

April 13, 1937.

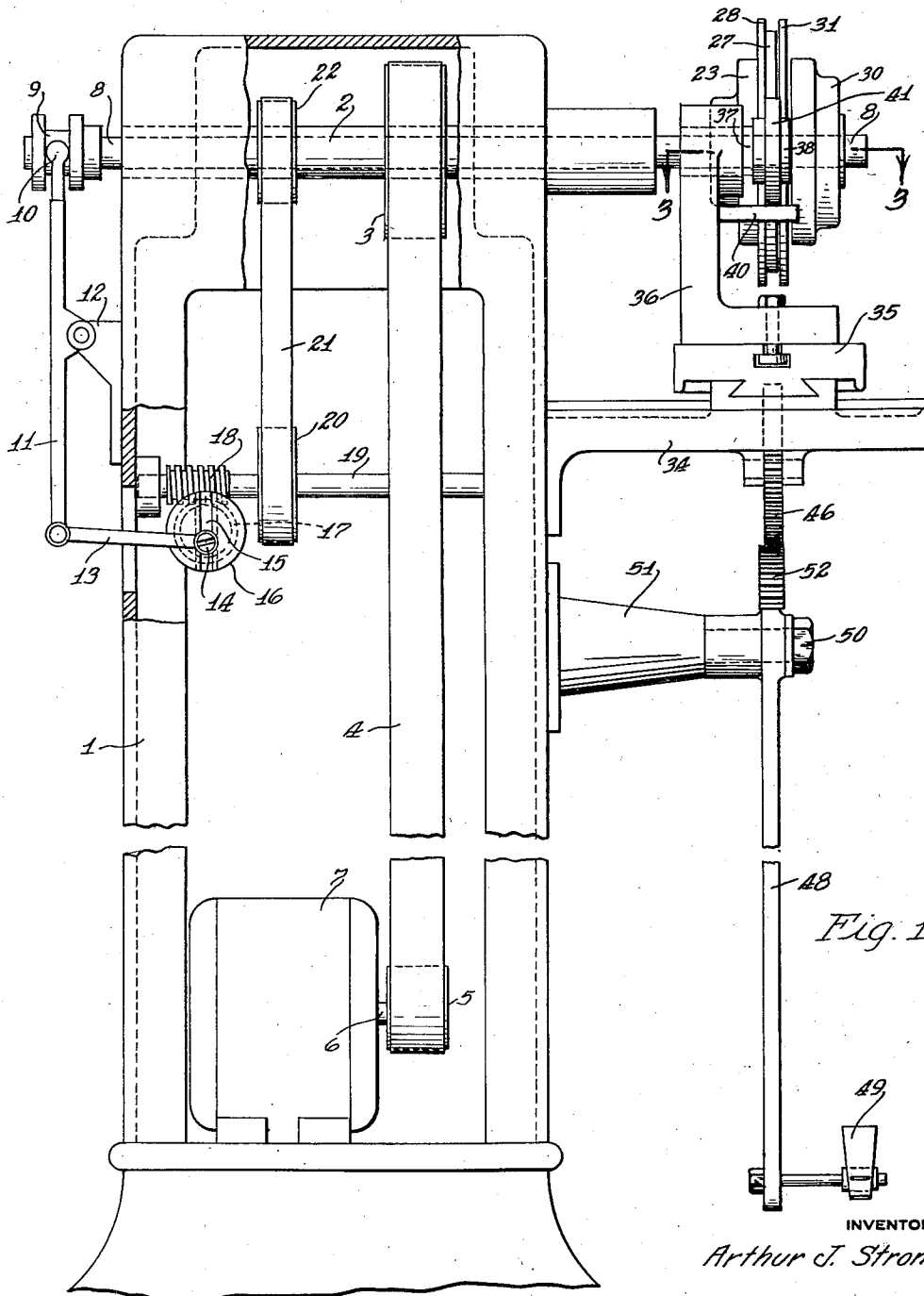
A. J. STRONG

2,076,601

LAPPING MACHINE

Filed April 18, 1935.

