May 9, 1933. S. PLAYER ET AL 1,908,048

LAPPING MACHINE

Filed Sept. 2, 1930 2 Sheets-Sheet 1

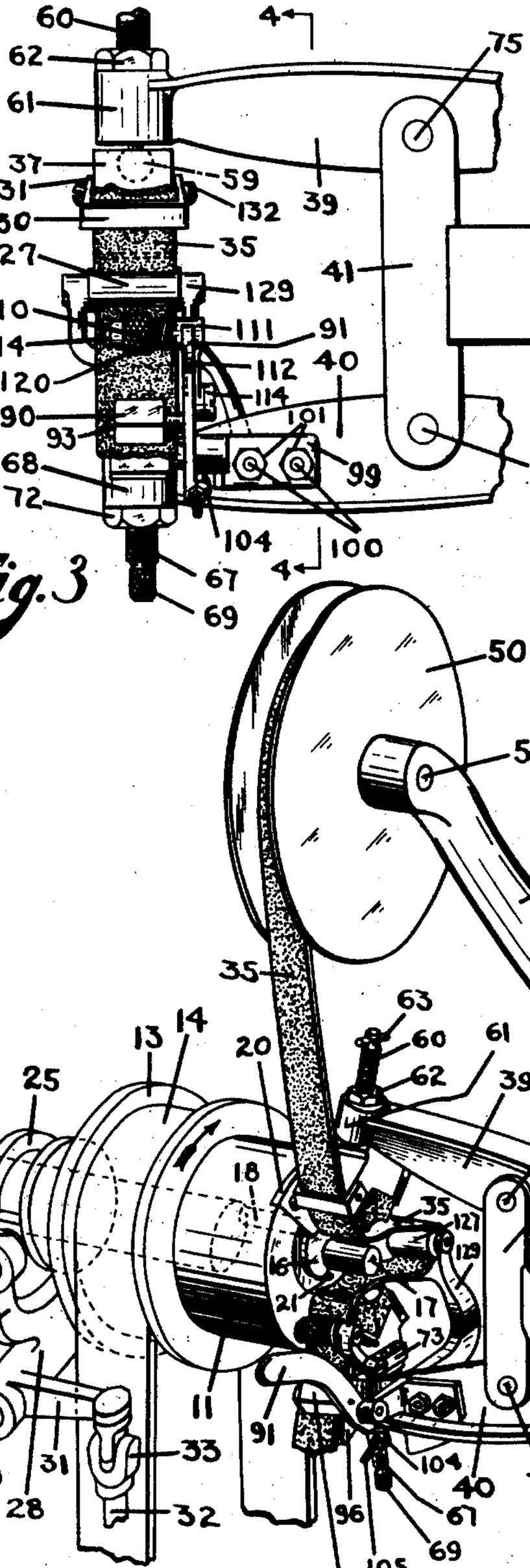

