

Aug. 30, 1949.

E. J. BULLARD

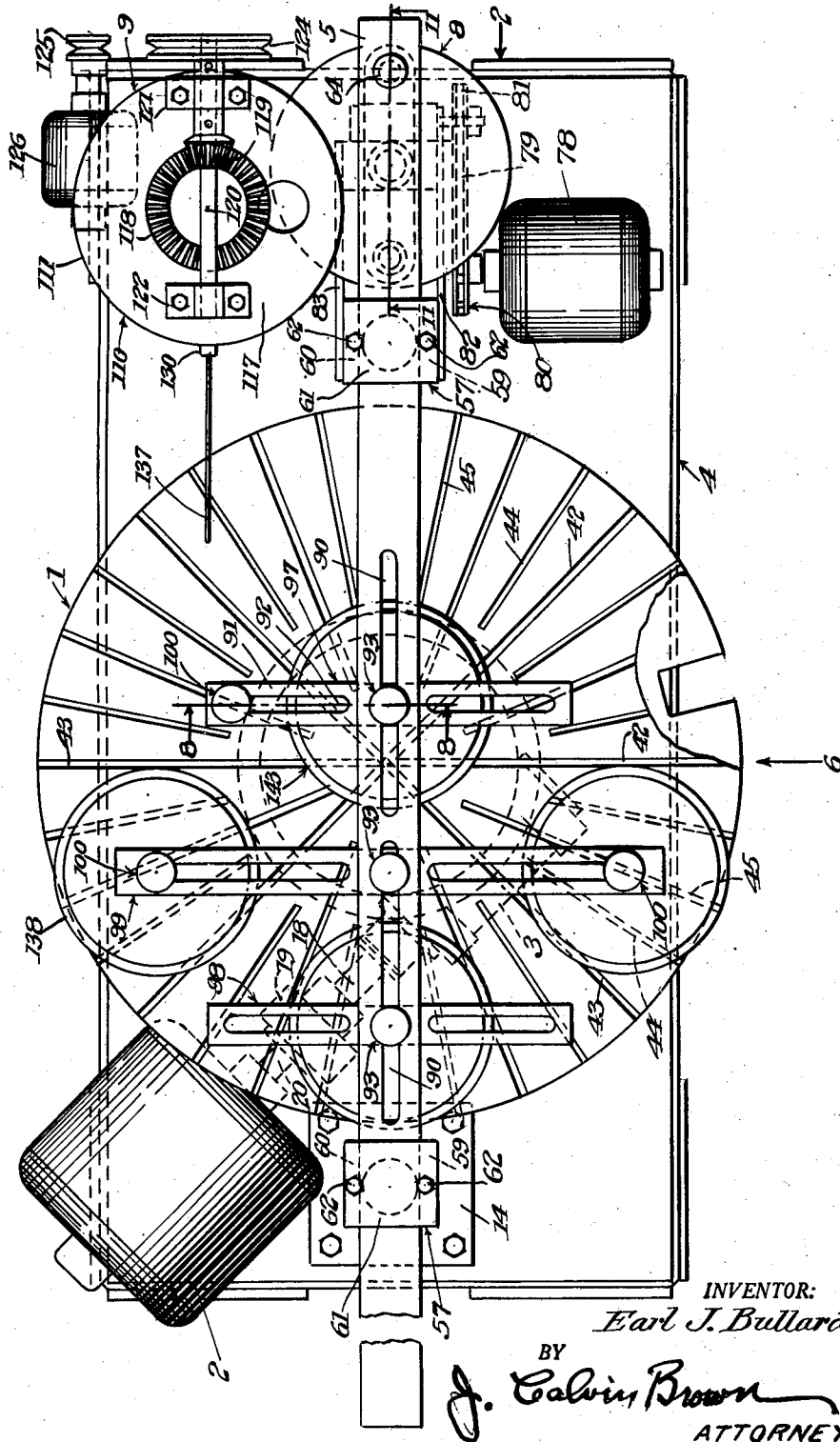
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LAPPING MACHINE

Filed Nov. 28, 1945

4 Sheets-Sheet 1

Fig. 1.