7 Sheets-Sheet 1



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LAPPING MACHINE

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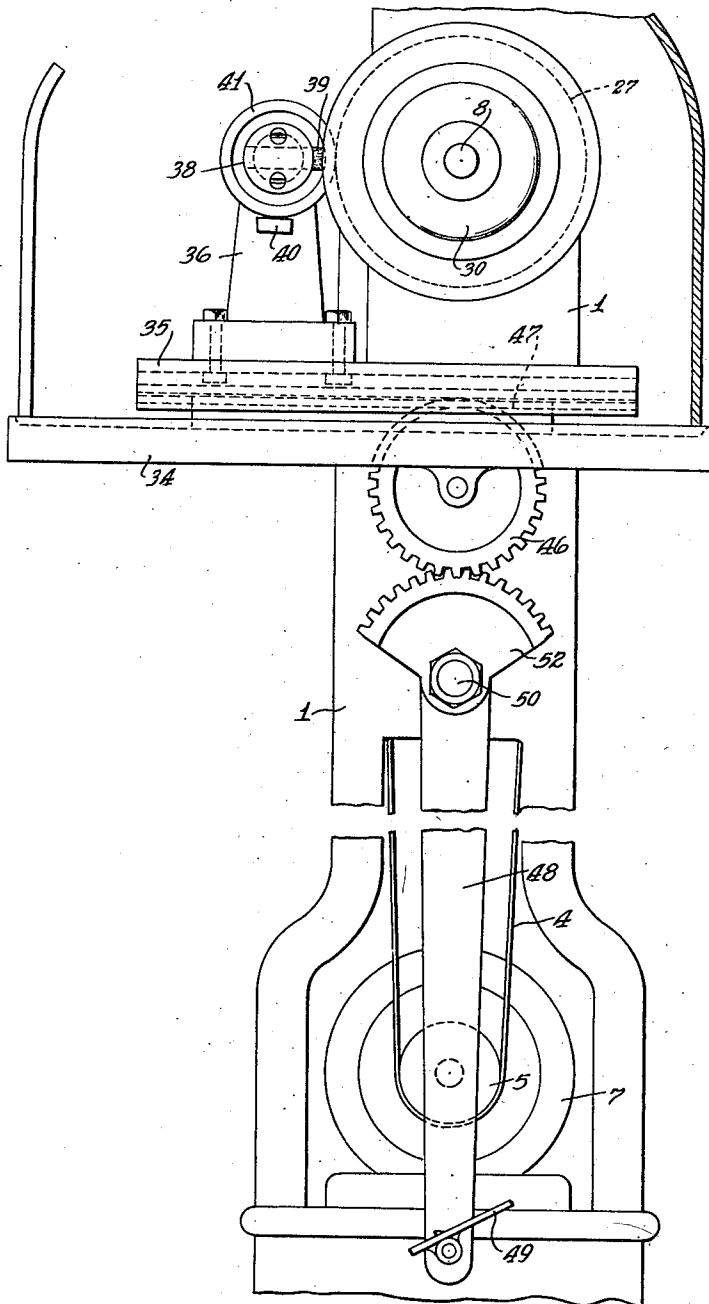


Fig. 2.

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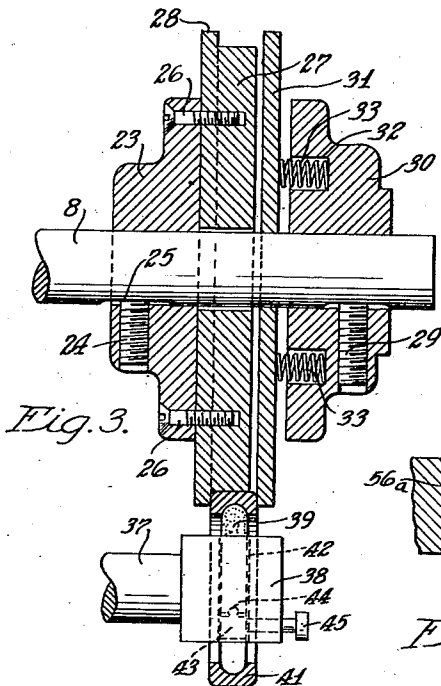


Fig. 3.

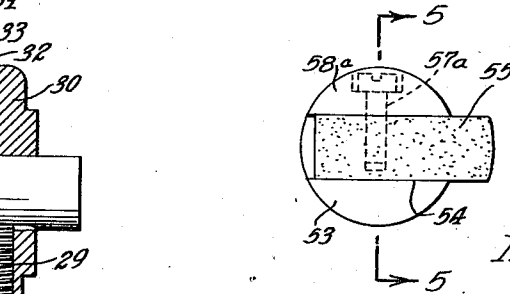


Fig. 4.

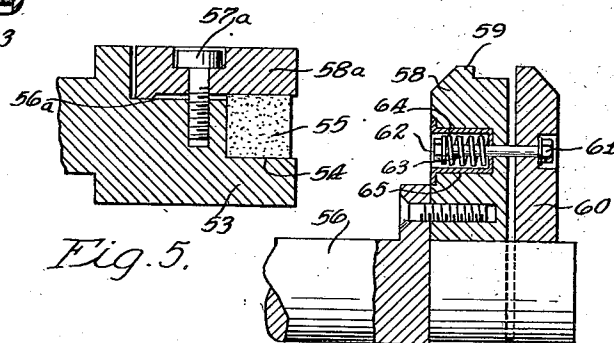


Fig. 5.

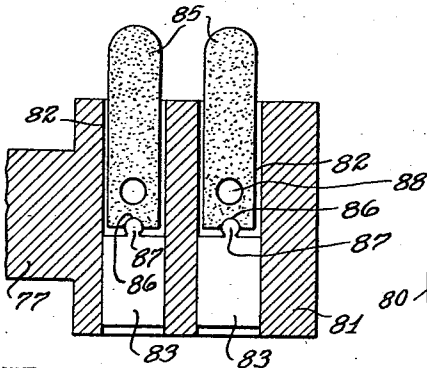


Fig. 11.

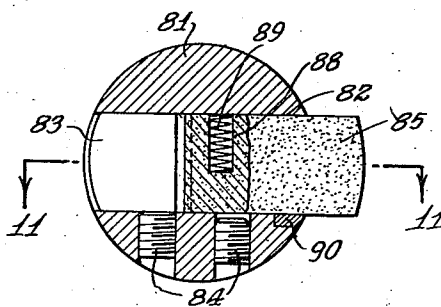


Fig. 10.