Fig. 3

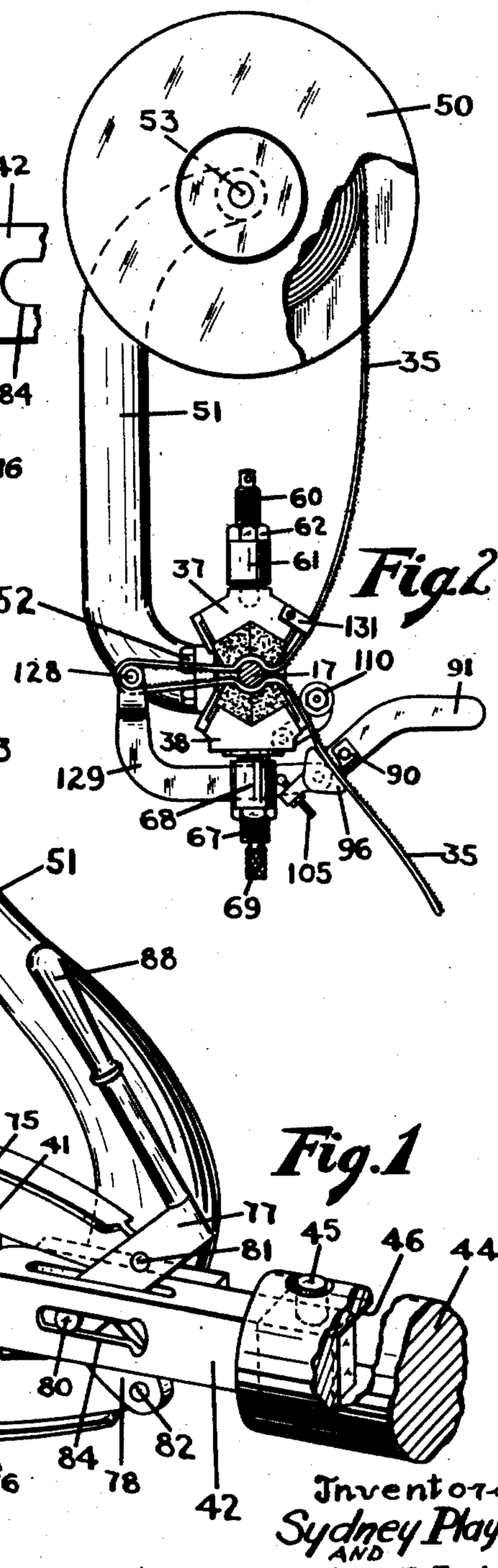

Fig. 2

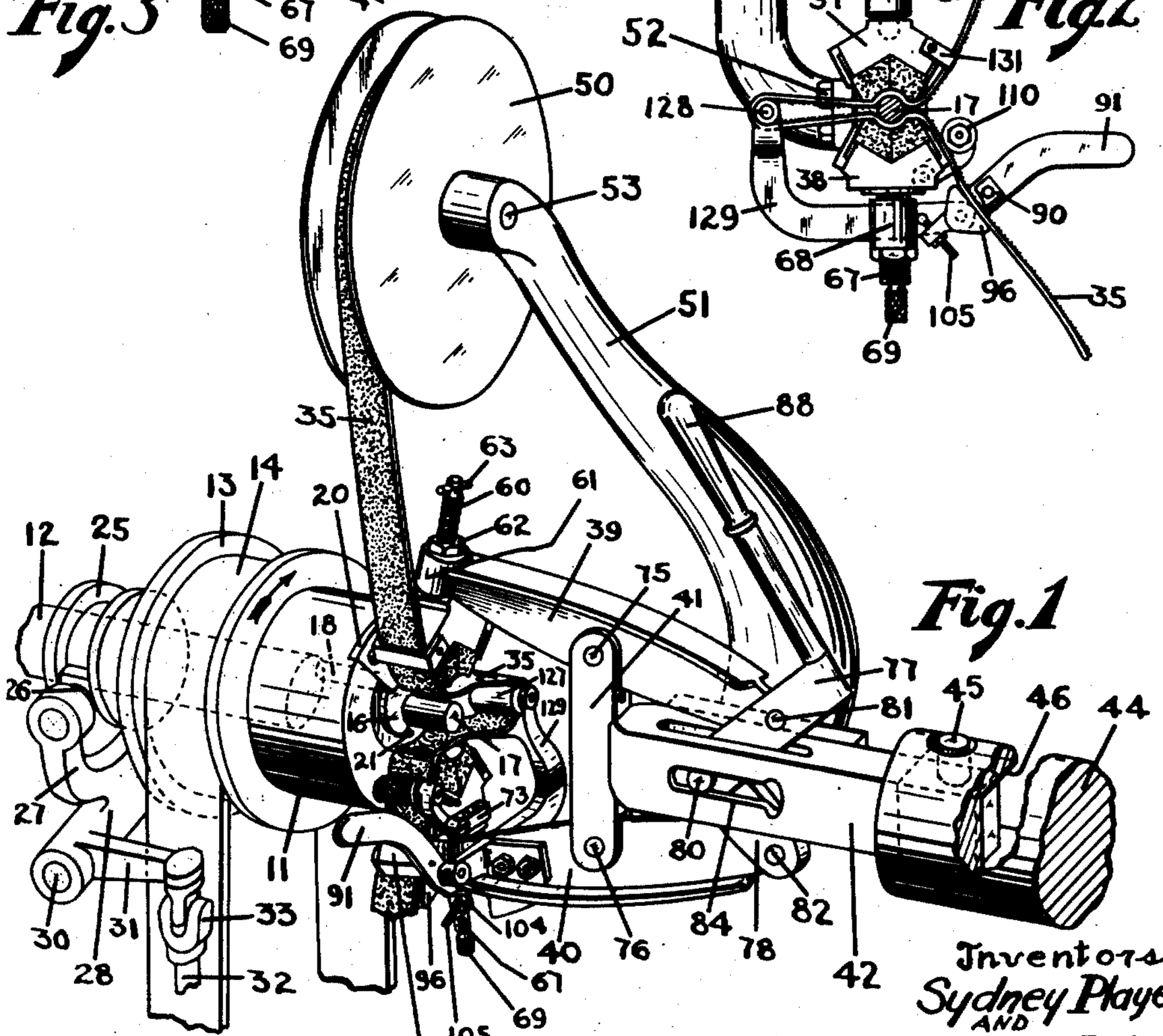

