April 19, 1927. 1,624,933

H. E. DURKEE

TAP GRINDER

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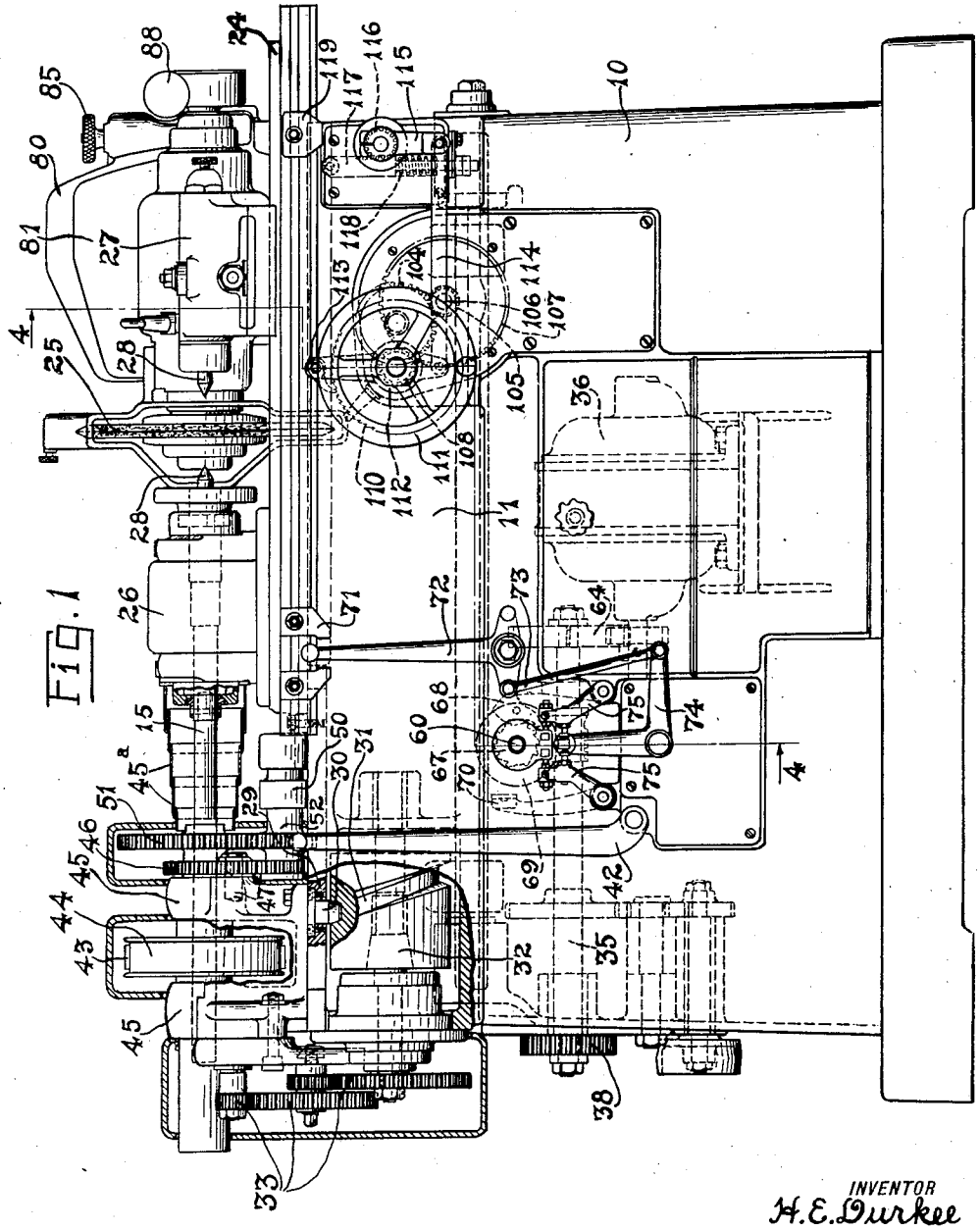


