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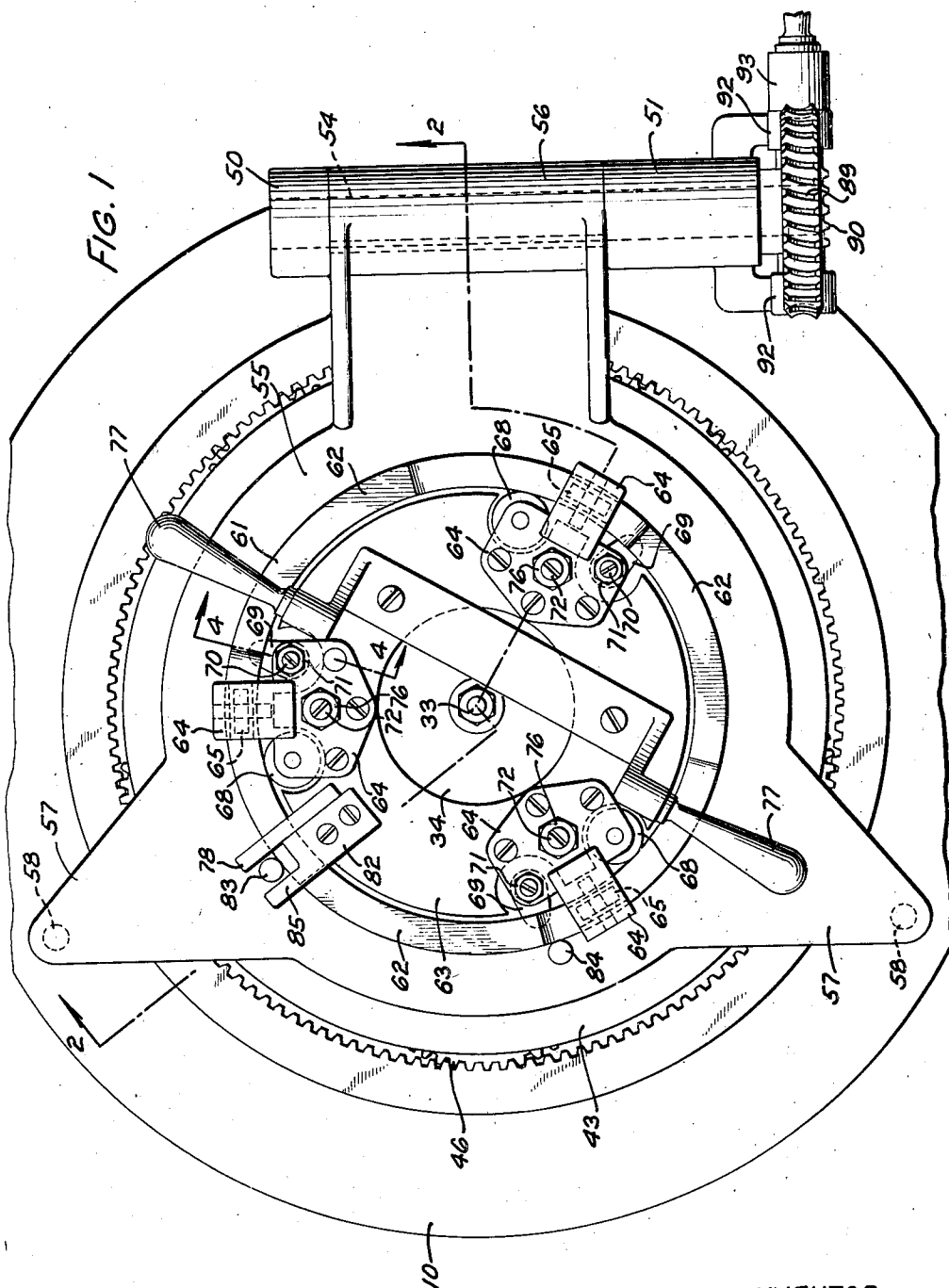
C. C. McCAIN