Fig. 1

Witness
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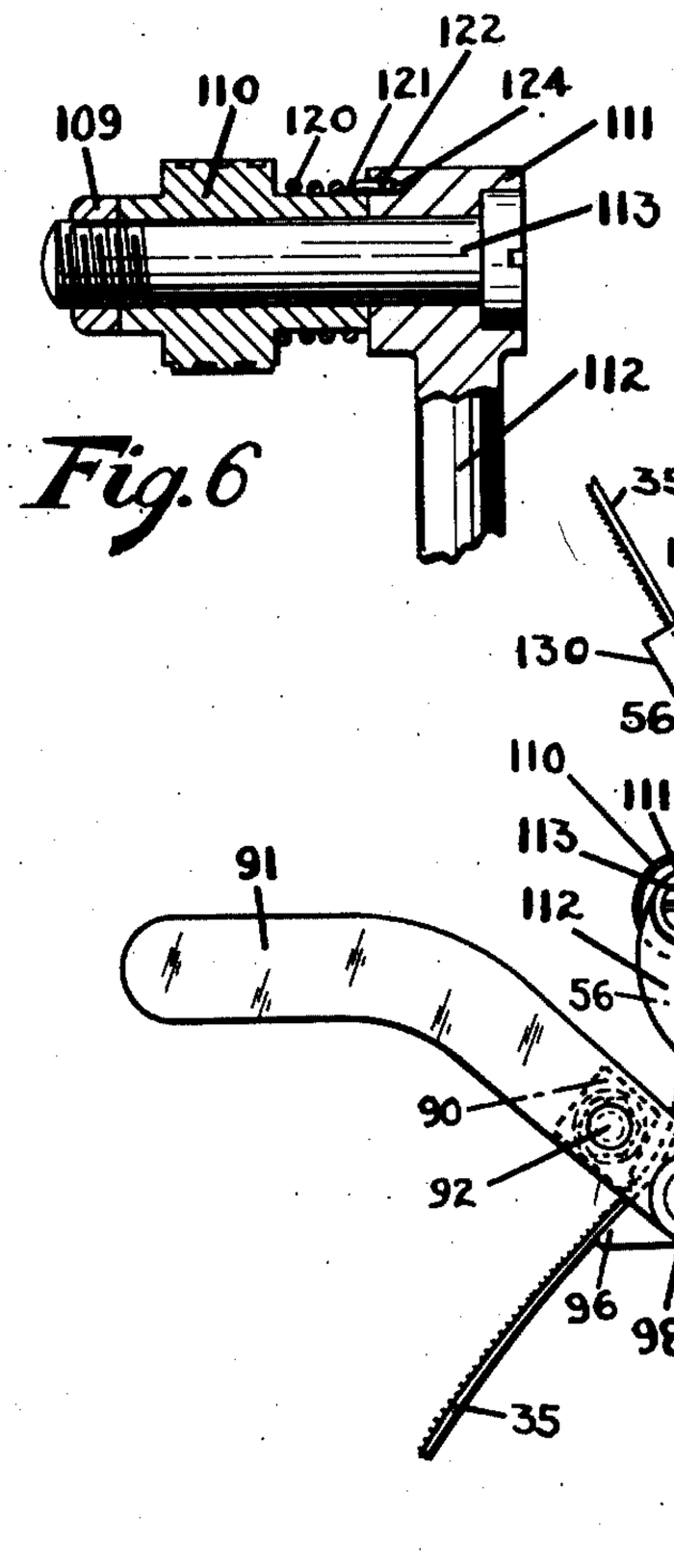

