Nov. 17, 1931. H. S. INDGE ET AL 1,831,958

LAPPING MACHINE

Filed Oct. 19, 1928 2 Sheets-Sheet 1

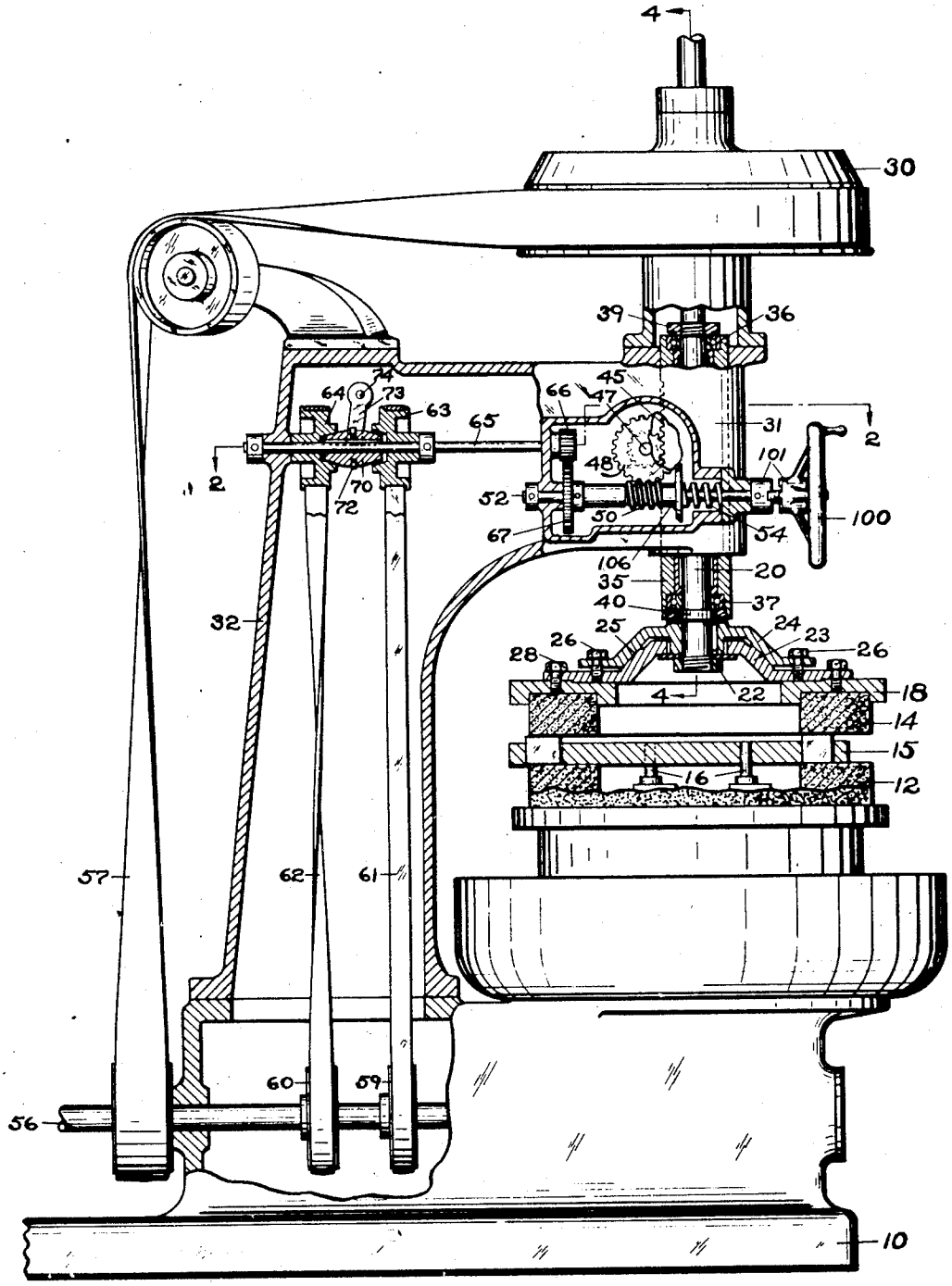


Fig. 1

Inventors

HERBERT S. INDGE

SYDNEY PLAYER

By Clayton R. Jenks

Attorney