2,401,953

LAPPING MACHINE

Filed Oct. 25, 1944

3 Sheets-Sheet 1



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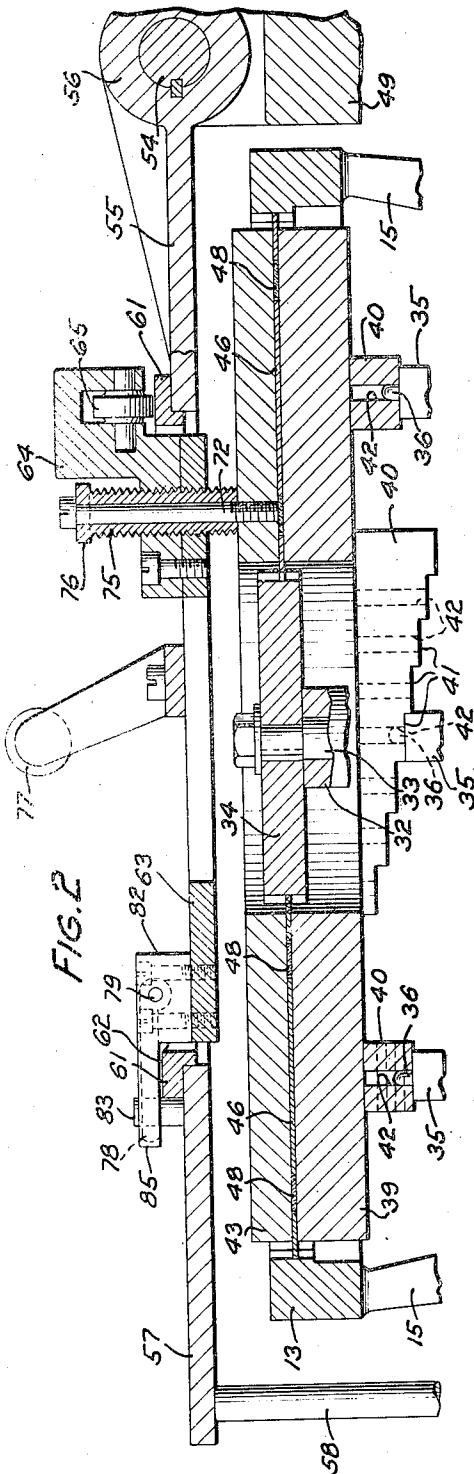
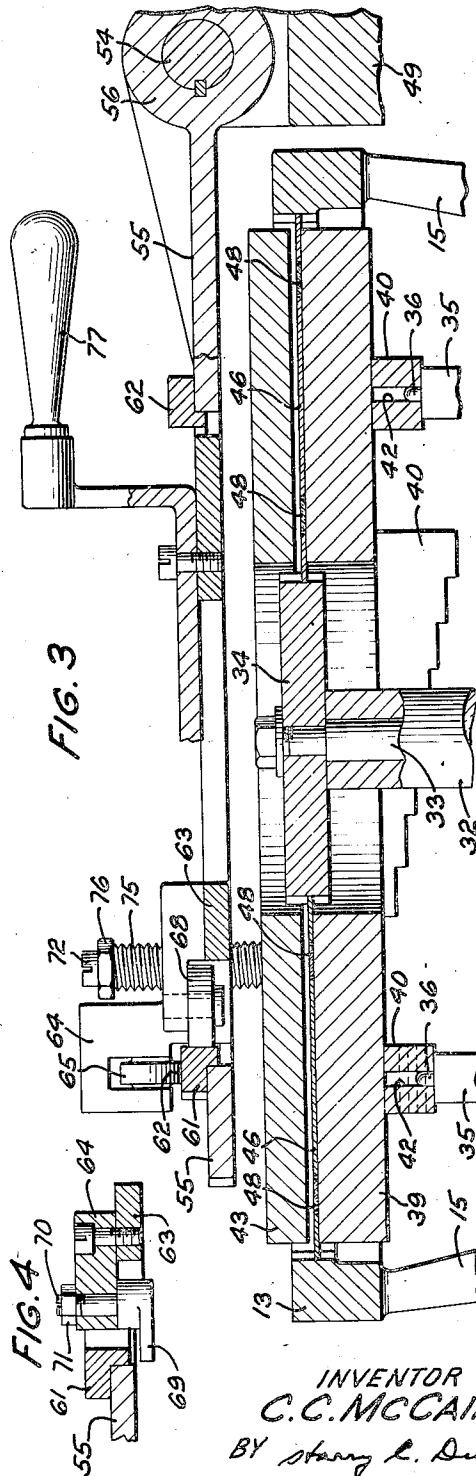