Fig. 6

Fig. 4

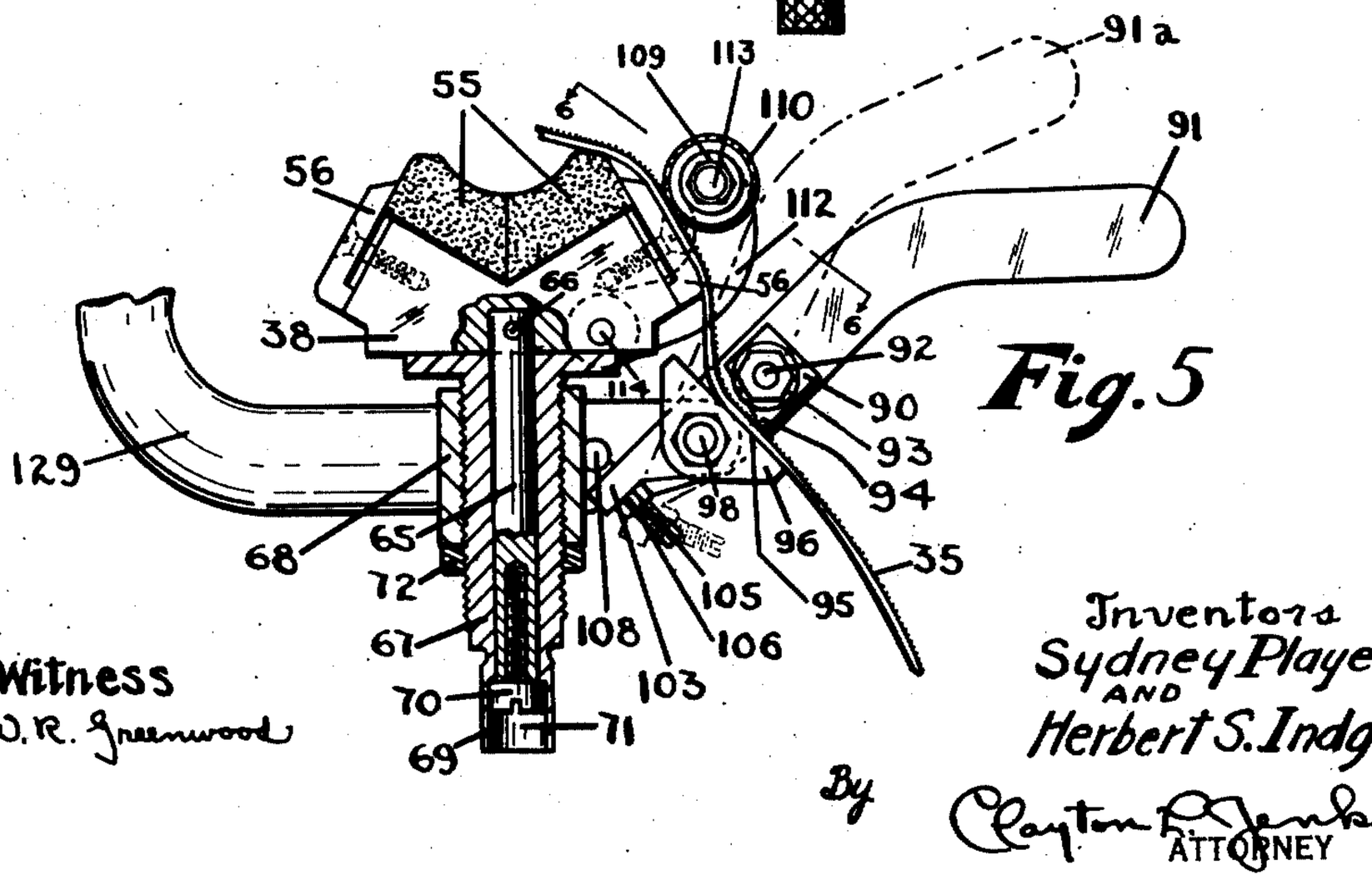

Fig. 5

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UNITED STATES PATENT OFFICE

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

LAPPING MACHINE

Application filed September 2, 1930. Serial No. 479,196.

This invention relates to lapping machines and particularly to a device for finishing the surface of a cylindrical piece of work.

It has been proposed to utilize a flexible strip of abrasive material in place of the abrasive blocks employed in the lapping machine shown in the patent to Player No. 1,711,061 of April 30, 1929, and in such a construction the abrasive strip is supported on two reels which are mounted directly on the clamping jaws. In this arrangement the paper is fed to present a fresh portion to the work by means of a feeding device operated by the motion of the jaws when they are moved to release the abrasive strip from the work piece. Owing to the lack of space in such a construction it has been necessary to use small reels of abrasive paper. This has consequently required frequent stoppage of the machine for replacement of the reels thus involving a waste of time and effort.

It is accordingly one object of this invention to overcome this difficulty and to provide a lapping device using a flexible strip of abrasive material which is so constructed and arranged that a large roll of abrasive material may be utilized for the lapping operation.

It is frequently necessary to lap a single piece of work which is supported in a chuck, as shown in the prior application of Player and Indge Serial No. 392,098 filed September 12, 1929, but in such prior construction the lapping medium has been a block of bonded abrasive material. It is found that a flexible abrasive paper may be advantageously used for producing certain types of finished surfaces.

It is therefore a further object of this invention to provide a machine for lapping a single piece of work in which the lapping medium comprises a flexible strip of abrasive material, and particularly to provide a lapping machine of this type which is simple in its construction and efficient in its operation.