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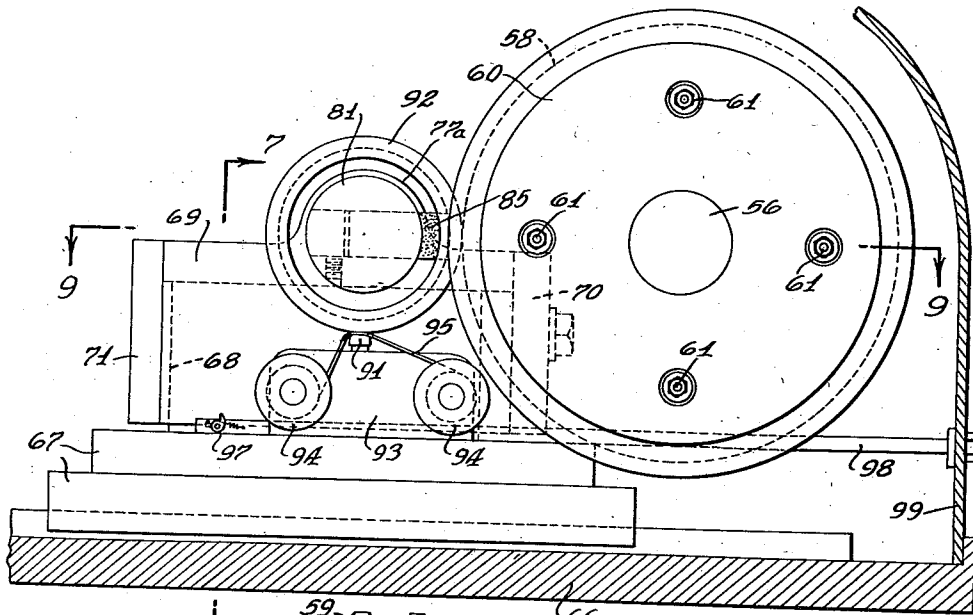


Fig. 6.

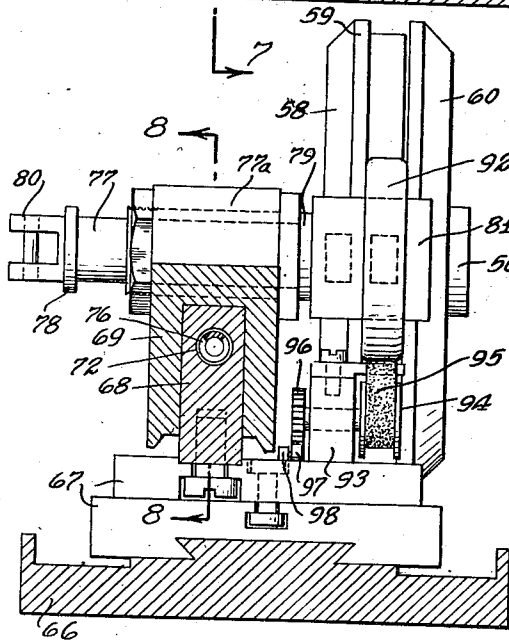


Fig. 7.

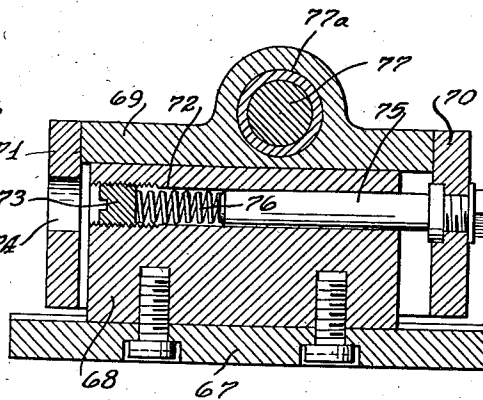


Fig. 8.

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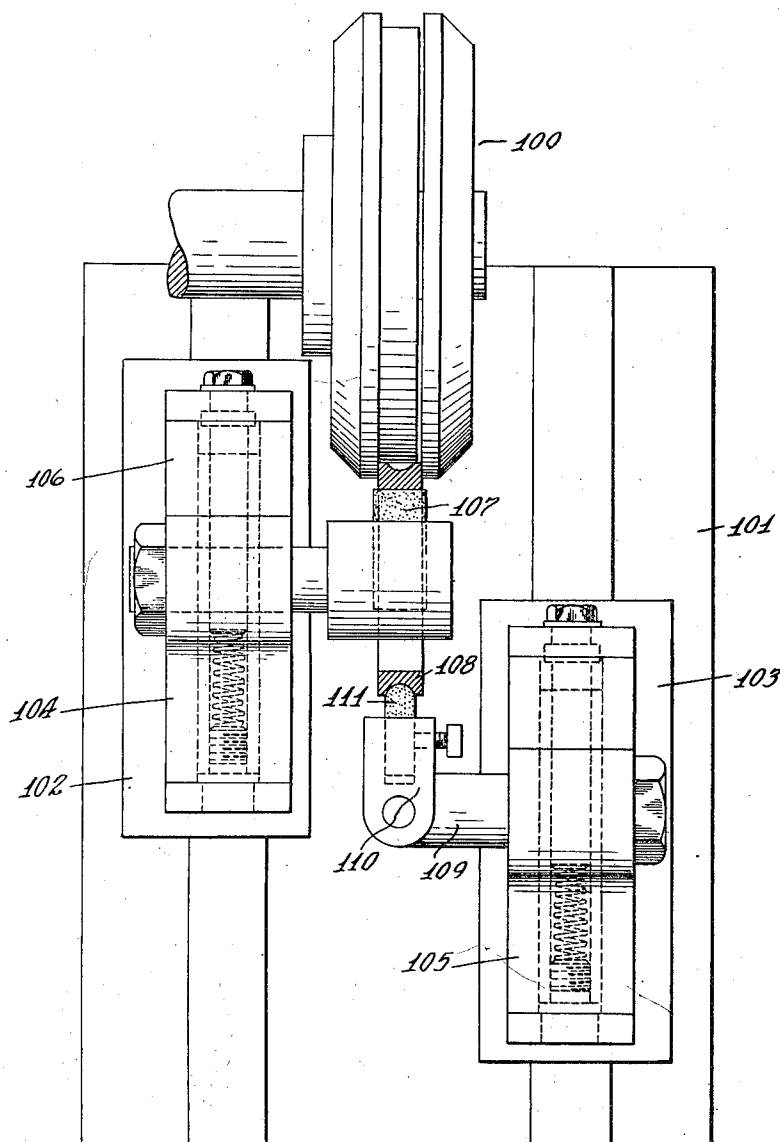