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Fig. 9-

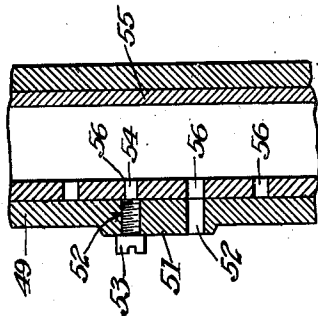


Fig. 8-

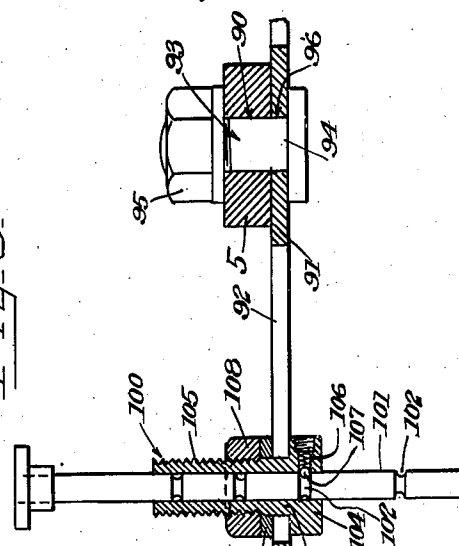


Fig. 7-

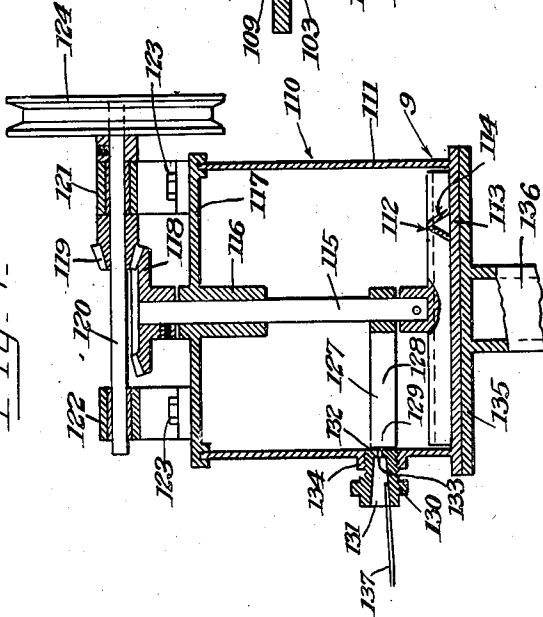


Fig. 11-

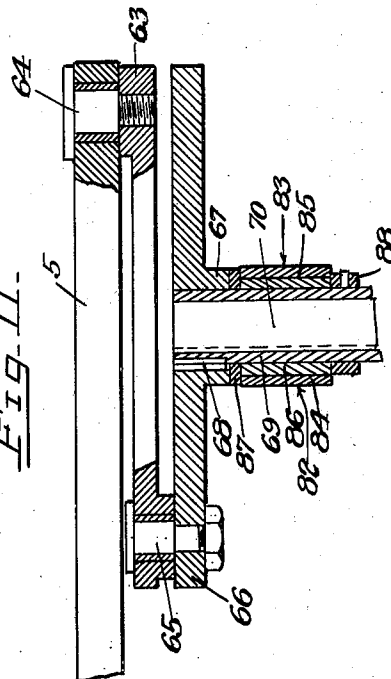


Fig. 10-

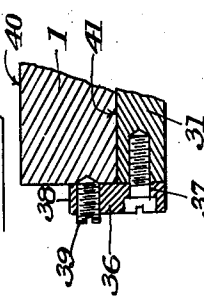
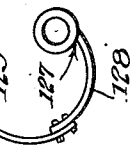


Fig. 12-



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LAPPING MACHINE

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1 Claim. (Cl. 51-123)

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The present invention relates to lapping machines.