A further object is to provide a lapping machine in which the flexible strip of abrasive material may be moved independently of the movement of the clamping jaws to present a fresh surface to the work and thereby bring the device more fully under the control of the operator.

With these and other objects in view as will be apparent to one skilled in the art, this invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

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

Fig. 1 is an enlarged perspective view of the lapping device;

Fig. 2 is an end view of the lapping device showing the supply reel and the parts in their respective positions for the lapping operation;

Fig. 3 is an enlarged detail front view showing details of construction of the lapping mechanism;

Fig. 4 is a sectional view on an enlarged scale, taken along the line 4—4 of Fig. 3;

Fig. 5 is a detailed sectional view of the lower jaw member of Fig. 4; and

Fig. 6 is an enlarged detail view, in section, of the friction roller taken along the line 6—6 of Fig. 5.

In accordance with this invention, a lapping device for round objects may comprise a flexible strip of abrasive material and a holder therefor having a shaped surface corresponding to that of the object to be lapped and which is arranged to clamp about the work piece and hold the flexible strip in abrading contact with the work while it is being rotated and reciprocated. The holder for the strip preferably comprises a clamping device having two jaw members, each of which is provided with a concaved shoe capable of holding the abrasive strip in abrading contact with the work piece. These jaws are movable toward and from each other to permit replacement of the work and they may be locked in an operative position about the work piece when it is desired to lap or abrade the latter.

The entire lapping mechanism including

the clamping jaws may be supported on an arm which is mounted in the tailstock of the machine and pivoted so as to swing about a vertical pin to move it from an operative position and out of alignment with the axis of rotation of the work piece. This arm serves to hold the lapping mechanism stationary and to prevent it from moving longitudinally along the work axis during the rotation and reciprocation of the work.

In order that a large supply of the abrasive material may be available at all times for the lapping operation, it is desirable to employ a large reel on which is wound a considerable length of abrasive strip sufficient to last for several days, and to mount the reel in close proximity to the lapping mechanism but to support it independently therefrom so as to be unaffected by the movement of the clamping jaws. Furthermore, it is also desirable to feed the abrasive strip to the lapping zone by a mechanism which is operable independently of the jaw movement.

Referring more particularly to the drawings, one embodiment of this invention is shown as applied to a machine of the general type shown in the patent to Player No. 1,711,061 of April 30, 1929, but which is applicable for lapping but a single piece of work at a time. As illustrated in the drawings, a work piece is shown as supported in a work holder or chuck 11 carried by a suitable headstock (not shown) for rotation and reciprocation by a driving sprindle 12 suitably fastened thereto and driven by a pulley 13 and a belt 14 from any suitable source of power. The chuck 11 may be of any suitable construction but as illustrated it is arranged to receive a special type of work piece comprising a counter-balanced crankshaft having a balancing disk 16 and a projecting crankpin 17 arranged eccentrically with respect to the crankshaft spindle 18. The chuck 11 is provided with a suitable bore to receive the crank spindle 18 and the front face is suitably recessed to completely accommodate the balancing disk 16, said recess occupying such a position with respect to the bore that the crankpin 17 may be positioned accurately in alignment with the axis of the chuck 11 and the spindle 12. The chuck 11 is provided with a segment plate 20 which projects over the outer face of the balancing disk 16, when the latter is in an operative position, to retain the work piece in the holder against endwise movement. A driving pin 21 set in the recessed face of the holder is arranged to engage the periphery of the balancing disk 16 at a predetermined point to angularly position the crankpin 17 for rotation about its own axis and in alignment with the axis of the spindle 12.

To oscillate the spindle 12 during the rotation of the chuck 11 and to reciprocate the crankpin 17 during the lapping operation, any suitable mechanism may be utilized, but in the preferred construction, as shown in Fig. 1, this may comprise a grooved collar 25 mounted on the spindle 12 and arranged to be engaged by the forked arms and the engaging pins 26 of the yoke 27 forming one arm of a bell crank lever 28. The bell crank lever 28 is pivotally mounted on the headstock of the machine (not shown) by a pin 30 and carries a second arm 31 which is connected to an operating rod 32 by means of a swivel coupling 33. The lower end of the operating rod 32 may be connected to any suitable eccentric device, such as a power driven crank, to longitudinally oscillate the work carrying spindle 12 along its axis during the rapid rotation of the latter by power. This feature of the construction may be made as shown in the prior patent to Player.