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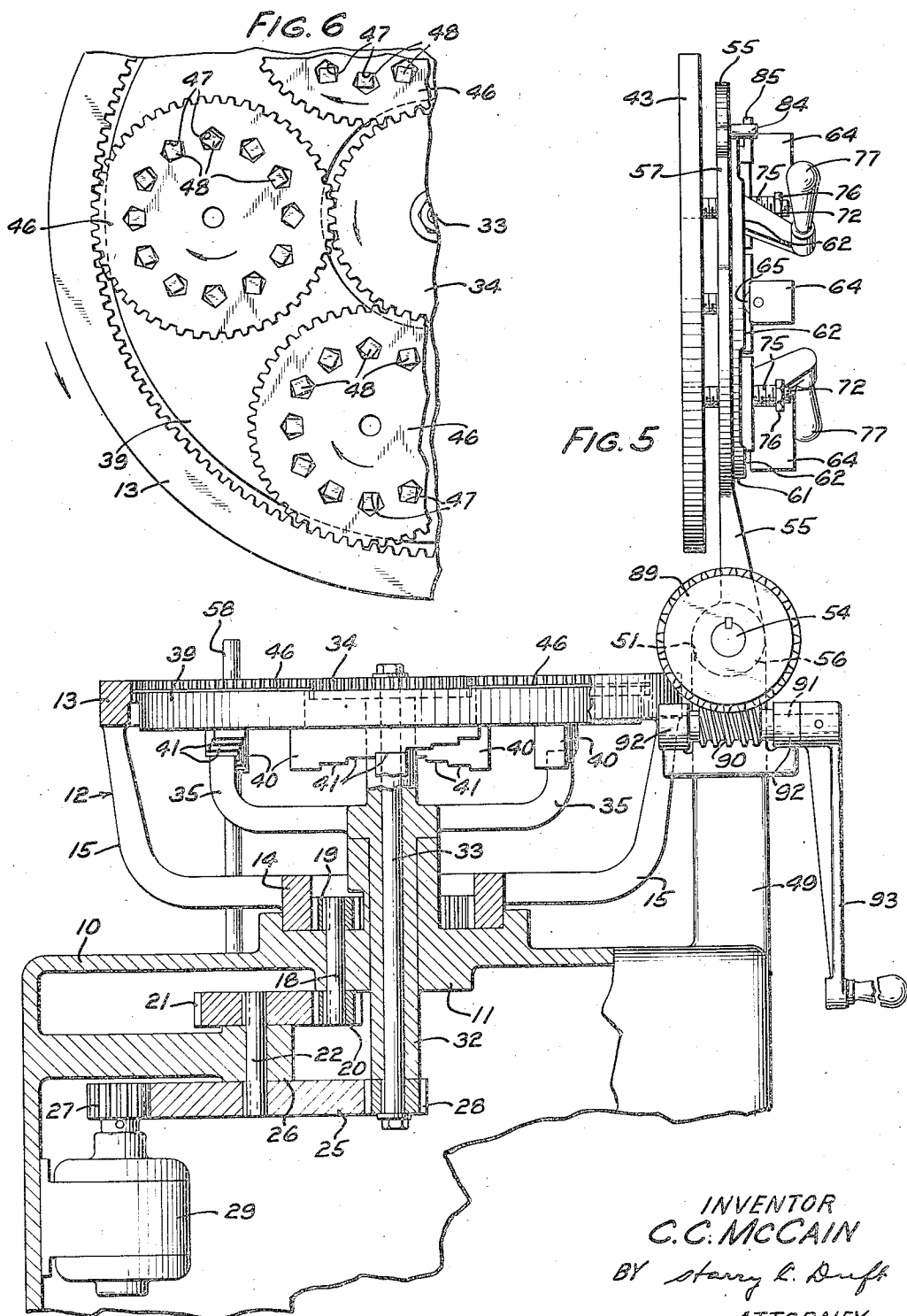
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UNITED STATES PATENT OFFICE