An object of the invention is to provide a means for moving the work over a lap in such a manner that all parts of the lap are covered.

Another object of the invention is to provide a lapping machine adapted to hold work of various depths.

Another object is to provide a lapping machine utilizing work holders wherein the work holders may be located on the lap at any selected location.

Another object is to provide in a lapping machine a construction wherein the lap maintains a predetermined surface while in use.

Another object is to provide in a lapping machine a lap so constructed and arranged that particles from the work are cleared, to the end that the work is not scratched or abraded.

Another object is to provide in a lapping machine means whereby grit may be constantly conveyed to the surface of the lap.

Lapping machines now known to the inventor require frequent dressing of the lap to maintain the same in a predetermined condition, for instance absolutely flat. As the work, which is generally placed in a work holder, is ground by the lap during rotation of the lap, the lap wears unevenly. Certain lapping machines, in an endeavor to overcome this defect, have attempted to have a sweeping movement of the work over the lap as the lap rotates. However, this does not prevent the lap from wearing unevenly, with the result that after a short period of time the lap must either be removed from the machine and resurfaced, or special dressing is applied to the lap surface while on the machine. Such a resurfacing operation is long and tedious and requires the utmost of skill in the dressing operation. My invention automatically maintains the lap surface in condition during the grinding of work, hence no shutdown for a dressing operation.

The invention also contemplates the use of a lap which is dressed on both surfaces, so that when one surface wears to a certain depth the lap may be turned over and the other surface used. Both surfaces are so constructed that they remove grid and particles from the lap surface during the operation of the lapping.

In the drawings:

Fig. 1 is a fragmentary top plan view of the lapping machine;

Fig. 2 is an end elevation of the lapping ma-

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chine looking in the direction of the arrow 2 of Fig. 1;

Fig. 3 is a plan view of a wear ring and disc which may be utilized in the practice of the invention;

Fig. 4 is a sectional view on the line 4-4 of Fig. 3;

Fig. 5 is a plan view showing the work within the ring shown in Fig. 3;

Fig. 6 is a fragmentary elevation, partly in section, of the lapping machine and looking in the direction of the arrow 6 in Fig. 1;

Fig. 7 is an elevation, partly in section, of a tank for holding grinding compound utilized in the practice of the invention;

Fig. 8 is a fragmentary view, partly in section, and on an enlarged scale, on the line 8-8 of Fig. 1;

Fig. 9 is a fragmentary sectional view on an enlarged scale taken on the line 9-9 of Fig. 6;

Fig. 10 is a fragmentary sectional view on an enlarged scale on the line 10-10 of Fig. 6;

Fig. 11 is a fragmentary, partially sectional view on an enlarged scale taken on the line 11-11 of Fig. 1 and looking in the direction of the arrows; and,

Fig. 12 is a plan view of a wiper to be utilized in the tank of Fig. 7.

Referring now with particularity to the drawings:

The improved lapping machine includes a lap 1, adapted to be rotated by means 2, through a reducer 3, the said reducer and means 2 being mounted upon a supporting frame 4; means 5 carried in adjustable supports 6 and 7, the means 5 being positioned transversely of the lap 1 and adapted to be reciprocated diametrically of the lap by means 8, together with means 9, whereby grit may be progressively fed to the surface of the lap.

Preliminarily, it may be stated that the means 5 includes bars provided with members for holding work and in such a manner that during reciprocation of the means 5 and rotation of the lap 1 the work is progressively played over the entire surface of the lap and in such a manner that the lap surface is maintained at a pre-selected angle, whether the surface be concave, convex or plane.