Fig. 1

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TAP GRINDER

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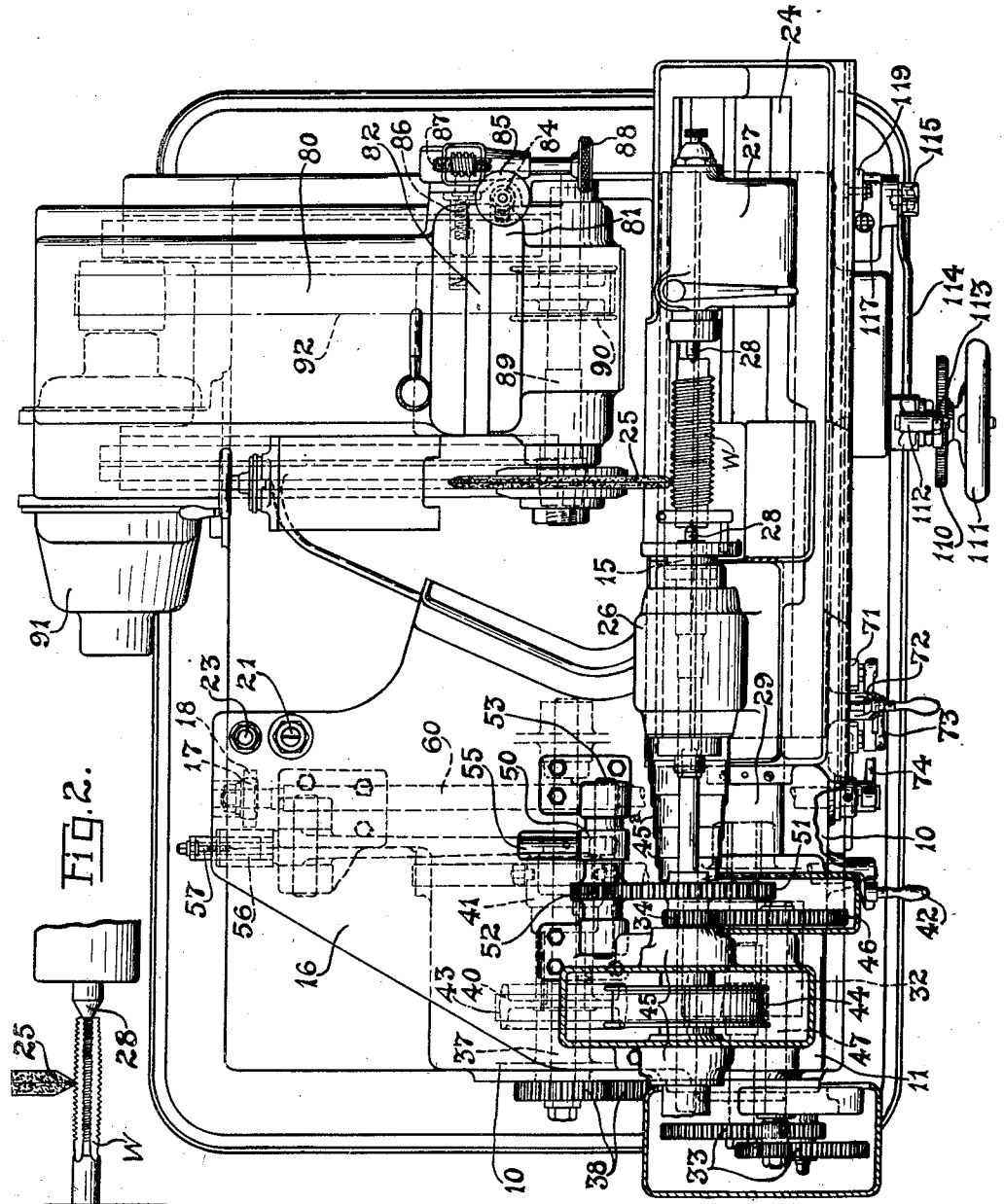


Fig. 2.

Fig. 12.