Fig. 12.

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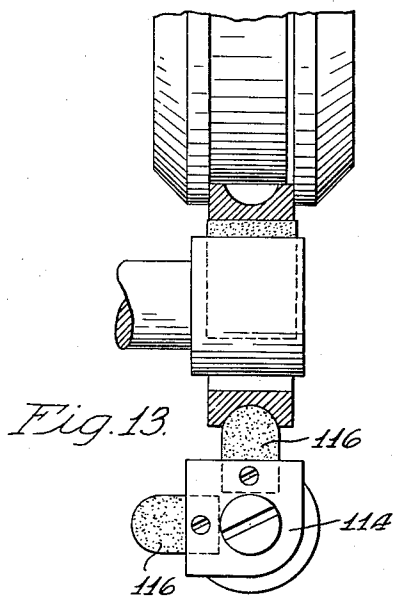


Fig. 13.

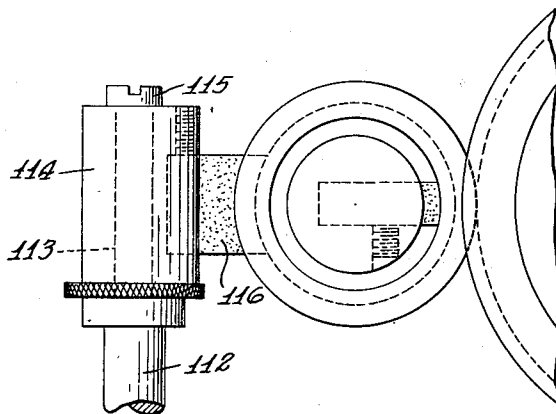


Fig. 14

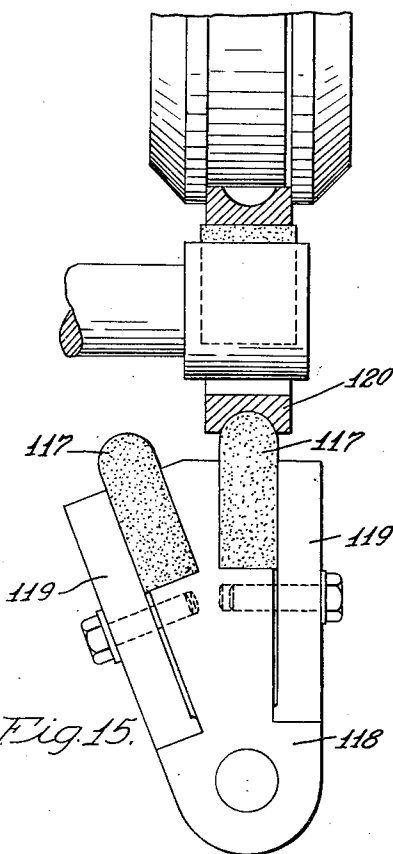


Fig. 15.

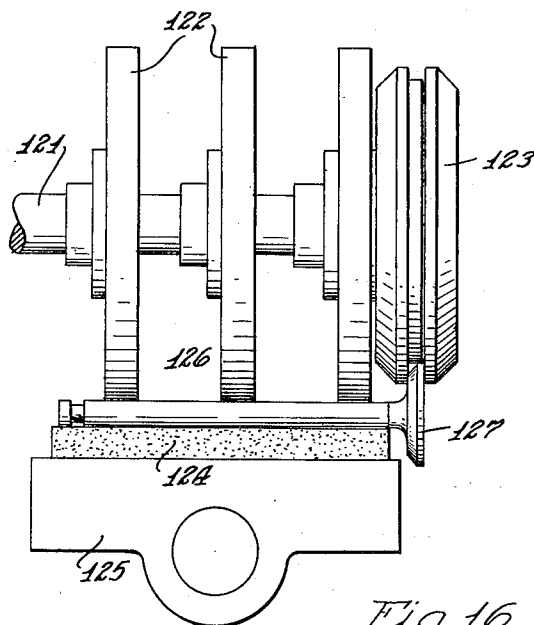


Fig. 16.