The frame 4 is conventional in form, and so constructed as to best support the various elements of the invention. In the present instance the frame is rectangular and provided with corner legs 10 for longitudinal channel members 11 and transverse members 12, the legs suitably

braced by means of webs 13. Extending between the longitudinal channel members 11 are plates 14, 15 and 16, and it is upon these plates that the elements of the invention are mounted and secured.

Fastened to plate 15 by bolting or otherwise is reducer 3, which comprises a series of gears, not shown, one of which connects with shaft 17 for rotating the lap 1. The gears in the reducer, through the medium of a shaft 18, shown in dotted lines in Fig. 1, connect with a clutch 19, the clutch in turn being connected with a shaft 20 of the motor 2. This motor may be of small H. P. and of the type adapted to rotate approximately 1740 R. P. M., the reducer cutting down the rotative speed of the motor shaft so that the shaft 17 rotates the lap at approximately 50 R. P. M. No particular type of clutch 19 is specified, although the clutch should be of the variable rotative type which allows the motor to run at a constant speed while the clutch gradually rotates the lap to its final speed. Clutches of this type are obtainable on the market, one of which is sold under the commercial name of Hillard. Supported by reducer casing 21 is a bearing plate 22, the said bearing plate being spaced from the reducer casing by means of adapters 23, of which there may be a plurality and through which adapters are passed bolts 24. The said bearing plate is formed with a central opening 25 through which shaft 17 is passed, and said plate is concentrically recessed at 26. The recess 26 is adapted to confine a pair of annular race members 27 and 28, between which are placed bearings 29. An annular adapter 30 is positioned between the inner race member and the periphery of shaft 17 and has a part which overlies the top of one of the race members.

The lap 1 is carried by a table 31. This table in the present instance is circular and has substantially the same diameter as the lap. The said table is formed with an axial opening 32 and with a hub 33 on its under surface. Radial webs of decreasing depth extend from the hub 33 to the rim of said table, to give strength to the construction and prevent bending movement. The hub end rests on the adapter 30.

The lap 1 is held against shifting relative to the table 31 by clamps 35, see Fig. 10. These clamps include plates 36, bolted or otherwise secured as indicated at 37 to the edge of the table, and with a portion 38 projecting above the table top and carrying a set screw 39. This set screw is adapted to engage the edge of the lap, as indicated. A plurality of the clamps are spacedly secured to the table top, as illustrated in the several figures.

The lap 1 may be of any desired thickness, depending generally upon the diameter of the lap. This lap has two surfaces 40 and 41, both provided with radial grooves 42, the radial grooves of one surface of the lap being offset with relation to the grooves on the opposite surface, as best illustrated in Fig. 6. Certain of the grooves 42 extend diametrically of the lap surfaces, as indicated at 43, while other of the said grooves, as shown at 44 and 45, terminate outward of the center of the lap and do not intersect. It is intended that both surfaces of the lap should be used, and when one surface, as 40, has been worn down so that the grooves are no longer useful, the lap may be reversed to position the surface 41 on top. Such a system of course prolongs the useful life of the lap.

Secured to plates 14 and 16 are the adjustable

supports 6 and 7. These supports include pedestals or housings 46 and 47. As the pedestals are identically formed, one thereof will be described, the same reference characters applying to the other. The pedestal 46 is provided with a flanged base 48 which is bolted or otherwise secured to the plate 14. The tubular portion 49 of said pedestal is braced by providing webs 50 between said portion and the base. The transverse dimension of the tubular portion 49 is enlarged at 51, and provided with one or more transverse bores 52, see Fig. 9. One of the bores receives a screw 53, the end of which is reduced in diameter at 54. Adapted for adjustable movement within the tubular pedestal or housing is a slide 55. This slide is tubular in form and is provided with a series of spaced transverse perforations 56, adapted to receive the reduced end portion 54 of screw 53. The upper end of said slide 55 transversely carries a guide 57. This guide includes a base plate 58, provided with two spaced apart parallel side members 59 and 60, indicated by the dotted lines in Fig. 1. The cover or cap 61 spans the sides 59 and 60 and is secured thereto by means of bolts 62. This construction provides an enclosed way for movement of the bar 5. The bar 5 is an elongated rectangular-cross-sectioned member, as best illustrated in Figs. 1 and 6.

