Dec. 14, 1926. 1,610,984

H. L. VAN KEUREN

LAPPING MACHINE

Filed Nov. 26, 1921

Fig. 2.

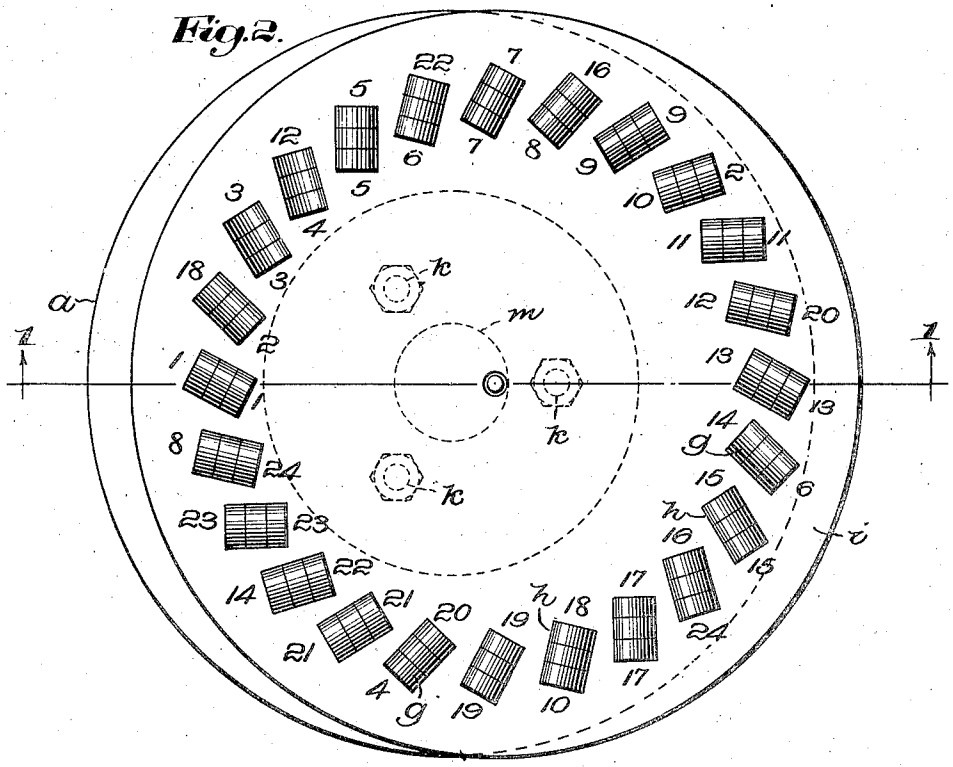
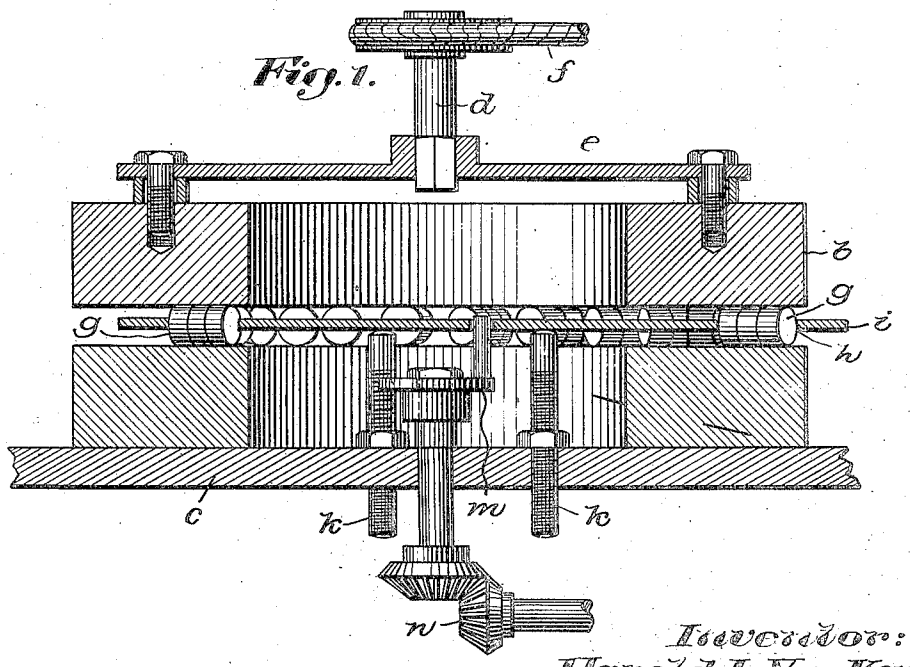


Fig. 1.