2,401,953

LAPPING MACHINE

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This invention relates to lapping machines and more particularly to a pressure plate lifting device for lapping machines.

The invention is particularly useful in lapping machines of the type employing upper and lower lapping plates, between which the work pieces held in moving holders are ground on their opposite faces. The upper plate, which serves as a pressure plate, is quite heavy and, upon completion of the lapping operation, the practice has been to simultaneously rotate and lift the plate by direct manual manipulation in order to break the adherence between the plate and the work pieces so that the work pieces will not adhere to the upper plate. This manipulation of the upper plate is quite difficult to accomplish by direct manual effort and is quite fatiguing to an operator.

An object of this invention is to provide a simple and practicable pressure plate lifting device for lapping machines whereby such a plate may be rotated and lifted with a minimum of manual effort by a slight rotary movement of the plate.

In accordance with the above object, the present invention, in one embodiment thereof, as applied to a commercial type lapping machine for lapping piezo-electric crystals, comprises an annular member formed with a circular cam track, the member being mounted on a pivotal supporting member which is normally horizontally disposed. A fixed upper pressure plate suspended from the supporting member, and which normally freely bears upon the work pieces, carries a plurality of rollers which, in the normal operative position of the plate, are free of the cam track and, upon a slight rotary movement of the plate by means of attached handles, the rollers engage and ride up on rise portions of the cam track to lift the plate from the work pieces. The combined rotary and lifting movements of the plate serve to break the adherence between the plate and the work pieces. Other rollers carried by the plate and riding upon an inner circular vertical edge of the annular member serve to guide the plate during its slight rotary motions. Crank actuated means is provided for elevating the supporting member about its pivot after the disengagement of the plate from the work pieces.

Other objects and advantages of this invention will more fully appear from the following detailed description, taken in conjunction with the accompanying drawings, in which

Fig. 1 is a fragmentary plan view of a lapping machine having the pressure plate lifting device

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embodying the features of this invention applied thereto, the plate being shown in its normal operative position;

Fig. 2 is an enlarged fragmentary irregular vertical section taken on the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 2 showing the position of the plate lifting device after being operated to rotate and lift the pressure plate;

Fig. 4 is a fragmentary vertical section taken on the line 4—4 of Fig. 1;

Fig. 5 is a fragmentary side view on a reduced scale, partly in section, showing the position of the pressure plate supporting member after being elevated about its pivot; and

Fig. 6 is an enlarged fragmentary plan view of Fig. 5 showing the work piece holders resting upon the lower lapping plate.

Referring to the drawings in detail and particularly to Fig. 5, the numeral 10 indicates a frame or housing which is shown fragmentarily. Journalled in a bearing 11 on the upper end face of the housing 10 is a spider 12, comprising upper and lower ring gears 13 and 14 of different diameters interconnected by four equally spaced radial arms 15. Also journalled in the bearing 11 is a jack shaft 16 having keyed to opposite ends thereof similar pinions 19 and 20. The pinion 19 meshes with the inner periphery of the ring gear 14 and the pinion 20 meshes with a gear 21 keyed to the upper end of a jack shaft 22, to the lower end of which is keyed a gear 25, the shaft being journalled in a bearing 26 on the housing 10. Meshing with the gear 25 are pinions 27 and 28, the pinion 27 being fixed to a shaft of a driving electric motor 29 suitably mounted on the housing 10. Fixed to the bearing 11 in concentric arrangement with the ring gears 13 and 14 is a sleeve 32, in which is journalled a shaft 33, to the lower end of which is fixed the pinion 28. To the upper end of the shaft 33 is fixed a gear 34, which is in the plane of the ring gear 13. Extending outwardly and upwardly from the sleeve 32 are four equally spaced radial arms 35 which terminate at their outer vertical ends in reduced pin-like extensions 36 (Figs. 2 and 3). Disposed within and free of the ring gear 13 is a lower fixed abrasive circular plate 39, to the lower face of which are attached four equally spaced blocks 40, which are formed on their lower faces with a series of steps 41, each step being provided with an aperture 42 for receiving the pin-like extensions 36 on the arms 35. With this arrangement of supporting the lower abrasive plate 39, it will be obvious that the plate may be fixed in different planes, as de-

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terminated by the different steps 41 on the blocks 40, for a purpose to be described hereinafter.