The means 8 includes a link or Pitman 63, secured by means of a pivot pin 64 to the bar 5 and adjacent one end thereof, the opposite end of said Pitman being secured by a pivot pin 65 to a disc 66 and adjacent the rim of said disc. The disc 66 is provided with a hub 67, keyed at 68 to a sleeve shaft 69. A solid shaft 70 is telescopically received within the sleeve shaft, the said solid shaft being provided with a longitudinal keyway 71, adapted to receive a key 72, carried by the lower end of the sleeve shaft. The solid shaft is secured to the upper member 73 of a coupling 74, the lower member 75 of the coupling is connected to a shaft 76 leading to a gear reduction means 77. The gear reduction means in turn is adapted to be driven by a motor 78. For the sake of simplicity the drive between the gear reducing means and the motor is shown as a continuous belt 79 passed between pulley 80 carried by the shaft of the motor and pulley 81 mounted on a shaft leading to the gears of the gear reducing means.

To support the disc 66 and its sleeve shaft are a pair of spaced apart brackets 82 and 83; one of the ends thereof is secured to the sides 59 and 60 of a guide 57, and the opposite ends 84 and 85 thereof are secured to a bearing 86 which surrounds the sleeve shaft. Between the bearing 86 and the end of the hub 67 of the disc is a washer 87, while the lower end of said bearing is held in position by means of a collar 88, secured to the sleeve shaft. Any convenient means may be utilized for holding the outermost bracket ends to said bearing 86, such as by screws 89 shown in Fig. 6.

The bar 5 is provided with one or more elongated slots 90. Carried by said bar are cross-bars or arms 91. Said crossbars are provided with one or more elongated slots 92. The crossbars may be held to the bar 5 by means such as illustrated in Fig. 8 at 93. This means includes a bolt 94, adapted to receive a nut 95, the shank of said bolt being passed through a bore 96 in the crossbar and through one of the slots 90 of the bar 5, and then locked in position at some desired point by means of the nut 95. In the present instance the bore 96 is situated midway between ends of a crossbar, and the elongated

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slots, 92 extend from adjacent each end of a crossbar to a zone near the center thereof. Furthermore, the crossbar is transversely positioned beneath the bar 5. The crossbars may also vary as to length, as it will be seen that the crossbars shown at 97 and 98 are shorter than the crossbar shown at 99. The manner of determining the proper length of crossbar to be used and the method of using the same will be detailed in the statement of operation.

In order to maintain the work upon the lap I have provided means 100, the construction of which is detailed in Fig. 8. The said means includes a pin 101, provided with one or more spaced apart annular grooves 102, the said pin being passed through a sleeve 103 provided with a head 104, the external surface of which sleeve is screwthreaded in part at 105. The head 104 is transversely bored at 106 to receive a spring pressed detent 107. The detent is adapted to be positioned in some one of the annular grooves 102 of the pin. A nut 108 is carried on the threads 105, and the said means 100 when in position of service upon one of the cross arms or bars has the base 104 engaging the under surface of said bar and straddling the slot 92 therein, with a washer 109 lying against the opposite surface of said bar and carried on the sleeve 103. When the nut 108 is turned, the nut, washer and base are brought into clamping relationship with the bar in the well understood manner.