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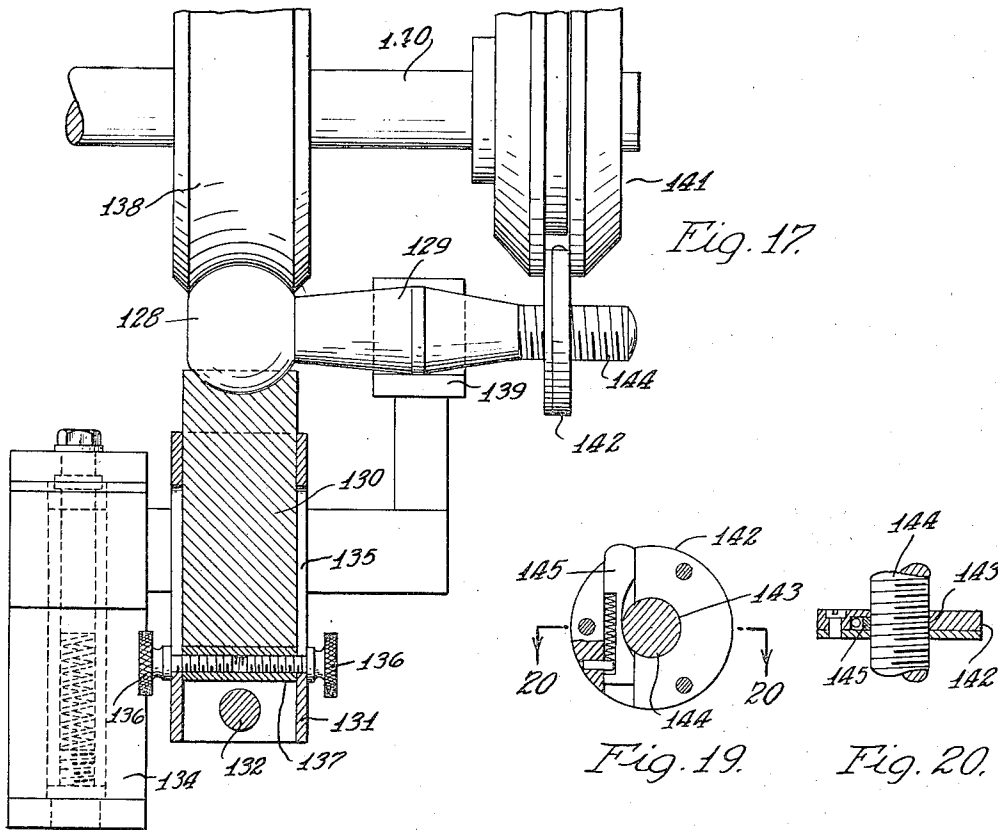
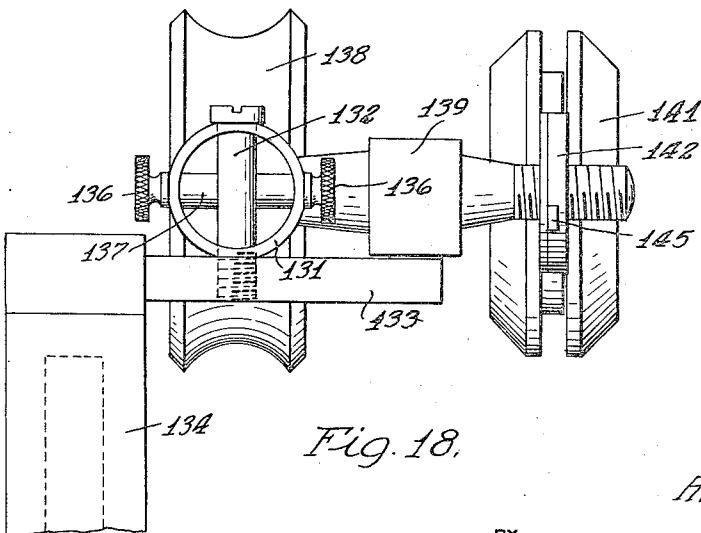
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7 Sheets-Sheet 7



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2,076,601

LAPPING MACHINE

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Application April 18, 1935, Serial No. 16,984

7 Claims. (Cl. 51—58)

The present invention pertains to a novel lapping machine for providing smooth surfaces on various parts to be finished.

The primary object of the present invention is to provide a machine for lapping annular pieces of work, such as bearing races, rapidly and efficiently, the machine comprising means for receiving and supporting the work in contact with a tool and means for causing rotation of the work while it is in contact with the tool, the means for receiving and supporting the work being constructed to permit rapid removal and replacement of the work thereon.

Another object of the present invention is to provide a lapping machine comprising an adjustably movable tool supporting carriage and a constantly rotating frictional driving element, the tool carriage having means for placing work thereon in contact with the tool and suitable means for moving the tool carriage to cause contact between the work and the driving element whereby the latter causes rotation of the work. In connection with the movable carriage it is a further object of the invention to provide resilient means between the point of application of the pressure and the tool so as to render the machine fool proof to the extent that it is impossible to apply an excessive amount of pressure on the tool with resulting damage to the work. In connection with the frictional work driving element it is another object of the present invention to provide adjustable means for oscillating the same as it is rotated in order that it may cause the work to oscillate as it is rotated in contact with the tool.