In order to lap the work, a flexible strip of abrading material 35, such as abrasive coated paper or cloth, is shown as being held in abrading contact with the surface of the crankpin 17 and this strip is supported by a holder comprising, in the form illustrated, two concave jaw members 37 and 38 which are mounted on the clamping arms 39 and 40. These are pivotally supported on the T-head 41 forming a part of the supporting arm 42 which is pivotally mounted in the tailstock member 44 so as to swing about a vertical pin 45. A suitable recess 46 is provided in the end and side of the member 44 for the reception of this arm 42 so that it may swing about the pin 45 to the rear of the machine in order to move the lapping mechanism away from an operating position and out of alignment with the work axis.

In order that the flexible strip of abrasive material may be supported for movement through the lapping zone, a supply reel 50 is mounted on an arm 51 rigidly secured to the supporting arm 42 in such a manner as to be unaffected by the movement of the clamping arms 39 and 40. To this end, the studs 52 suitably threaded into the arm 42 and passing through suitable openings in the end of the arm 51 serve for holding it on the arm 42. The supply reel 50 may be suitably constructed as a metal spool rotatably supported on the end of the arm 51 by a pin 53. The abrasive strip 35 is wound on the supply reel 50 with its abrasive or work engaging surface outwardly so that it may contact with the work for the abrading operation.

The jaws 37 and 38 are shaped to substantially conform to the shape of the work surface; and in order to hold the abrading strip firmly in position and prevent it from movement during the lapping operation it is preferred to have the clamping portions of the jaws formed of abrasive blocks 55 inserted in recesses in the faces of the jaws

and there held in position by the clamping fingers 56 secured to the respective side faces of the jaw members by suitable screws. These blocks 55 are preferably formed of abrasive grains suitably bonded with vitrified ceramic material or other suitable bond which has been shaped during manufacture to provide concave jaw faces having partially cylindrical surfaces conforming substantially to the outer surface of the flexible strip 35 when it engages the work.

The clamping jaws are preferably so mounted that they may be removed from the arms 39 and 40. The upper jaw 37 is freely suspended from a ball 59 formed on the lower end of the post 60 threaded into a hub 61 on the end of the arm 39. The ball fits into a suitable socket in the jaw to permit a swiveling movement of the jaw 37 and enable it to adjust itself to the surface to be lapped. The jaw member 37 may be easily positioned by means of the nut 62 which engages the top of the threaded hub 61, thus serving as an adjusting stop for the post 60 which is vertically moved when turned in the hub 61 by means of a pin 63 inserted in a hole in the upper end of the post 60.

The lower clamping jaw 38 is mounted on the upper end of a post 65 and secured there by a pin 66 which is mounted for angular movement in a sleeve 67 threaded into the hub 68 of the arm 40. The jaw member 38 may be easily adjusted in position by means of the depending knurled head 69 on the sleeve 67 whereby the sleeve may be rotated freely about the post 65 to move the jaw to the desired position. A screw 70 located in the recess 71 in the head 69 and threaded into the lower end of the post 65 serves to hold the post in the sleeve 67. A nut 72 on the sleeve 67 engages the bottom of the hub 68 and serves to lock the sleeve 67 in position. A stop bar 73 secured in an upright position by suitable screws on the top portion of the hub 68 serves to limit the amount of swiveling movement of the jaw 38 about the sleeve 67.

In order that the operator may open or close the clamping jaws to release or engage a piece of work, the arms 39 and 40 are pivotally mounted by means of the pins 75 and 76 on the T-shaped head 41, the pivot points 75 and 76 being located substantially centrally of the arms. The links 77 and 78, which are pivotally connected by a pin 80, are pivotally mounted on the ends of the arms 39 and 40 respectively by means of the pivot pins 81 and 82 and serve for moving the arms together. The pin 80 is arranged to project laterally from the links 77 and 78 and slide within a slot 84 formed in the arm 42. The pin 80 is held in position by means of a suitable head portion (not shown).

The operator may manually move the clamping jaws by means of a hand lever 88 mounted on an extended portion of the link 77 so that movement of the hand lever downwardly (Fig. 1) will lower the clamping jaw 37 and raise the jaw 38 to grip the work piece.

The feeding mechanism for moving the abrasive strip may comprise a manually operable feeding device. This device as illustrated includes a feeding tool 90 pivotally fastened to the side of a hand lever 91 by a pin 92 and there held in position by means of a nut 93 threaded on the end of the pin. The feeding tool 90 has a projecting serrated portion 94 at one end which contacts with the abrasive strip 35. This strip passes over the edge of the jaw 38, thence downwardly and over a flat portion 95 which constitutes the top surface of a block 96. This block 96 is rigidly secured by a pin 98 on a bracket 99, as illustrated in Fig. 4, the bracket being fastened to the arm 40 by the bolts 100 and nuts 101. The feeding tool 90 has its serrated portion 94 so located relative to the pivot pin 92 that when reciprocated in a downward direction the tool 90 will frictionally engage the strip 35 and cause it to move with the handle 91. When the tool moves upwardly with the handle, it tilts about the pivot pin 92 and rides freely over the strip, thereby feeding the strip in one direction only during the manual movement of the hand lever 91.