It is essential during the operation of a device of the character of this invention that the surface of the lap be supplied with a gritty fluid, and at 110 I have provided means whereby a liquid containing grit may be constantly fed to the lap and at any desired location on said lap. The arrangement of the device is such that the flow is continuous and without clogging. The means 110 includes a tank 111, within which is an agitator 112. This agitator is positioned adjacent to base 113 of the tank and extends substantially diametrically thereof. The agitator includes two wing portions meeting at the apex to form a V, as shown at 114. The agitator is centrally secured to a shaft 115, which is passed through a guide sleeve 116, carried by the tank cover 117. The shaft extends through the cover and exteriorly mounted thereon is a bevel gear 118, which meshes with bevel gear 119, mounted on shaft 120, this shaft being carried in suitable bearing-type brackets 121 and 122 secured to the cover, as indicated for both brackets at 123. One end of the shaft has secured thereto a pulley wheel 124. A continuous belt is passed around the pulley wheel 124 and pulley wheel 125 on the shaft of a motor 126, see Fig. 2, whereby the agitator may be rotated.

Secured to shaft 115 is a wiper 127. This wiper has a curved arm 128 to which is attached a strip of leather or other material 129. Secured to the side wall of the tank is a fitting 130. This fitting has a tapered bore 131 and an end wall 132, provided with a transverse perforation 133. The transverse perforation 133 is of small diameter, and the arrangement is such that the leather wiper blade 129 is adapted to play over the end 132 of the fitting and constantly maintain the surface clear of any grit which might tend to build up on the surface and close the perforation 133. The said fitting is held to the container side wall in any convenient manner, such as by means 134, constituting a collar secured to the side wall of the tank and in screw-threaded engagement with the fitting. The tank

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is secured to a platform 135, the platform in turn being on the upper end of a tubular stand 136, the lower end of which stand is flanged so that the same may be fastened to the plate 16 in any appropriate manner, such as by bolts.

A wire 137 is secured to the fitting in communication with the tapered bore 131. This wire may be of extended length and positioned over the lap surface. It has been found in practice that the grit carrying liquid will follow the wire and drop from the end thereof at any desired location. It is of course obvious that any number of fittings 130 and wires 137 may be secured to the tank or tanks as may be necessary.

The operation, uses and advantages of the invention are as follows.

The work may be placed within the confines of wear rings of the character illustrated in Fig. 3 at 138. These wear rings are annular in form and usually made of cast iron, the material forming no part of the invention, however. Adapted for placement within the confines of the wear rings and over the work 139 is workholding disc 140. Usually a felt disc 141 is interposed between disc 140 and the work, as this serves to accommodate for any unevenness or variation of thickness in the work which is being lapped. The disc is formed with a central opening 142, adapted to receive one of the pin ends of a pin 101. Having selected the number of wear rings necessary to hold the work to be lapped, the crossbars are regulated relative to the bar 5 in such a manner that when the bar 5 is reciprocated the wear rings will move over substantially the entire surface of the lap. Taking Fig. 1 by way of example, it will be observed that the pins are positioned in crossbar 99 near the outermost ends thereof, and the wear rings would be positioned as indicated. The wear rings are positioned centrally of crossbars 97 and 98. In the position of the bar 5 of Fig. 1 the bar has reached the limit of its excursion in one direction and the crossbar at 97 has its wear ring overlapping the diametrical groove 43 indicated at 143. When the bar 5 is reciprocated to the limit of its excursion in the opposite direction, the bar at 97 will be close to the rim of the lap, or substantially in the position now occupied by the crossbar shown at 98.

It is not always necessary to use a wear ring. Wear rings are usually employed when the work is of small diameter and flat. When the work is of large diameter and has an opening or openings therein, the pins 101 directly engage such work. However, it is essential that either the work alone or the work within wear rings be so located relative to the crossbar that the work traverses the entire surface of the lap during reciprocation of the said bars. I have found that the use of wear rings which extend beyond the edges of the lap, as indicated in Fig. 1, is of advantage, as it assures that the lap surface is evenly worn. Other positions of the work may be resorted to as long as the work is so distributed as to cover the lap when the work is reciprocated across the surface of the lap. By way of example, the pins 101 might be positioned within the slots of the crossbars 97 and 98, and in place of utilizing the nut and bolt arrangement of Fig. 8, shown at 93, the pins 101 may be substituted. Different arrangements may be resorted to, as stated, as long as the principle of the invention is adhered to, to wit: that the lap surface must be covered or substantially covered during a reciprocation of the work across the lap surface.