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Fig. 2

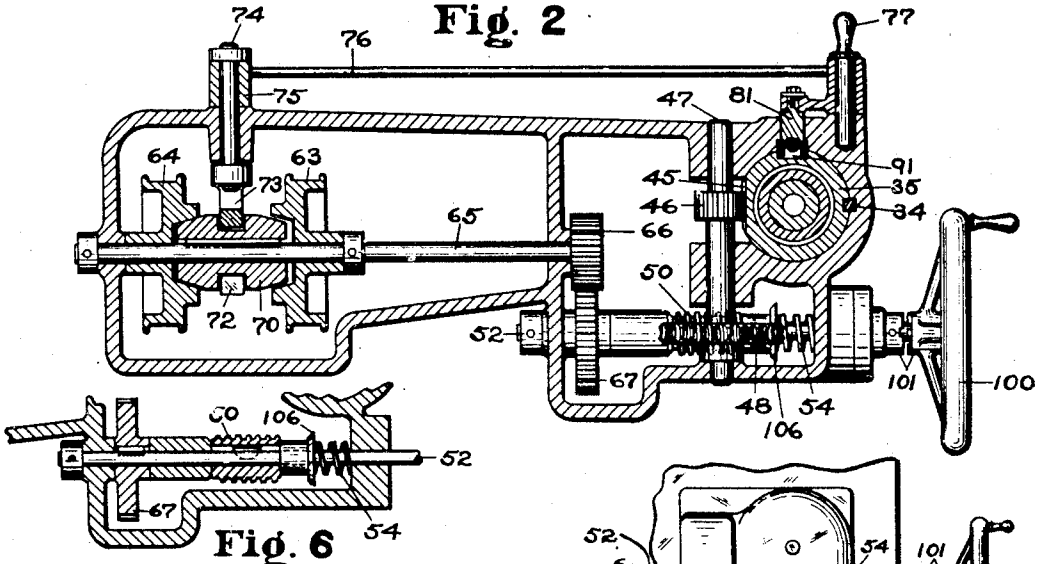


Fig. 6

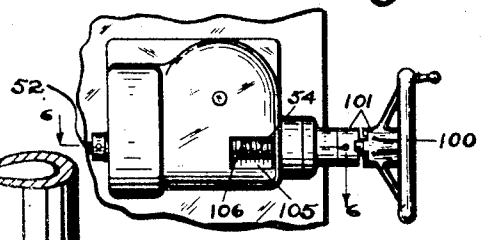


Fig. 3

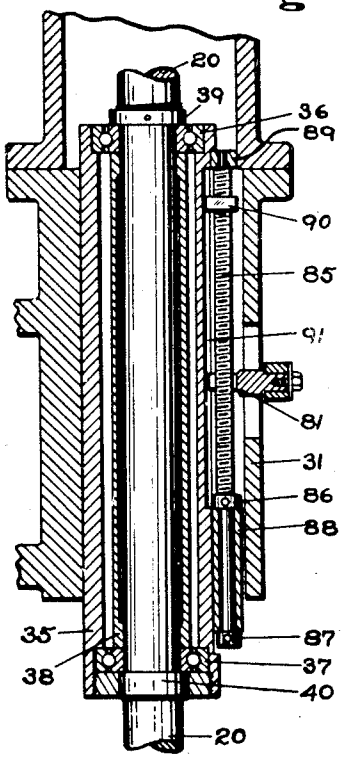
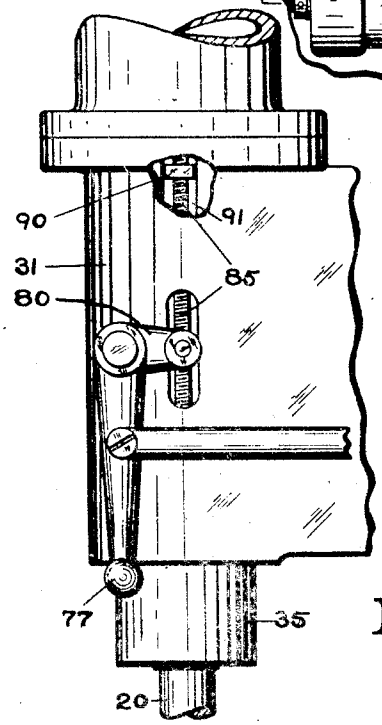