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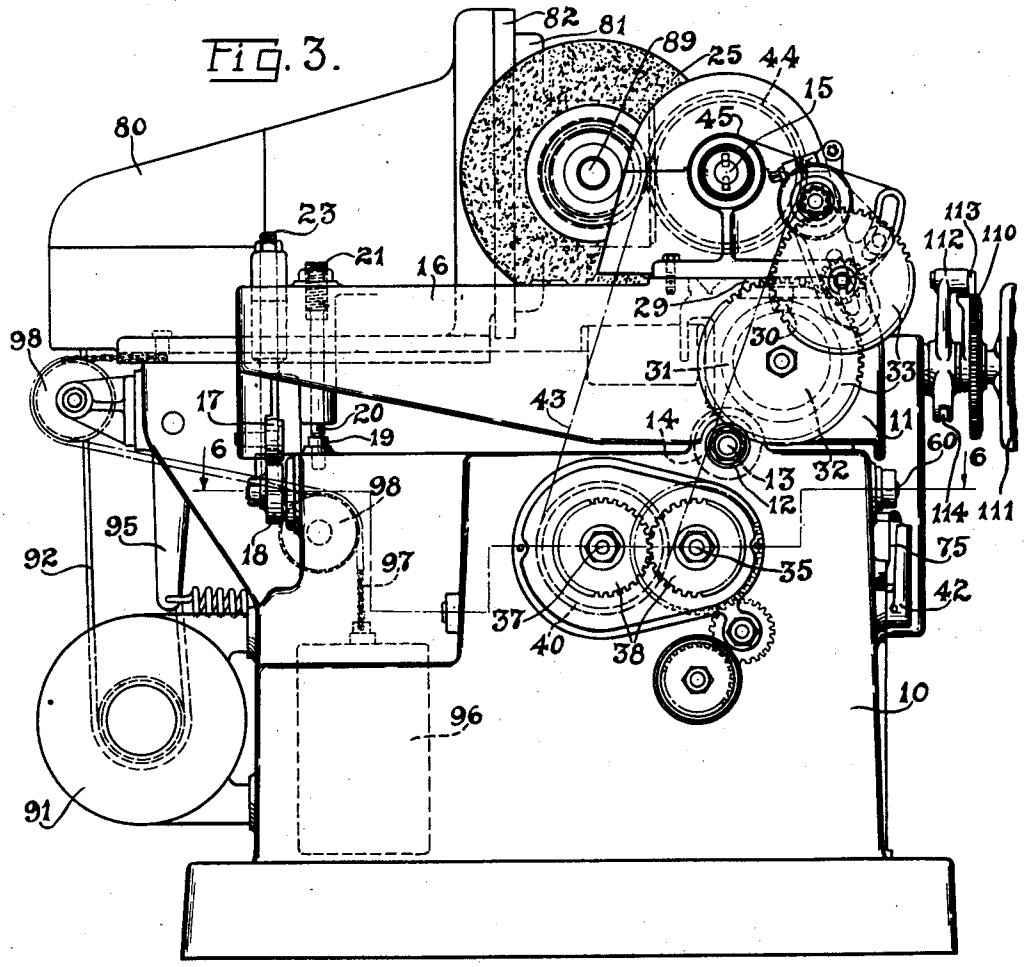
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Fig. 3.