When the device first commences operation the motor 2 rotates the reducer 3 through the clutch 19, and gradually the lap picks up speed. The motor 78 drives the gear reduction means 77, which in turn rotates the sleeve shaft and the solid shaft which are in keyed connection, to turn the disc 8 and move the Pitman 63 to cause reciprocation of bar 5 within its guides 57. This reciprocation will of course move the work held by the pins over the surface of the lap and in such a manner that all areas of the lap are contacted. It is of course realized that in a lap of any diameter the speed of movement increases with the radius. As a consequence, work is not always properly dressed due to this change in lap speed. However, by reciprocating bar 5 the work is so moved as to play over all portions of the lap and cause equal wearing of the lap.

While this operation is proceeding, the motor 126 is driving the agitator or impeller 112 within the tank to keep the grit from settling and likewise evenly distributing the grit in the tank. As the shaft 115 rotates the wiper blade constantly passes over the inlet end of the fitting 136, maintaining it free and permitting the grit laden fluid to pass into the fitting at a slow speed. The wire 137 is readily bendable so as to position the outermost end thereof in any location desired on the lap, so that the grit may be fed to such portions of the lap as may be desired. As the lap rotates and the work is ground or dressed, cuttings and other debris, including grit, are received within the radial grooves 43—45 inclusive of the lap, which clears the lap surface of any substances which may tend to abrade or otherwise damage the work. The rotation of the lap, while at a low speed, nevertheless causes centrifugal action tending to direct the liquid and its cuttings outwardly toward the rim. These cuttings and fluid are received within the container type car shown in Fig. 6 at 144.

A feature of the invention resides in the adjustment permitted whereby work of different sizes may be accommodated on the lap. To accomplish this adjustment the tubular sleeve or housing 49 carries movable screw pins 53, see Fig. 9, which engage in one of the selected transverse bores 56 in the slide 55. Thus the slides may be elevated relative to their housings, and then held against movement by means such as shown in Fig. 6 at 145. This means constitutes a clamp screw passed through a screwthreaded enlargement on the housing, the end of which screw engages the slide. The screw pins 53 are then inserted within the proper openings in the slide, whereupon the clamp screw 145 may be released. Such movement of the slides will of course elevate the bar 5. However, such elevation does not affect the operating characteristics of the machine for the reason that the sleeve shaft 69 will move relative to the solid shaft 70, and as the two are keyed together, rotation of one

produces rotation of the other. One of the guides for the bar 5 carries bracket members 82 and 83, which support the disc 66, together with the Pitman 63. As the sleeve shaft is secured to the disc by keying, it is obvious that as the slides are elevated the sleeve shaft is moved relative to the solid shaft.

The pins 101 are adjustable as to height above the work. This adjustment permits the pins to be released from the work after a grinding operation, as well as correctly positioning the pins when for any reason the slides are elevated above the lap.

I have previously stated that any number of fittings 130 may be provided, together with wires leading from said fittings. Thus the grit laden fluid may be conducted to the surface of the lap and at different zones of said surface as necessity requires.

I claim:

In a lapping machine; a circular lap having a working face; a bar positioned above and diametric of said lap; supports for said bar; said bar formed with a longitudinal slot; an arm transverse to said bar and adjustable pin connections between said arm and said bar and movable within the bar slot to position the arm relative to the lap surface; said arm being formed with longitudinally extending slots and adjustable pin connections passed through said slots for engaging work, said adjustable pin connections being so positioned in the slots that when the lap is rotated and the said bar is reciprocated, the work engages the entire surface of said lap to thereby produce even wear of the lap surface.

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