Fig. 4



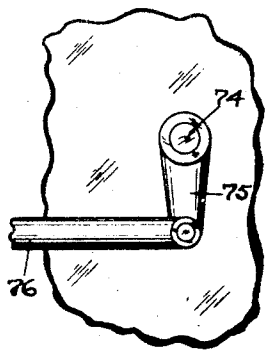


Fig. 5

Inventors

HERBERT S. INDGE

SYDNEY PLAYER

By Clayton R. Johnson

Attorney

Patented Nov. 17, 1931 1,831,958

UNITED STATES PATENT OFFICE

HERBERT S. INDGE AND SYDNEY PLAYER, OF WESTBORO, MASSACHUSETTS, ASSIGNORS TO NORTON COMPANY, OF WORCESTER, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

LAPPING MACHINE

Application filed October 19, 1928. Serial No. 313,549.

This invention relates to lapping machines of the type in which a multiplicity of duplicate work pieces are mounted in a cage between two opposed laps, the cage and the laps being relatively movable to cause a lapping action.

In order to place pieces of work in the work retaining cage of this type of lapping machine, it is customary to move the upper lap away from the lower through a considerable distance. Owing to the weight of the upper lap, the operation of raising it either requires considerable effort on the part of the operator or involves considerable waste of valuable time which should be utilized in producing the lapped articles.

It is therefore one object of this invention to provide a power operated lifting device capable of moving one of the laps toward or from the other, and particularly one which may be manually controlled to regulate the distance through which one of the laps may be moved in either direction, the lap being stopped automatically in any desired position relative to the work or to the other lap and held there until further adjustment is made.

A further object is to provide a lapping machine with both a power operated lifting mechanism for moving one of the laps and a manually operated mechanism which may be utilized for finely adjusting the movable lap into a correct position relative to the work to be lapped.

The ordinary lapping operation is one in which the upper lap rests upon the work with a pressure which is determined solely by the influence of gravity upon this freely movable lapping element. However, there are some types of work which require more pressure from the laps than do others in order to produce the most efficient lapping operation.

It is therefore another object of this invention to provide a lapping machine with a mechanism which will permit the laps to be pressed against the work with a variable but predetermined amount of pressure, and particularly a manually controllable mechanism capable of providing a pressure which may be gradually varied from a very slight touch to a heavy thrust upon the work and which may be quickly released whenever desired.

A further object of the invention is to combine these various features into a lapping machine and thereby to produce a power operated, manually controlled machine which will be highly serviceable for lapping various types of articles on a large scale production basis.

A lapping machine made in accordance with this invention comprises two opposed laps having a work cage therebetween, which are relatively movable to lap the pieces of work held within the cage. One of the laps is movable toward or away from the other lap, and if the laps are horizontally arranged, the lower lap is preferably stationary and the upper lap is moved vertically toward and from the lower lap. The movable lap is moved by a power driven mechanism, and in order that the movable lap may be stopped in any desired position, a stopping device is provided which may be set as desired so that the movable lap may rapidly move to a predetermined position and be definitely held there until further adjustment.

The power operating mechanism preferably comprises a clutch controlling device which may be manually adjusted to any desired position so that when the movable lap has rapidly traveled to a given location the clutch will be automatically disengaged to stop any further power movement of the lap. This driving mechanism also preferably includes a worm which is so arranged that, when the clutch has been disengaged, the weight of the lap will not cause any further descent, but the lap will remain in that position until moved either manually or by power.