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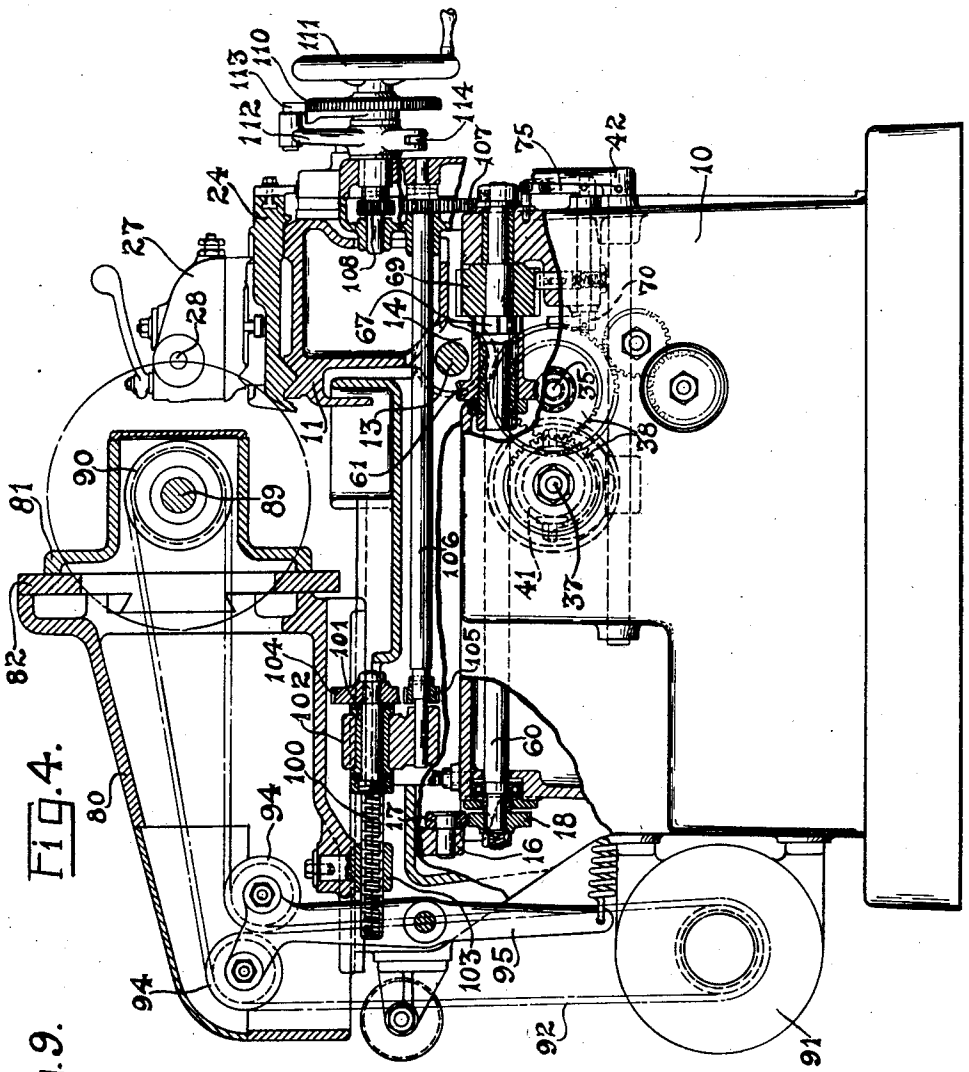


Fig. 4.

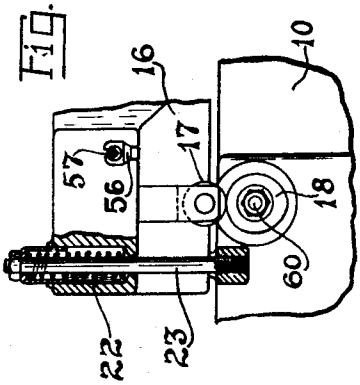


Fig. 9.

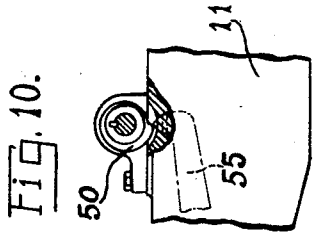


Fig. 10.

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Fig. 5.

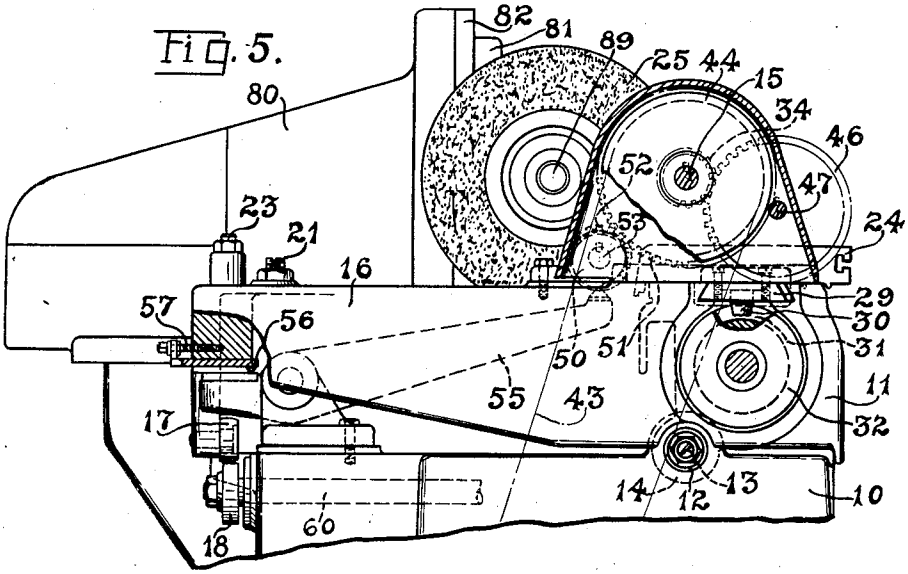
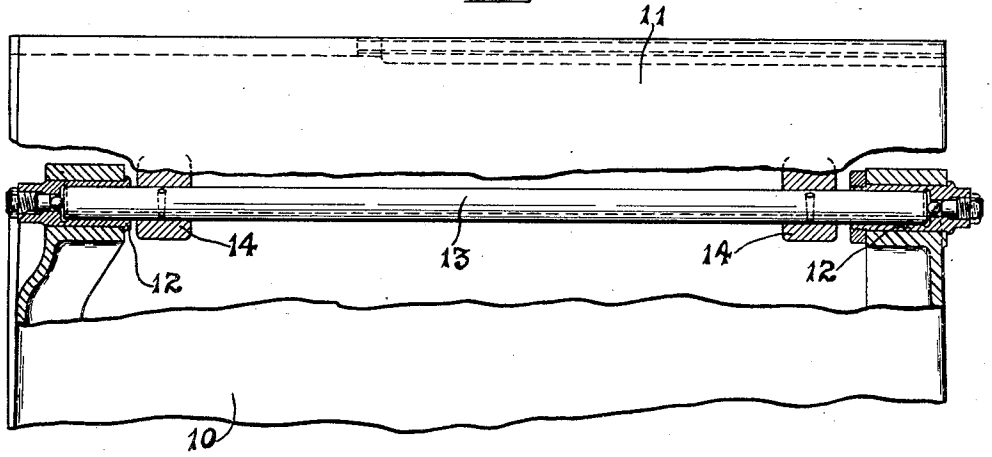