To adjust the extent of reciprocation of the feeding tool 90 and consequently regulate the amount of the strip 35 which is being fed at one time, the hand lever 91 is provided with an extension 103 having a flat portion 104 projecting laterally therefrom, in which is mounted a stop screw 105. This screw 105 may be easily adjusted in position by means of the nut 106 which engages the bottom of the portion 104 and serves as an adjusting stop and is arranged to engage a stop pin 108 mounted in the side of the bracket 99.

In order to hold the abrasive strip against further feeding movement into the lapping zone except at such times when it is being fed by movement of the feeding tool 90 and also against the formation of slack in the strip, a knurled roller 110 is mounted on a hub 111 at the end of a pivoted arm 112 for rotation about a stud 113 located within the hub 111 and projecting therefrom to position the roller opposite the strip 35. A nut 109 suitably threaded on the end of stud 113 adjacent to the roller 110 serves for holding the roller on the stud. The arm 112 is pivotally mounted on the jaw 38 by means of a stud 114 so that it will pivot thereabout to move the roller 110 toward the abrasive strip 35 and in engagement with its outer surface to hold it against the clamping finger 56 thereunder on the jaw 38, dur-

ing the upward movement of the handle 91 and the tool 90 to a feeding position. A spring 115 under tension is fastened to the jaw 38 by a pin 116 and its opposite end surrounds and is located by a stud 118 projecting from the hub 111 and serves to hold the roller 110 securely in frictional engagement with the abrasive strip 35. A second spring 120 is freely mounted on the roller 110 (Fig. 6) and in frictional engagement with the smooth cylindrical surface 121 on the reduced end of the roller. The spring has an in-turned end 122 which fits within a hole 124 in the hub 111 of the arm 112. This arrangement is such that the roller 110 may turn freely in the bore of the spring and about the stud 113 during the feeding movement of the paper, but causes a twisting of the coils of the spring when an attempt is made to rotate it in the opposite direction, whereby the spring grips the roller surface 121 and prevents rotation of the roller. Consequently, the paper cannot be fed backwards through the lapping zone because the roller 110 will not rotate in such a direction as to permit this movement.

In order to prevent the abrasive material from being withdrawn from the lapping zone during the opening of the jaws and to hold the abrasive material in separated relation during the removal of the work piece and the insertion of a new one between the abrasive strip, the abrasive strip 35 coming from the supply reel 50 is passed along the side and around the end of the jaw 37 and around a roller 127 rotatably mounted on a pin 128 carried by a bracket 129. The bracket 129, which is mounted in an upright position on the arm 40 is rigidly secured to the arm by means of the bolts 100 which serve for holding the bracket 99 thereon.

Mounted on the jaw 37 is a clip 130 of substantially U-shaped form having in-turned ends 131 which are securely fastened to the jaw 37 by means of suitable screws 132. This clip is arranged to project outwardly from the side face of the jaw and into the path of movement of the abrasive strip 35 where it serves to guide the strip and retain it in place on the jaw at all times, and also to prevent it from moving out of position with respect to the blocks 55 during any aligning movement of the jaw 37 with the work surface of the crankpin 17.

The operation of the device will be apparent in view of the foregoing explanation. When the work piece has been placed in position, the hand lever 91 is grasped by the operator and moved upwardly to a position 91*a*, as shown in dotted outline in Fig. 5, preparatory for feeding the paper. The lever 91 is then moved downwardly, causing the serrated edge 94 of the feeding tool 90 to grip the abrasive paper 35 and draw it along the surface 95 of the block 96. Movement of the strip continues with the reciprocation of the tool 90 over the block 96 until the bottom of the screw 105 contacts with the pin 108 thereby stopping further movement of the paper through the lapping zone. The hand lever 88 is thrown downwardly, thereby moving the link members 77 and 78 to a vertical position so that the arms 39 and 40 move toward each other and the abrasive strip supported in the jaws is clamped about the work piece. At the completion of the lapping operation, the hand lever 88 is thrown to a vertical position, thereby imparting movement to the links 77 and 78 and rocking the arms 39 and 40 about their respective pivot points 75 and 76 and opening the clamping jaws of the lapping device to permit the removal of the work piece and the insertion of a new work piece.