An upper fixed circular abrasive plate 43 is normally arranged in parallel relation with and above the abrasive plate 39 as shown in Figs. 1 and 2. During the operation of the machine, a plurality of circular work piece holders 46, each comprising a relatively thin plate having a plurality of pentagonal-shaped openings 47 (Fig. 6) for receiving, in the present instance, piezoelectric crystals 48, the opposite faces of which are to be ground, and which are positioned between the fixed abrasive plates 39 and 43. The holders 46 are formed with external gear teeth which mesh with the teeth on the gear 34 as well as the teeth on the inner periphery of the ring gear 13. In the grinding operation, the upper abrasive plate 43, which is quite heavy, rests on the crystals 48 arranged between the fixed abrasive plates 39 and 43.

It will be apparent that, as undue wear occurs on the teeth of the ring gear 13 and gear 34 from the meshing thin teeth on the holders 46, the lower abrasive plate 39 may be lowered or raised to vary the points of engagement of the teeth by first lifting the plate 39 upwardly to disengage the pin-like extensions 36 on the arms 35 from the apertures 42 in the stepped blocks carried by the plate and then giving the plate a slight rotation to align another set of apertured steps 41 with the pin-like extensions and thereafter entering the extensions in the apertures.

Upon rotation of the gear 34 and the ring gear 13, in a counter-clockwise direction, as indicated by the arrows (Fig. 6), through the gear trains previously described, the ring gear 13 will be rotated at a slower speed in R. P. M. than the gear 33 and thus the crystal holders 46 meshing therewith will be caused to travel bodily in a planetary path about the gear 34 and at the same time slowly rotate about their own axes. This results in an efficient grinding of the faces of the crystals 48 and a more uniform wear on the abrasive plates 39 and 43. After the crystals 48 have been ground, the upper abrasive plate 43 has to be lifted to permit the removal of the crystals and, in order to prevent them from adhering thereto, it has been found necessary to simultaneously rotate and lift the plate to break the referred-to adherence. As disclosed in the drawings, this is accomplished with a minimum of manual effort in the following manner:

Integral with the frame 10 and rising from the upper face thereof at its right hand side (Figs. 1 and 2) is a bifurcated standard 49 having two spaced bearing portions 50 and 51 in which is journaled opposite ends of a shaft 54, to which is secured a ring-like supporting plate 55 having an integral sleeve portion 56 surrounding and keyed to the shaft. Extending from the thus pivoted plate 55 at its left hand side (Fig. 1) are two arms 57, which, when the plate is in a horizontal operative position, rest upon two posts 58 fixed to the upper face of the frame 10. Secured to the upper face of the plate 55 at its inner periphery is an annular member 61 having formed upon its upper face a circular cam track which includes three equally spaced cam rises 62. Concentrically arranged within and free of the annular member 61 is an annular member 63, to the upper face of which are secured three equally spaced roller supporting brackets 64. Each of the brackets carries a vertically arranged cam roller 65 in alignment with the cam track and a horizontally arranged roller

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68 in alignment with and at all times in rolling engagement with the inner peripheral face of the annular member 61. During the grinding operation on the crystals 48, the cam rollers 65, as shown in Figs. 1 and 2, are free of the cam track on the annular member 61, since the abrasive plate 43 is resting upon the crystals 48 being ground. Also supported by each of the brackets 64 is an eccentric pivotal locking member 69, which, by means of an attached stud 70, slotted at its upper end face, may be rotated into locking relation under the lower face of the annular member 61 and then held in position by a nut 71 threaded onto the stud and clamped against the upper face of the bracket. The arrangement is such that, by means of the locking members 69, the annular member 63, with the parts carried thereon, already referred to, and other parts, to be presently described, will be carried by the pivotal plate 55 upon movement of the plate from the position shown in Fig. 2 to that shown in Fig. 5. The upper abrasive plate 43, previously referred to, is adjustably suspended by three screws 72 threaded into the plate 43, which are freely surrounded by externally threaded sleeves 75 threaded through apertures provided in the annular member 63 and the brackets 64.