A further feature of this invention comprises a manually operable mechanism which may be employed either to move the lap throughout the entire distance desired or to finely adjust the position of the lap relative to the work after it has been brought nearly to a correct position by the power driven

mechanism, whereby the lap may be moved rapidly to its approximate position and then very carefully brought into contact with the work without danger of injury either to the work or to the laps.

Another feature comprises a finely adjustable pressure mechanism, such as a spring actuating device, which may be manually controlled to impress any required pressure, varying from a mere touch to a heavy thrust, upon the work during the lapping operation.

Referring to the drawings which illustrate one embodiment of the invention and in which like numerals indicate like parts:

Fig. 1 is a vertical elevation partly in section of the assembled lapping machine;

Fig. 2 is an enlarged view in section along the line 2—2 of Fig. 1 showing the clutch and manual control mechanism;

Fig. 3 is a fragmentary view of the hand wheel and scale associated therewith for determining the amount of pressure to be exerted upon the work;

Fig. 4 is a fragmentary section taken along the line 4—4 of Fig. 1 for the upper lap and the associated parts therewith;

Fig. 5 is a fragmentary elevation showing the relation of the clutch operating arm with the adjustable device which determines the position of the lap when the clutch is disengaged; and

Fig. 6 is a fragmentary section taken along the line 6—6 of Fig. 3, showing the parts mounted upon the hand wheel shaft.

Referring more particularly to the embodiment illustrated, the lapping machine may be constructed in its general aspects similar to the machine illustrated in the United States patent to Indge No. 1,610,527, and this machine as shown in the prior patent and here illustrated comprises a base 10 upon which is mounted a lower lap 12 and an upper lap 14 and between which is arranged a work supporting cage 15. The lower lap may be stationary or rotatable insofar as the present invention is concerned, and the work cage 15 will be movable or stationary in accordance with the nature of the movement imparted to the other members of the machine, but these features do not constitute a part of the present invention. It however is to be noted that the work cage 15 is illustrated as mounted for revolution relative to the laps by means of the revolving posts 16 provided for that purpose, these being arranged as shown in the patent to Indge No. 1,610,527.

The upper lap 14 is suitably mounted on a support 18 and this support is adjustably carried on a vertical shaft or spindle 20 which is mounted for vertical movement relative to the lower lap. As illustrated, the spindle 20 has threaded on its lower end a cap 22 which supports two members 23 and 24 of a ball and socket joint so arranged that the upper lap 14 may be adjusted to various positions relative to the plane of the lower lap and preferably for the operation of truing the upper lap when it is necessary that the two laps be brought into exact parallelism. These members may be left free for movement, if desired, so that the lap may continually adjust itself during a lapping operation to the plane of the tops of the work pieces. These members 23 and 24 contact on a substantially spherical surface 25, as illustrated in Fig. 1, and they are held in proper alignment by a series of screws 26 arranged to permit adjustment of the two parts relative to each other. The support 18 which carries the upper lap is fastened to the lower member of the universal joint 23 by means of further screws 28.

In order to permit vertical movement of the upper lap, the spindle 20, which is arranged to be revolved by means of a pulley 30 mounted on its upper end, is rotatably mounted within the housing 31 which projects laterally from the vertical casing 32 of the base as shown in Fig. 1. The spindle 20 is rotatably mounted in the sleeve 35 which is keyed to the housing by key 34 so that it may move only vertically. Suitable bearings 36 and 37 are arranged between the sleeve 35 and the spindle 20. These bearings are held in place by a further sleeve 38 placed therebetween and surrounding the spindle 20 as will be evident upon inspection of Fig. 4 of the drawings. Collars 39 and 40 on the spindle serve to position the spindle and sleeve relative to each other. It will be noted that the supporting members 23 and 24 are clamped against the under side of the collar 40 (Fig. 1) and that the upper member 24 is keyed to the spindle 20 so that it must rotate therewith.