Another important object of the invention is to provide a novel driving element for rotating work in contact with a tool, the driving element comprising spaced apart disks between which the edge of the part to be rotated is interposed and resilient pressure means associated with the disks for causing them to grip the work with sufficient friction to cause rotation of the work. Although the driving element is particularly adapted for use in combination with annular parts such as bearing races it is illustrated by way of modified showings that it is not confined to this use alone.

Another object of the present invention is to provide, in a lapping machine, a tool support for accommodating a plurality of tools, the support being easily movable for the purpose of interchanging tools and thus making it possible to provide different grades of tools which may be used selectively without necessitating re-tooling

operations in order to provide for the use of light lapping or heavy roughing lapping.

Another object of the present invention is to provide a tool support embodying means for compensating for wear of the tool, and in the event that the work is oscillated while it contacts with the tool the said compensating means is constructed to permit a limited amount of pivotal movement of the tool relative to its support.

Another object of the invention is to provide a lapping machine embodying a rotatable driving element and means for supporting tools whereby both the inner and outer surfaces of an annular element may be lapped simultaneously.

Still another object of the present invention is to provide an adapter for use with work having no part suitable for engagement by the present frictional driving element, the adapter being constructed to permit its rapid assembly on the work and its removal therefrom.

Figure 1 is a front elevation, partly broken away, and in cross section;

Fig. 2 is a side elevation;

Fig. 3 is a cross section taken on the line 3—3 of Fig. 1;

Fig. 4 is an end elevation of a modified tool support;

Fig. 5 is a cross section taken on the line 5—5 of Fig. 4;

Fig. 6 is an end elevation illustrating a modified tool supporting carriage;

Fig. 7 is a cross section taken on the line 7—7 of Fig. 6;

Fig. 8 is a cross section taken on line 8—8 of Fig. 7;

Fig. 9 is a cross section taken on line 9—9 of Fig. 6;

Fig. 10 is a cross section taken on line 10—10 of Fig. 9;

Fig. 11 is a cross section taken on line 11—11 of Fig. 10;

Fig. 12 is a fragmentary plan illustrating tools for internal and external lapping;

Fig. 13 is a plan illustrating a modified tool support;

Fig. 14 is a side elevation relating to Fig. 13;

Fig. 15 is a plan of another modified form of tool support;

Fig. 16 is a plan view of a tool and means for lapping valve stems;

Fig. 17 is a plan view of an arrangement embodying a tool for lapping a substantially spherical piece of work;

Fig. 18 is an elevation corresponding to Fig. 17;

Fig. 19 is a detail of an adapter for use with work such as shown in Fig. 17, and

Fig. 20 is a cross section taken on the line 20—20 of Fig. 19.

5 Like characters of reference are employed throughout to designate corresponding parts.

With reference more particularly to Figs. 1 and 2 there is shown a machine comprising a base 1 rotatably supporting a sleeve 2 having a pulley 3 10 connected by a belt 4 to a pulley 5 on the shaft 6 of a motor 7. Splined or slidably keyed within the sleeve 2 is a shaft 8 having a collar 9 secured to one end thereof and receiving the forked end 10 of a lever 11 which is pivoted intermediate its 15 ends to a bracket 12 secured on the base 1. The opposite end of the lever 11 is connected by a link 13 to a pin 14 which is secured in a slot 15 in a disk 16, the pin 14 being movable in the slot for the purpose of adjusting the same to a position 20 co-axial with the disk or eccentric thereto. The disk 16 has a worm gear 17 connected thereto which meshes with a worm gear 18 on a shaft 19 carrying a pulley 20. The pulley 20 is connected by a belt 21 to a pulley 22 on the sleeve 2.

25 At the stage of the description it will be understood that the shaft 2 is driven by the motor 7 and imparts rotation to the shaft 8. The disk 16 is likewise rotated through worm 18, gear 17, pulley 20 and belt 21, and in rotating with the 30 pin 14 adjusted to a position eccentric thereto causes lever 11 to rock and to oscillate shaft 8. The purpose of such oscillatory movement will become apparent as the description progresses.

Secured to the other end of the shaft 8 is a frictional driving element comprising a collar 23, the 35 means for securing the collar being shown by way of example as a set screw 24 engaging a flat 25 on the shaft 8 as more clearly shown in Fig. 3. Secured by screws 26 to the collar 23 is a disk 40 27 having a flange 28, this disk preferably being formed of fibrous material. Secured on the shaft 6 by a set screw 29 is a collar 30 and a disk 31, 45 also of fibrous material, is loosely interposed between the disk 27 and the collar 30, the disk 31 being free to rotate relative to the shaft 6 and free to move longitudinally a limited amount between the disk 27 and the collar 30. The collar 30 has a series of holes 32 receiving coiled springs 33 which urge the disk 31 toward the disk 27.

