the walls of said outer gimbal ring on an axis at right angles to the pivotal axis of the latter, and means carried by said inner gimbal ring for gripping the work.

5. In a lapping machine, work holding means for supporting work subject to operative engagement by a moving lapping tool and in self-adjusting relation thereto comprising a support having spaced upstanding posts, an outer gimbal ring having oppositely extending diametrically aligned trunnion arms both pivotally and slidably engaged through said posts, an inner gimbal ring having oppositely extending diametrically aligned trunnion arms both pivotally and slidably engaged through the walls of said outer gimbal ring on an axis at right angles to the pivotal axis of the latter, and means carried by said inner gimbal ring for gripping the work.

6. In a lapping machine, a lapping tool, means to impart combined rotary and reciprocable movements to said tool, and a work holding means for supporting work subject to operative engagement by said lapping tool and in self-adjusting relation thereto comprising a support having spaced upstanding posts, an outer gimbal ring having oppositely extending diametrically aligned trunnion arms both pivotally and slidably engaged through said posts, an inner gimbal ring having oppositely extending diametrically aligned trunnion arms both pivotally and slidably engaged through the walls of said outer gimbal ring on an axis at right angles to the pivotal axis of the latter, and means carried by said inner gimbal ring for gripping the work.

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