Fig. 11.



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TAP GRINDER

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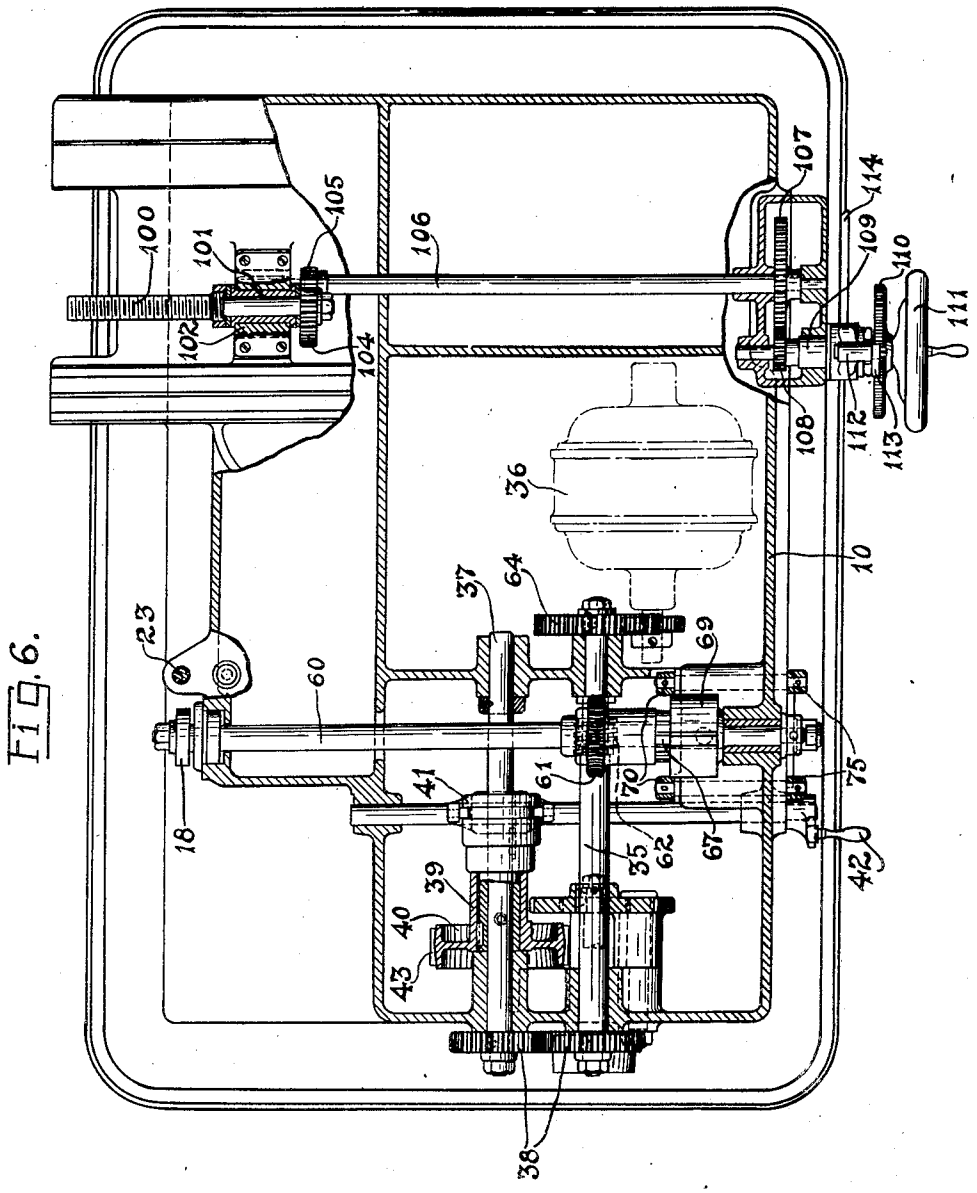