Thus, when the abrasive plate 39 is elevated or lowered, in the manner and for the reasons previously described, it is necessary to move the abrasive plate 43 correspondingly to maintain the same relation between the plates. The elevating or lowering of the plate 43 is effected by first loosening the screws 72 and turning the sleeves 75 by means of hexagon shaped upper ends 76 thereof. This, it will be apparent, changes the position of the sleeves 75 in a vertical direction in the member 63 and the brackets 64 and upon the screws 72 being tightened again, the plate 43 will be correspondingly positioned.

Attached to the upper face of the annular member 63 is a bracket supporting two handles 77 for manually rotating the member and thereby the cam rollers 68 carried by the brackets 64, as well as the abrasive plate 43 suspended from the member 63 by means of the screws 72 and sleeves 75. For the purpose of maintaining the member 63 in its normal operative position, as shown in Figs. 1 and 2, a latch device is provided. In the operative position the rollers 65 are free of the low or dwell portions of the cam track, as shown in Fig. 2, and are also positioned adjacent the ends of the cam rises 62 furthest from the ends thereof, at which the rollers make contact. The latch device comprises a latch member 78 pivoted at 79 to a bracket 82 fixed to the annular rotatable member 63. Extending upwardly from the pivotal supporting plate 55 are two stop pins 83 and 84, the pin 83 being in the path of the latch member 78 and an arm 85 of the bracket 82, as shown in Fig. 1, in the operative position of the abrasive plates 39 and 43, whereby the rotatable member 63 is prevented from rotating until the latch member 78 is lifted from its horizontal position to clear the pin 83, whereupon the member 63 may be rotated in a counterclockwise direction until the bracket arm 85 engages the stop pin 84. The bracket arm 85, in cooperation with the pin 83, also serves to prevent rotation of the member 63 when the abrasive plates are in operative position.

Upon completion of a grinding operation, the abrasive plate 43 suspended from the pivotal supporting plate 55 is moved from the horizontal position thereof (Fig. 1) through an angle of 90°

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or more (Fig. 5) for the purpose of unloading and reloading the machine for the following grinding operation. To facilitate this movement of the abrasive plate 43, the shaft 54, to which is keyed the pivotal supporting plate 55, has keyed to one end thereof a worm wheel 89, which meshes with a worm pinion 90 formed on a shaft 91 journaled in spaced bearings 92 formed integral with the standard 49. Upon the right hand end of the shaft 91 is fixed a crank handle 93, whereby the worm pinion 90 may be rotated to raise or lower the supporting plate 55 and thereby the abrasive plate 43 from or into operative position with the abrasive plate 39, wherein, in the latter position, it rests by the action of gravity on the crystals 48.

The operation of the abrasive pressure plate lifting device above described, and, assuming that the grinding of the crystals 48 has been completed and the machine is to be unloaded for the next grinding operation, is as follows: Referring particularly to Figs. 1 and 2, wherein the machine is idle and the pressure plate 43 is shown resting on the crystals 48, the operator first rocks the latch member 78 about its pivot 79 to withdraw it from locking relation with the stop pin 83. Thereafter, the handles 77 are grasped and the annular member 63, from which is suspended the pressure plate 43, is given a counter-clockwise rotation until the arm 85 on the member 63 engages the stop pin 84. The greater portion of this rotary movement of the pressure plate 63 occurs while the plate is engaging the crystals and this engagement is abruptly broken when the rollers 65 ride up the rise portions 62 of the circular cam track on the annular member 61 which takes place during the continued rotary movement of the pressure plate and shortly before the arm 85 engages the stop pin 84. This position of the abrasive plate 43 is shown in Fig. 3. Thus, the adherence between the ground crystals 48 and the pressure plate 43 is broken by the combined rotary and lifting movements of the plate with a minimum of manual effort solely by a slight rotary movement of the plate and the crystals 48 remain in the holders 46. To permit the unloading and reloading of the machine, the supporting plate 55, with the parts carried thereon, is elevated to the position shown in Fig. 5 by a rotation of the crank handle 93.