One feature of this invention involves a power lifting device for moving the spindle vertically. In order that this may be accomplished, the sleeve 35 is provided upon one side with teeth 45 which mesh with a pinion 46 (Fig. 2) suitably fastened on the short shaft 47 journaled in the housing 31. A worm wheel 48 fastened on this shaft meshes with a worm 50 which is slidably keyed to a cross shaft 52 journaled in the housing 31, as shown in Figs. 1, 2 and 6. This worm 50 is normally retained in position at the left-hand end of the shaft, as shown in Fig. 1, by means of a spring 54 which is located between the end of the worm and the interior of the housing. These parts are therefore so arranged that when the worm is rotated in either direction, the sleeve 35 and the upper lap carried thereby will be moved vertically toward or away from the lower lap.

In order to move this upper lap by means of a power mechanism, a suitable power take-off is provided to transmit power from the main driving shaft of the machine to this worm. As illustrated, the main shaft 56 in the bottom of the machine may be connected

by a belt 57 to the pulley 30 to drive the upper lap. This shaft 56 also has two pulleys 59 and 60 fixed thereon carrying the belt 61 and the crossed belt 62 which are connected to two pulleys 63 and 64 loosely mounted on the shaft 65 journaled in the upper portion of the casing 32. This shaft 65 is connected through the gears 66 and 67 to the shaft 52 which drives the worm 50.

A suitable clutch is provided to connect the shaft 65 with either of the pulleys 63 or 64. As illustrated, a friction driving clutch device may be utilized for this purpose comprising, as simply shown in the drawings, a double cone clutch member 70 having conical faces which are arranged to engage corresponding conical recesses in one or the other of the pulleys 63 and 64. This clutch member 70 is slidably keyed to the shaft 65 and will therefore drive the shaft in one direction or the other depending upon which pulley it engages. The clutch may be controlled manually by means of a suitable yoke 72 which is thrown by the arm 73 mounted on the short shaft 74 which is journaled in the wall of the casing 32. On the outer end of this shaft 74 is fixed a crank arm 75 (Fig. 5) which is connected by a link 76 with a hand lever 77 pivotally mounted upon the housing 31 for convenient movement by the operator. Upon throwing the clutch into engagement with one or the other of the driving pulleys 63 and 64, the upper lap will be moved toward or away from the lower lap. Also it will be readily seen that, whenever the clutch is thrown to a neutral position, this upper lap will remain in its new position because the rack 45 cannot drive the worm backwards, hence there is no danger whatever of the upper lap falling and injuring either operator or the work.

The invention further comprises a mechanism which may be set arbitrarily to stop the downward movement of the upper lap in any desired position relative to the lower lap so that the operator need not give attention to this when it is not in working position. To this end, the handle 77 is fashioned as a bell crank lever which carries pivoted at the end of its short arm 80 a yoke member 81. This yoke member 81 projects through a suitable opening in the housing 31 and straddles a screw threaded member 85 which is rotatably mounted on the sleeve 35. The lower end of this screw 85 has collars 86 and 87 which position the screw relative to the projections 88 and 89 on the sleeve and in which the screw is rotatably mounted. A nut 90 is threaded upon the screw 85 above the yoke member 81 and also is keyed in the keyway 91 in the side of the sleeve 35 so that it cannot rotate. The collar 87 projects to an accessible position and is provided with a series of holes in which a pin may be inserted to rotate the screw 85 any desired amount, thereby causing the nut 90 to travel up or down the screw 85.

It will be readily seen that as the upper lap approaches the lower lap, the nut 90 approaches the yoke member 81 until it contacts with it and throws the bell crank arm 77 to neutral position thus disengaging the clutch 70 and stopping the upper lap in the desired position. Similarly, as the upper lap recedes from the lower, the collar 86 contacts with the yoke member 81, throwing the arm 77 to a neutral position, and thereby limits the upward stroke of the upper lap, thus saving the machine from possible damage should the operator neglect to stop the upper lap in its travel. This mechanism makes it possible to raise and lower the upper lap by means of a power driven mechanism. It is also feasible to raise and lower the upper lap by manually rotating the shaft 52, and the lap may be stopped in any desired position by means of the hand lever 77 and held there until the worm 50 is rotated to a further extent.