Fig. 6.

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TAP GRINDER

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Fig. 8.

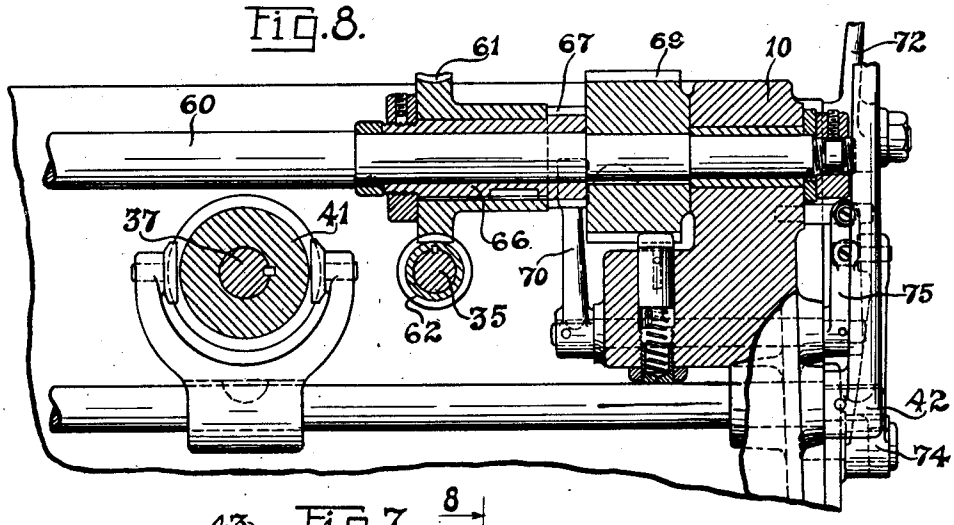
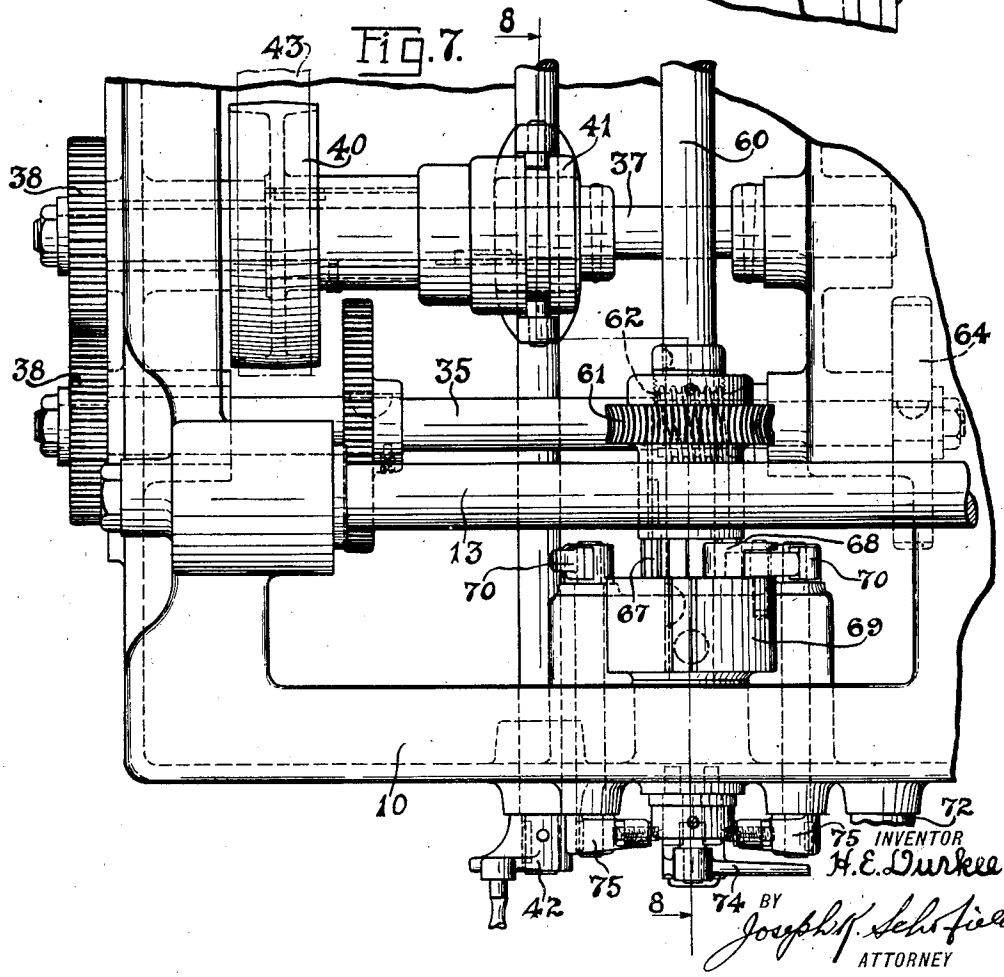