It will now be understood that since the supply reel for the flexible strip is supported independently of the movable arms carrying the clamping jaws, and out of the path of movement of the jaws, then it is feasible to locate the reel in such a place that it may be of any suitable large size and it is not necessary to employ a small reel with its attendant disadvantages. In the present construction, the jaw which clamps the paper against the work is movable in a diametrical plane passing vertically and longitudinally through the work axis, and the arm carrying the jaw is in turn mounted on a support which swings laterally towards and from this plane. This makes it easy to remove the abrasive paper from proximity to the work for inspection or replacement of the work, since the paper reel swings laterally with the jaws. This double movement of the jaws is particularly useful for lapping single work pieces which are rotatably carried in a chuck. Also, it is feasible to feed the abrasive strip through the lapping zone independently of the movement of the clamping jaws and entirely under the control of the operator. The reciprocable member 91 may be moved to a variable extent as determined by the requirements of the lapping operation, and in order that the paper movement may be the same for successive duplicate operations, the screw 105 may be set as desired to limit the movement of the feeding device. The frictional gripping member on the handle 91 operates to move the paper only in one direction and the friction roller 110 serves to hold the paper against backward movement when the handle 91 is moved upwardly. Many other advantages in this construction will be apparent to one skilled in the art.

Having thus described the invention, what is claimed as new and desired to secure by Letters Patent is:

1. A lapping machine comprising means

for rotatably supporting a work piece, a flexible strip of abrasive material, a clamping jaw, an arm supporting the jaw which is movable in a diametrical plane through the work axis and serves to hold the strip in operative lapping relationship to the work surface, and a movable support for the arm arranged to swing it laterally towards/and from said plane of the work axis.

2. A lapping machine comprising means for rotatably supporting a work piece, a flexible strip of abrasive material, a jaw having a surface which serves to clamp the strip in abrading contact with the work, an arm supporting said jaw and arranged to move the jaw to and from an operative position relative to the work, and means mounted on the jaw which is operable independently of the jaw movement to feed a predetermined length of the strip through the lapping zone.

3. A lapping machine comprising a stationary base, a spindle journaled in said base for rotating and supporting a work piece, a flexible strip of abrasive material, a pair of jaws on opposite sides of the work, each jaw having a surface which serves to clamp the strip in abrading contact with the work, means to move the jaws to and from an operative position relative to the work, means mounted on one of said jaws and operable independently of the jaw movement for feeding a predetermined length of the strip through the lapping zone, and adjustable means for varying the length of strip fed at one time.

4. A lapping machine comprising means for supporting a rotatable work piece, a flexible abrasive strip, a movable clamping jaw for holding the strip in operative contact with the work, a strip feeding member mounted on said jaw for reciprocation relative thereto, manually operable means for reciprocating said member independently of the jaw movement, and means carried by said member which causes the strip to move therewith in such a direction as to feed it through the lapping zone and to an extent depending on the distance through which said member is moved.

5. A lapping machine comprising a flexible strip of abrasive material, a movable jaw having a surface which serves to hold the abrasive strip in abrading contact with the work, an arm pivotally mounted on said jaw, a roller rotatably mounted on the arm, means which permits movement of the roller only in one direction, and means tending to move the arm and resiliently hold the roller in operative engagement with the abrasive strip.

6. A lapping machine comprising a support for a rotatable work piece, a flexible strip of abrasive material for lapping said work piece, a holder, clamping jaws pivotally mounted thereon and movable radially of the work piece to hold the strip in abrading engagement thereagainst, a supporting mount for the abrasive strip fixedly secured to the holder and movable therewith but being unaffected by the opening and closing movements of the clamping jaws, said holder being mounted to move both the jaws and the strip mount together, while the jaws and strip remain in their properly associated operative relationship, so as to remove the abrasive strip laterally from operative abrading contact with the rotatable work piece.

7. A lapping machine comprising a support for a rotatable work piece, a flexible strip of abrasive material for lapping said work piece, a holder, clamping jaws pivotally mounted thereon and movable radially of the work piece to hold the strip in abrading engagement thereagainst, a supporting mount for the abrasive strip fixedly secured to the holder and movable therewith but being unaffected by the opening and closing movements of the clamping jaws, said holder being mounted to move both the jaws and the strip mount together, while the jaws and strip remain in their properly associated operative relationship, so as to remove the abrasive strip laterally from operative abrading contact with the rotatable work piece, a reel rotatably supported on said mount for supporting one end of the abrasive strip, and a manually operable feeding device mounted on one of said jaws and movable independently of the jaw movement for moving the abrasive strip relative to the jaws.

Signed at Worcester, Massachusetts, this 28th day of August 1930.

SYDNEY PLAYER.
HERBERT S. INDGE.