A further feature of the invention involves a mechanism whereby the operator may cause the laps to exert a desired degree of pressure upon the work. For this purpose, we utilize the spring 54 which surrounds the shaft 52 and maintains the slidable worm 50 in position. On the outer right-hand end of the shaft 52 is placed a hand wheel 100 which is loosely mounted upon the shaft and is adapted to engage it through suitable clutch teeth 101 (Fig. 3). By means of this hand wheel, the worm 50 may be rotated, when the clutch member 70 is in a neutral position, and the upper lap suitably adjusted. If the upper lap is lowered to rest upon the work and the power disengaged by manually or automatically throwing the hand lever 77 into a neutral position, and if the hand wheel 100 is thereafter turned in such a direction as to tend to force the upper lap downwardly, the result is to cause the worm 50 to slide longitudinally on the shaft 52 against the pressure of the spring 54 which pressure may be increased to any desired extent by proper manipulation of the hand wheel. Such rotation of the hand wheel, while the laps are contacting with the work, tends to compress the spring 54 and serves therefore to maintain a pressure upon the work during the lapping operation. In order to properly gauge the pressure imparted by the laps upon the work, a suitable scale and pointer are provided. This may comprise a scale 105 suitably placed on the edge of an opening in the outer housing of the machine as shown in Fig. 3. A collar 106 on the worm 50 is so located that it will be close to the scale 105 and thereby show the position of the worm and indicate the pressure imparted to the spring to hold the worm in such position.

By means of this construction it is possible to manually raise or lower the upper lap and after the lap has contacted with the work, it

may be forced against it with a heavy pressure or with a very slight pressure. If the operator wishes to alter the pressure during the lapping operation, he may rotate the hand wheel 100 in the desired direction.

The operation of the machine will be readily apparent. The operator may move lever 77 to engage the clutch 70, whereby the upper lap is rapidly lowered by power until it reaches a position just out of contact with the work; whereupon the nut 90, having been previously adjusted in position, throws the lever 77 back to a neutral position by contacting with the yoke 81 fastened to the lever 77, thereby stopping the downward travel of the lap at the desired position. The operator may then lower the upper lap through the slight remaining distance by engaging the clutch 101 and revolving the hand wheel 100 in the required direction until the lap contacts with the work. Further revolution of this hand wheel imparts the required pressure upon the work by the laps, which may be determined by the pointer 106 upon the scale 105. When the lapping operation has continued sufficiently, the operator throws the lever 77 into a reverse position thereby rapidly raising the upper lap by power. If he fails to disengage the clutch 70 by throwing lever 77 again to neutral position when the upper lap has been raised the required amount, the collar 86 in its upward travel will engage the yoke 81 attached to lever 77 thereby throwing lever 77 to a neutral position and stopping the upper lap in its travel.

The arrangement described is a simple mechanism which will serve to move the upper lap either manually or by power and to a desired extent as predetermined by the position of a suitable stop, and the same mechanism will serve to apply a predetermined pressure upon the work. The laps 12 and 14 may be composed of any suitable material, such as iron employed with loose abrasive powder, or of bonded abrasive material similar to grinding wheels, it being understood that the nature and size of the abrasive grains and the type and hardness of the wheel bond may be such as are determined to be best for any particular operation.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A lapping machine comprising two opposed laps, a work cage therebetween arranged to hold a multiplicity of work pieces in peripherally spaced lapping engagement therewith, said parts being relatively movable to lap the work, means for moving the laps relatively toward and from each other, adjustable mechanism for impressing a predetermined pressure upon the work by said laps, and manually operated means for varying said pressure.

2. A lapping machine comprising two opposed laps having annular lapping surfaces, and a work cage therebetween arranged to hold a multiplicity of work pieces in peripherally spaced engagement with said surfaces, means to cause a relative lapping movement between the work and the laps, means for moving the laps relatively toward and from each other, positively acting pressure mechanism tending to force one lap toward the other and thereby impart a definite pressure upon the work by said laps, and a manually adjustable device for varying the pressure minutely during the lapping operation.

3. A lapping machine comprising two opposed laps and a work cage therebetween which are relatively movable to lap the work, means to move one of the laps toward and from the other, a manually controlled pressure device arranged to exert a predetermined but variable pressure by the laps upon the work, and a device whereby said pressure is indicated at all times.