50 Attached to the base 1 is a carriage bracket 34 supporting a tool carriage 35 upon which is bolted a post 36 carrying a stub shaft 37 having a head 38 in which is mounted a lapping tool 39. Extending outwardly from the post 36 is a work 55 rest 40 and in operation the work 41, shown by way of example as a bearing race, is placed over the tool 39 and is forced, by movement of the carriage 35, between the flange 28 and the disk 31 as shown in Fig. 3. When the edge of the work is 60 forced between the flange 28 and disk 30 the work is caused to be rotated in contact with the tool 39 and in the event that the pin 14 is set eccentric as above described the work will also be caused to oscillate. In order to permit oscillation 65 of the work it is necessary that the tool 39 be permitted to pivot and in order to provide for such pivotal movement the tool is loosely mounted in a slot 42 which is of greater width than the tool. A slidable block 43 is mounted in the slot and has 70 a ridge 44 engaging the rear end of the tool to back it, the block 43 being held against movement by a set screw 45.

In order to move the tool carriage to carry the work into and out of engagement with the flange 75 28 and disk 31 there is provided a gear wheel 46

on the carriage bracket 34, the gear wheel meshing with rack teeth 47 on the carriage 35. A lever 48 has a foot treadle 49 on its lower end and is pivotally secured by a removable pin 50 to a bracket 51 on the base 1. On the upper end of 5 the lever 48 is provided a gear segment 52 meshing with gear 46 so that rocking of lever 48 through manual pressure on the treadle 49 causes gear 46 to rotate and the carriage 35 to move to and fro. Between movements of the carriage 35 a piece 10 of work 41 may be easily removed and another piece substituted therefor.

In Figs. 4 and 5 there is shown a modified means of supporting a lapping tool and it will be understood that when this form of tool support 15 is used the pin 14 is adjusted to a point concentric with the disk 16 to eliminate oscillation of shaft 8 in the event that the work piece has an arcuate cross section such as the work piece shown at 41. In the event that the work has a 20 flat surface, it will be understood that the shaft 8 will be caused to oscillate as above described. In detail, the work support of Figs. 4 and 5 comprises a head 53 having its end notched as at 54 to receive a tool 55. Secured in a recess 56a by a 25 set screw 57a is a clamping plate 58a which clamps the tool 55 in the notch 54. In use, the head 53 is mounted on a carriage such as the carriage 35 described above.

With reference to Figs. 6, 7, 8 and 9 there is 30 shown a modified arrangement comprising a driving shaft 56 which is the equivalent of shaft 8 in the above described embodiment. On the shaft 56 is formed a flange 57 to which is bolted a 35 fibrous disk 58 having a flange 59. Loosely received on the shaft 56 is a fibrous disk 60 which is loosely tied to the disk 58 by a series of pins 61. Under heads 62 on the pins 61 are placed coiled 40 springs 63 which are received in metal inserts 64 in holes 65 in the disk 58. The springs 63 exert resilient pressure on the pins 61 tending to draw the disk 60 toward the disk 58.

On a carriage bracket 66 is supported a movable tool carriage 67 having a guide block 68 45 bolted thereto. Slidably received on the block 68 is a tool support housing 69 having end plates 70 and 71 secured thereto to limit the sliding movement of the housing relative to the guide block. The guide block 68 has a lengthwise extending bore 72, screwthreaded at the end adjacent 50 to end plate 71 to receive a screwthreaded plug 73 which may be adjusted through an aperture 74 in the plate 71. In the end plate 70 is secured a bolt 75 to extend into the bore 72 and between the end of the bolt 75 and the plug 73 is interposed a compressed coiled spring 76. 55 On the housing 69 is provided a bearing 77a receiving a tool support 77, the latter being slidable relative to the bearing and having collars 78 and 79 for limiting the sliding movement thereof and means indicated at 80 for attaching mechanism thereto for moving the same. On the tool support 77 is provided a head 81 having 60 slots 82 formed therein in spaced relation, this construction being more clearly shown in Figs. 10 and 11. In the slots are slidably received blocks 83 and set screws 84 are mounted in the head to engage the blocks 83 to hold them in 65 adjusted positions. In each slot is provided a lapping tool 85 narrower than the slot in which it is received. Each tool has a groove 86 in the end thereof to engage a projection 87 on the adjacent block 83 and a hole 88 receiving a coiled spring 89 which presses against the wall of the slot to offer a small resistance to movement of 70 75

the tool in the slot. At the forward end of each slot is provided a "Carboloy" insert 90 to eliminate, as much as possible, wearing away of the wall of the slot.

5 As will be observed with reference to Fig. 10 each slot has two set screws 84 arranged so that as the tool 85 wears away through use the block 83 may be advanced and held by first one and then the other of the set screws.

10 On the housing 69 is provided an outwardly extending work support 91 and in operation the work 92 is placed on one or other of the tools 85 and the carriage 67 is moved so as to carry the work into engagement with the flange 59 and disk 60 which cause the work to rotate. By shifting the tool support 77 longitudinally from its illustrated position to a position where collar 78 limits further movement the other tool will be brought into an operative position. The construction thus provides for the use of two different grades of tools.

It is contemplated that manual means, an example of which is disclosed above, will be employed to move the carriage to cause engagement of the work with the driving disks. The pressure of the means for moving the carriage is transmitted to the tool support housing through the coiled spring 76 and therefore the device is fool proof to the extent that an excessive amount of pressure on the manual means will not be transmitted to the tool support.