After reloading the machine, the supporting plate 55 is lowered and then the annular member 63 is rotated by means of the handles 77 until the arm 85 engages the stop pin 83. The pivotal latch member 78 is then returned to its operative position, shown in Figs. 1 and 2.

What is claimed is:

1. In a lapping machine, a pair of opposed lapping plates between which work pieces are ground, means for rotating the work pieces, one of said plates being normally urged toward said other plate, a supporting plate surrounding said one plate, means on said one plate for guiding it for movement within said support member, a cam track on said support member, cam rollers on said one plate for engagement with portions of the cam track to raise said one plate when it is moved within the supporting plate, and means for moving said one plate to engage the cam rollers with said portions of the cam track.

2. In a lapping machine, a lower lapping plate, an upper lapping plate yieldingly urged toward said lower plate, a pivotal arm operable to withdraw said upper plate from proximity to said lower plate, a rotatable work holder between said

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plates, means including a plurality of circularly arranged cam rises on said pivotal arm and cam followers bodily movable with said upper lapping plate for lifting said upper plate upon movement of said upper plate with respect to said arm, and means for thereafter actuating said arm to further withdraw said upper plate.

3. In a lapping machine, a pair of opposed lapping members between which work pieces are ground, means for moving the work pieces over opposed faces of said members, a rotary supporting member from which one of said lapping members is suspended and normally urged by gravity toward said other lapping member, an element surrounding said supporting member, cooperating cam followers on said supporting member and cam rises on said element for effecting movement of said supporting member and said one lapping member suspended therefrom from said other lapping member during rotation of said supporting member to disengage the ground work pieces which tend to adhere to said one lapping member when said supporting member is rotated, and means for rotating said supporting member.

4. In a lapping machine, a pair of opposed lapping members between which work pieces are ground, means for moving the work pieces over opposed faces of said members, a rotary supporting member from which one of said lapping members is suspended and normally urged by gravity toward said other lapping member, a circular cam track having a plurality of cam rises, cam followers carried by said supporting member and normally disengaged from said cam track, and means on said supporting member for rotating the same to cause said cam followers to ride up said cam rises and thereby move said supporting member and said one lapping member suspended therefrom from said other lapping member to disengage the ground work pieces which tend to adhere to said one lapping member.

5. In a lapping machine, a pair of opposed lapping members between which work pieces are ground, means for moving the work pieces over opposed faces of said members, a rotary supporting member, means for suspending one of said lapping members therefrom, said supporting and lapping members normally urged by gravity toward said other lapping member, a pivotal ring-like plate surrounding said supporting member, means carried by said supporting member for rotatably guiding the same on the inner periphery of said plate and for causing its retention on said plate during pivotal movements of the latter, a circular cam track having a plurality of cam rises on said plate, cam followers carried by said supporting member and normally disengaged from said cam track, means on said supporting member for rotating the same to cause said cam followers to ride up said cam rises and thereby move said supporting member and said one lapping member suspended therefrom from said other lapping member to disengage the ground work pieces which tend to adhere to said one lapping member, and means operatively connected to said plate for pivotally moving the same.

6. In a lapping machine, a lower lapping plate, an upper lapping plate yieldingly urged toward said lower plate, means for rotating the work pieces between said plates, a rotary supporting member operatively connected to said upper plate, means for rotating and simultaneously lifting said supporting member and said upper plate during a rotary movement of said supporting

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member to disengage the ground work pieces which tend to adhere to said upper plate, a latching device carried by said rotary supporting member, and fixed stop members cooperating with said latch device to prevent rotation of said plate supporting member during the grinding operation and for limiting rotary movements of the supporting member.

7. In a lapping machine, a lower lapping plate, an upper lapping plate yieldingly urged toward said lower plate, means for rotating the work pieces between said plates, a rotary supporting member operatively connected to said upper plate, a pivotal ring-like plate surrounding said sup-

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porting member, means carried by said supporting member for rotatably guiding the same on the inner periphery of said ring-like plate and for causing its retention on said plate during pivotal movements of the latter, cooperating means on said supporting member and ring-like plate for rotating and simultaneously lifting said supporting member and upper plate during a rotary movement of said supporting member to disengage the ground work pieces which tend to adhere to said upper plate, and means for thereafter actuating said pivotal plate to further withdraw said upper plate.

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