Fig. 7.



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UNITED STATES PATENT OFFICE.

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TAP GRINDER.

Application filed February 15, 1926. Serial No. 88,471.

This invention relates to an improved form of tap or thread gage grinding machine adapted particularly for rapid production of accurate taps or threaded gages of widely different sizes and characters of thread.

An object of the invention is to provide improved actuating means for moving the work support longitudinally of the machine past the abrasive wheel in timed relation to its rotative motion.

Another object of the invention is to provide improved cam actuated means for oscillating the work supporting means toward and from the wheel in timed relation to the longitudinal movements of the work supporting carriage so that the wheel may be engaged and disengaged relative to the work at the ends of the movement of the supporting means for the work in either direction.

One feature which enables me to accomplish the above named objects is that I mount a pivotally supported member on a base, and, on this pivotally mounted member, provide a longitudinally movable work supporting table; cam means being adapted to control the oscillatory movements of the supporting member to engage and disengage the work relative to the wheel; an independent cam being provided for effecting the longitudinal movements of the work table.

Another object of the invention is to provide supplemental cam means to oscillate the pivotally mounted member a plurality of times during each rotation of the work spindle so that taps may be suitably relieved or backed off during the grinding operation to improve their cutting qualities.

A further object of the invention is to provide the driving means for each of these cams from means directly connected to and driven from the work rotating spindle.

With these and other objects in view, my invention consists in the features of construction and operation set forth in the following specification and illustrated in the accompanying drawings.

In the accompanying drawings annexed hereto and forming a part of this specification, I have shown my invention embodied in a semi-automatic tap grinding machine of medium size, but it will be understood that the invention can be otherwise embodied and that the drawings are not to be construed as defining or limiting the scope of the invention, the claims appended to this specification being relied upon for that purpose.

In the drawings:

Figure 1 is a front elevation, partly in section, and showing a complete tap grinding machine.

Fig. 2 is a plan view of the complete machine.

Fig. 3 is an end elevation taken from the left end of the machine as seen in Fig. 1.

Fig. 4 is a vertical transverse section taken substantially upon the line 4—4 of Fig. 1.

Fig. 5 is a side elevation, partly in section, showing the means for oscillating the pivotally mounted member.

Fig. 6 is a horizontal sectional view taken substantially on line 6—6 of Fig. 3.

Fig. 7 is a horizontal view of the actuating mechanism for the engaging and disengaging cam.

Fig. 8 is a sectional view of the mechanism for the engaging and disengaging cam taken on line 8—8 of Fig. 7.

Fig. 9 is a detail view of the engaging and disengaging cam and adjacent mechanism.