4. A lapping machine comprising two opposed laps and a rotatable work cage therebetween which are relatively movable to lap the work, means to move the work cage through an ever-changing path during its rotation whereby each work piece will be moved over the entire opposed lapping surfaces, a support for one of the laps permitting it to be moved towards and from the other lap, positively acting yieldable pressure mechanism tending to force one lap towards the other and thereby impart a definite predetermined pressure upon the work by said laps and manually adjustable means for varying said pressure by minute increments to any desired extent.

5. A lapping machine comprising two opposed laps and a rotatable work cage therebetween which are relatively movable to lap the work, means to move the work cage through an ever-changing path during its rotation whereby each work piece will be moved over the entire opposed lapping surfaces during the lapping operation, a support for one of the laps permitting it to be moved towards and from the other lap, positively acting pressure mechanism including a spring tending to force the movable lap towards the other, and means to gradually vary the tension of said spring and thereby vary the pressure of the laps upon the work to any desired extent.

6. A lapping machine comprising two opposed laps and a work cage therebetween which are relatively movable to lap the work, a support for a lap permitting it to be moved toward and from the other lap, means for impressing a predetermined but variable pressure upon the work by the laps, and power operated mechanism for moving the laps relatively away from each other and thereby automatically releasing the pressure upon the work.

7. A lapping machine comprising two opposed laps and a work cage therebetween which are relatively movable to lap the work, power operated means for moving one of the laps relative to the other to vary the distance therebetween, and manually adjustable mechanism for exerting a variable predetermined pressure upon the work during the lapping operation.

8. A lapping machine comprising two opposed laps and a work cage therebetween which are relatively movable to lap the work, power operated means for moving one lap toward the other, adjustable means for stopping the relative approach of the laps at a variable but predetermined position, and means for exerting a variable but predetermined pressure upon the work by said laps.

9. A lapping machine comprising two horizontally opposed laps and a work cage therebetween which are relatively movable to produce a lapping operation, mechanism for raising or lowering the upper lap, mechanism for stopping the approach of the upper lap at a predetermined but variable position, and manually controllable mechanism for impressing a variable predetermined pressure upon the work by said laps.

10. A lapping machine comprising two horizontally opposed laps and a work cage therebetween which are relatively movable to lap the work, power operated mechanism for moving the upper lap toward or away from the other lap, means for stopping the upper lap in any predetermined position, and means for manually moving the upper lap toward the other and for exerting a variable predetermined pressure upon the work by said laps.

11. A lapping machine comprising a base, a lap mounted thereon, a vertically movable, rotatable lap mounted thereabove, a work cage interposed between the laps, power operated mechanism for moving the upper lap toward the lower lap, and manually adjustable mechanism to exert any desired pressure upon the work by the laps.

12. A lapping machine comprising two horizontally opposed relatively rotatable laps, a work cage therebetween, means for rotating one of the laps, power driven mechanism for raising and lowering the upper lap, mechanism for stopping the approach of the upper lap toward the lower lap at a predetermined position, and manually controllable mechanism for imparting a variable predetermined pressure upon the work by said laps.

13. A lapping machine comprising two opposed horizontal lapping members, one of which is movable vertically towards and from the other, a rotatable work cage therebetween, means for causing a lapping action upon the work, a manually controlled mechanism for pressing the movable lap against the work with a pressure which may be varied from a light to a heavy pressure irrespective of the weight of the lap and manually controlled power operated means to rapidly move the laps relatively away from each other on completion of the lapping operation.

14. A lapping machine having two relatively movable opposed lapping members, a work cage positioned therebetween, said parts being relatively movable through an ever-changing path for lapping the work, power operated mechanism to move a lapping member to any predetermined position relative to the work, including a manually controllable device which makes it possible to press said lapping element against the work with a variable but predetermined pressure.

Signed at Worcester, Massachusetts, this 18th day of October, 1928.

HERBERT S. INDGE.
SYDNEY PLAYER.