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PHOTO-LITHO by SACKETT & WILHELMS CORP. N.Y.

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UNITED STATES PATENT OFFICE.

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LAPPING MACHINE.

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This invention relates to a lapping machine which is particularly adapted to the production of cylindrical work and to certain methods the practice of which is exemplified by the operation of the machine disclosed. The purpose of the invention is to provide means for the rapid and accurate production of such articles as bearing rollers, cam rolls, piston pins, cylindrical gaging units, or any machine element requiring straight and uniform cylindrical surfaces.

My invention will best be understood by reference to the following description of the illustrative embodiment thereof shown by way of example in the accompanying drawings, wherein:

Fig. 1 is a partly diagrammatic central vertical section through a machine exemplifying my invention; and

Fig. 2 is a plan view thereof with the upper lap removed.

In accordance with my invention I provide a machine capable of finishing a considerable number of rolls at a single operation as contradistinguished from the grinding of rolls one at a time. Referring to the drawings, I preferably utilize flat ring-shaped laps *a* and *b*. Such flat laps, of any suitable material or prepared with a lapping surface in any desired way, may be easily maintained flat by rubbing three of them together with an abradant in accordance with the commonly known practice for securing flat surfaces. The two laps *a* and *b* oppose each other and are differentially rotated with the work between them and conveniently the lap *a* is stationary, being held on a suitable support, and the lap *b* is pressed toward the same by its own weight reinforced, if desired, by weights or springs. The lap *b* is rotated and I have herein shown the square end of a shaft *d* taking into a spider *e* secured to the lap *b* and adapted to be rotated by the belt *f*. The surfaces of the laps being perfectly flat, they do not require accurate alignment nor must the work holder be accurately positioned as in the case of grinding machines. During operation the two laps are spaced by the work such as the rollers *g* and these are held in position between the working face of the laps by being mounted in suitable slots *h* (see Fig. 2) in a disc or cage *i* which is interposed between the laps. Adjustable posts *k* in the table *c* may be provided for centering the work receiving disc or cage *i* between the laps so that it will embrace the rollers *g* substantially centrally of their diameters.

The rollers *g* which are to be lapped are produced in the rough—for example, they may be sections of a round rod—and are placed in the slots *h* on their sides. As distinguished from the lapping of flat blocks such as gage blocks as hitherto practiced, the rollers *g* must be permitted to roll in order that they may be uniformly lapped down. At the same time there must be a relative sliding motion betwen the lapping surface and the work in order to permit the former to cut or grind the latter but if such movement is localized by failure of the work to rotate, flat surfaces will be produced destroying the accuracy of the work. A combined rolling and sliding motion is secured in the machine shown by placing the slots *h*, which are arranged around a circle the diameter of which preferably corresponds to the mean diameter of the laps *a* and *b*, in a position oblique to radii of the disc. The action will best be understood by considering the limiting cases. If the slots were radial, clearly the rollers would simply be rotated on their own axes between the two laps and no sliding or lapping motion would take place. If the rolls were placed lengthwise around the circumference of a circle of the same mean diameter as the lapping faces, the motion would be all sliding with no rolling component and consequently two flat surfaces would be produced on the pieces being lapped instead of the desired cylindrical surfaces. The angle of the slots *h* may be varied with the rate of lapping desired but an angle of 45° as illustrated may be used.

To insure uniform wear of the laps *a* and *b* and to prevent any portion thereof from being unduly worn or stripped of abradant, provision is made to distribute the wear over their entire width. In the ordinary instance the roll or rolls in each of the slots *h* will not be as wide as the face of the laps *a* and *b* and to cause them to move across the face of these laps the disc *i* may be rotated about a center eccentric to the center of the laps so

as to move the work back and forth across these faces. In the present instance the crank *m* is provided on a central shaft having a crank pin loosely received in a central opening in the disc *i*. The throw of the crank may be equal to approximately half the width of the face of the laps *a* and *b*, this providing for moving completely across the faces of the laps the work in the slots *h* which, as stated, are preferably ranged around a circle of diameter equal to the mean diameter of the laps.

The work holder *i* may be permitted to be revolve freely between the laps *a* and *b* by the reaction of the latter and in this case it will gyrate since it will rotate about its own center and this center will also be forced to move through a small circular path by means of the crank *m*. The path of the rollers *g* which are being acted upon will thus be an epicyclic and while being moved in this path they will be held by the slots *h* in a position oblique to a radius of one of the circles generating the epicyclic, that is, the circle represented by the disc *i*. The work thus moves with a part sliding, part rolling action over the entire faces of the laps *a* and *b*.