On the movable carriage 67 is mounted a bearing block 93 supporting two spaced apart spools 94 around which is wound an abrading ribbon 95, the ribbon being trained over the work support 91 so that the outside surface of the work contacts therewith. Connected to one of the spools 94 is a ratchet wheel 96 cooperating with a spring pressed pawl 97 on a rod 98 whose end is attached to a stationary part 99 secured to the carriage bracket 66. Each time the carriage 67 is moved to carry a piece of work out of engagement with the driving disks and another piece of work into engagement with the driving disks the pawl advances the pulley to which the ratchet 96 is attached so as to present a fresh part of the ribbon 95 for engagement by the work.

In Fig. 12 there is illustrated an arrangement for lapping both the inner and outer surfaces of a piece of work. In this embodiment the driving disks are constructed as particularly described above and are generally designated by the numeral 100. Adjacent to the driving means 100 is a carriage bracket 101 supporting two separately movable tool carriages 102 and 103. On the carriage 102 is mounted a tool support housing 104 and on the carriage 103 is mounted a tool support housing 105, the two housings 104 and 105 being flexibly mounted relative to their respective carriages in the manner described above with reference to the tool support housing 69. On the housing 104 is provided a tool support 106 having a lapping tool 107 adapted to engage the inner surface of a piece of work 108 and to hold it in contact with the driving means 100. On the carriage 105 is provided a tool support 109 having a pivoted head 110 in which is secured a lapping tool 111. Due to the fact that the inner surface of the work is flat and the head 110 is pivoted the driving means 100 may be oscillated as it is rotated in the manner more particularly described above.

In Figs. 13 and 14 there is illustrated a tool support 112 having a spindle 113 rotatably re-

ceiving a head 114 and a set screw 115 for holding the head against rotation relative to the spindle. In the head are secured two lapping tools 116 adapted to be positioned for use in lapping a piece of work by rotating the head on the spindle. In Fig. 15 is illustrated a tool support similar in principle wherein tools 117 are secured to a rotatable head 118 by clamping plates 119. In this latter form either tool may be moved into cooperative relationship with the work 120 and is used, as is also the device of Figs. 13 and 14, for external lapping.

In Fig. 16 there is illustrated a driving shaft 121 having a plurality of idle rollers 122 thereon and a driving means 123 constructed as described above. An elongated lapping tool 124 is supported on the tool support head 125 and engages the stem 126 of a valve 127, the valve 127 being held by the tool in engagement with the driving means 123.

In Figs. 17 to 20 inclusive there is illustrated an embodiment wherein the invention is adapted to lapping the ball end 128 of a steering arm 129. In this embodiment the tool 130 is mounted in a sleeve 131 which is secured, by a set screw 132 on an arm 133 on a tool support housing 134. The sleeve 131 has diametrically opposite slots 135 and set screws 136 extend through the slots to engage a sleeve 137 which engages the end of the tool 130. The ball end 128 is held between an idle roller 138 and the tool 130 and the arm 129 rests upon a suitable support 139, the idle roller 138 being supported by a drive shaft 140 carrying driving means 141. An adapter 142 has a bore 143 permitting it to be slipped onto the end 144 of the steering arm and a spring pressed wedging member 145 is mounted in the adapter to frictionally engage the part 144 to hold the adapter against rotation. The adapter is adapted to engage the driving means 141 to cause rotation of the steering arm 129.

Although specific embodiments of the invention have been illustrated and described it will be understood that various changes may be made in the details of construction without departing from the spirit of the invention as set forth in the appended claims, and such changes are contemplated.

What I claim is:—

1. In a lapping machine, a rotatable shaft, a pair of friction disks mounted on said shaft with one of said disks secured to said shaft, the other of said disks being longitudinally movable relative to said shaft, and resilient means normally urging said disks together.

2. In a lapping machine, a rotatable shaft, a pair of friction disks mounted on said shaft with one of said disks secured to said shaft, the other of said disks being longitudinally movable relative to said shaft, resilient means normally urging said disks together, a movable tool support, means on said support for receiving a piece of work, and means for moving said support to move the edge of the work between said disks.

3. In a lapping machine, a constantly rotatable frictional driving means, means for oscillating said frictional driving means, a movable tool support, means on said tool support for receiving a piece of work, and means for moving said support to move said work into engagement with said driving means.

4. In a lapping machine, a constantly rotatable frictional driving means, means for oscillating said frictional driving means, a movable

tool support, a tool adapted to engage a piece of work, and means for moving said tool support whereby said tool causes engagement of the work with said driving means.

5 5. In a lapping machine, a rotatable driving element, a movable tool support, a tool on said support and adapted to have a piece of work placed thereon whereby it supports the same, manual means for moving said tool support
10 whereby said tool carries said work into engagement with said driving element, and a resiliently yieldable element between the manual means and the tool.

6. In a lapping machine, a rotatable shaft, a
15 pair of friction disks mounted on said shaft to

rotate therewith, said disks being relatively movable longitudinally of said shaft, resilient means normally urging said disks together, and rigid means between said disks maintaining them spaced apart.

7. In a lapping machine, a rotatable shaft, a pair of friction disks mounted on said shaft to rotate therewith, said disks being relatively movable longitudinally of said shaft, resilient means normally urging said disks together, and rigid
10 means between said disks maintaining them spaced apart, said rigid means having a circular contour whereby it provides an abutment for work placed between said disks.

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