While the disc *i* may be left entirely free I preferably arrange for driving the shaft of the crank *m* at a relatively slow rate, this being indicated in the drawing by the representation of the gear train *n*. For example, the upper lap *b* may be rotated at the rate of 50 revolutions per minute and the shaft of the crank *m* at about 10 revolutions per minute. The direction of rotation of the center of the work disc may be in the same or the opposite direction as that of the rotating lap *b* but I prefer to rotate it in one direction for one or more revolutions and then in the opposite direction continually repeating the cycle. By this means the wear on both the stationary lap *a* and the rotating lap *b* are made exactly equal.

After the lapping operation has proceeded for a certain length of time it may be that the work has proceeded futher at one point along the work disc *i* than at another and it is desirable to remove all the parts from the work disc, rearrange them and continue the lapping operation to equalize the work. The idea of promiscuously mixing up work and returning it for a continuance of an operation is not novel but I provide for a systematic rearrangement of the rolls *g* in a novel manner. Referring to Fig. 2, I preferably make the number of slots *h* in the work disc a suitable multiple of six. For example, I have here shown twenty-four. After the work has proceeded alternate rollers are shifted around the circumference of the work disc 120° or ⅓ of the circumference. Thus, referring to the drawing, the odd numbered rolls are left in the position indicated. The roll formerly in slot 2 is shifted to 10, 10 to 18 and 18 to 2. The next transposition is preferably in the reverse direction. The previous transposition being clockwise, 4 is shifted counter-clockwise to 20, 20 to 12 and 12 to 4. The inner numerals represent the original positions of the parts and the outer numerals the new positions. By this means rolls which were originally adjacent are shifted to a new position to approximately 120° apart. Thus, if original rolls 6, 7 and 8 were relatively high before, they are then distributed around the circle and any inaccuracy of the preceding operation is distributed. Futhermore, it will be recalled that three points determine a plane and therefore if there was a local high point in the preceding operation this maximum after the transposition occurs at three points around the circle and the upper lap is in substantial parallelism with the lower lap ready for unitary action. In contrast, if the shifting had been diametrical, the rolls of maximum height might be found opposite each other and the laps might tilt or teeter on the high point.

It will, of course, be understood that while I have herein illustrated one circular series of slots *h*, there might be a plurality of such series.

The lapping operation may be carried out in two or more steps utilizing laps of different degrees of fineness.

Having thus described in detail the particular embodiment of my invention shown by way of example in the accompanying drawings, the principles exemplified thereby which I claim as new and desire to secure by Letters Patent I shall express in the following claims.

I claim:

1. A lapping machine comprising opposed flat face laps, one of which is positively rotated, a freely rotatable work holder mounted between the laps and having openings to receive and position pieces of work, and driving means for said work holder effective to move the axis of the work holder in a circular path, such movement being supplemental to the free rotation of said disc and being at a slower speed of rotation than the movement of the positively rotated lap and also being in a circular path of small diameter and said diameter being much less than the diameter of the work holder and laps.

2. A lapping machine comprising a fixed lap, a rotated lap, a work holder mounted between said laps, positive means to move said work holder between said laps at a predetermined speed relative to the movement of said rotated lap and in a path eccentric to the axis of said rotated lap, and means to position pieces of cylindrical work in said work holder with the axis of the cylindrical

pieces oblique to radial lines in said holder and passing through said pieces, whereby a combined rolling and sliding movement of said cylindrical pieces over the surfaces of the laps is attained.

3. The combination in a lapping machine as set forth in claim 2, in which the means to drive the work holder rotates at a different speed from the rotated lap, causing the combined rolling and sliding movement of the cylindrical pieces to take place in successively different areas of said lapping surfaces.

4. A lapping machine comprising a fixed lap, a rotated lap, a work holder mounted between said laps and means to positively move said work holder in a plane parallel to and between said laps at a different speed from said rotated lap and in a path eccentric to the axis of said rotated lap, said work holder being also freely rotatable about its own axis.

5. A lapping machine having, in combination, a fixed lap, a positively rotated lap, an eccentric bearing member mounted to rotate at a speed different from that of said rotated lap, and a work holder freely rotatable about said eccentric bearing member.

6. A lapping machine having, in combination a fixed lap, a positively rotated lap, an eccentric bearing member mounted on a support to rotate about the axis of said rotatable lap, means to rotate said lap and bearing member support at relatively different speeds, and a work holder freely rotatable about said bearing member.

In testimony whereof I have signed my name to this specification.

HAROLD L. VAN KEUREN.