Fig. 10 is a detail view of the relief effecting cam.

Fig. 11 is a fragmentary view of the pivotal connecting means for the work support; and

Fig. 12 is a detail of the wheel operating upon a tap.

In the above mentioned drawings I have shown but one embodiment of the invention which is now deemed preferable, but it is to be understood that changes and modifications may be made within the scope of the appended claims without departing from the spirit of the invention.

Briefly, and in its broadest aspect, my invention comprises the following principal parts: first, a base; second, an oscillatory member pivotally mounted directly on the base; third, a work supporting table on the pivotally mounted member and movable longitudinally of the machine in a straight line; fourth, work supporting and rotating means on the table; fifth, cam actuated means within the oscillatory member to reciprocate the table longitudinally along the upper surface of that member; sixth, cam means to oscillate the pivotally mounted member relative to the base; seventh, driving mechanism for said table reciprocating cam to rotate it in predetermined relation to

the rotation of the work supporing spindle; eighth, an abrasive wheel support adjustable toward and from the work rotating means; ninth, an angularly adjustable wheel head thereon; tenth, a wheel rotatably mounted within said head; eleventh, motors for actuating the work and for rotating the wheel; and twelfth, supplementary cam means to oscillate the pivotal member to effect relieving movements of the work.

Referring more in detail to the figures of the drawings, I provide a base 10 on which is pivotally mounted an oscillatory member 11 forming a supplementary base adapted to be oscillated. For this purpose bearings 12 are provided adjacent the opposite ends of the base 10 through which extends a shaft 13. Projections 14 depending from the oscillatory member 11 are provided with bearings also engaging this shaft 13 so that this supplemental base 11 can be oscillated about the axis of the shaft 13. The axis of this shaft 13 extends longitudinally along the base 10 and parallelly to the axis about which the work spindle 15 is rotated. These parts are most clearly shown in Fig. 11.

This pivotal member 11 is provided with a rearwardly extending projection or arm 16 having a roller 17 adapted to engage the surface of a rotatable cam 18 by means of which it may be oscillated. In order to limit the oscillatory movements of the member 11 in one direction, an abutment 19 is provided on the base 10 adapted to be contacted with the lower end of a bar or rod 20 mounted in the pivotal member 11. This bar 20 is adapted to be adjusted slightly up or down by means of screw threads 21 provided on its upper end. By means of this adjustment the limiting position of the pivotal member 11 toward its operative position is determined and the pivotal member 11 may be held in this limiting position when the oscillating mechanism for the pivotal member 11 and its cam 18 is not in use. Also, to resiliently hold the oscillatory member 11 toward its limiting position but permitting oscillation by the cam 18, a spring 22 is provided preferably partially housed, as shown in Fig. 9, within the rearward extension 16 of the pivotal member 11. This spring 22 engages one end of a rod 23, the opposite end of which is secured within a portion of the base 10. The tension of this spring 22 therefore always tends to hold the oscillatory member with the lower end of the adjustable rod against the fixed abutment. The cam 18, as shown in Figs. 5 and 9, is of the peripheral heart-shape type, the peripheral surface of which is adapted to be contacted by the roller 17 on the extension 16 of the oscillatory member 11. Means to rotate this cam 18 through a half revolution at each end of the movement of a table 24 supporting the work W will be described in detail at another point in the specification. By these means the pivotal member 11 is alternately moved toward and from the abrasive wheel 25.

Mounted on suitable ways extending longitudinally along the upper surface of the oscillatory member 11 is a work supporting table 24. This table 24 is provided near one end with a headstock 26 preferably fixed permanently in position on the upper surface and also with an adjustable tailstock 27 permitting work W of different lengths to be rotatably mounted between them. For this purpose centers 28 of the usual type are provided in the headstock 26 and in the tailstock 27. Extending through the headstock 26 is a work rotating spindle 15 within which the headstock center 28 is mounted. The means to rotate this spindle 15 will presently be described.

To reciprocate this work supporting table 24 longitudinally upon the pivotal member 11 a bar 29 attached to and extending from one end of the table 24 is provided. This bar 29 has a depending projection 30, preferably conical and forming a cam roller, as shown, adapted to engage a cam groove 31 in the cylindrical surface of a rotatable cam 32. As shown clearly in Fig. 1, this cam 32 is mounted upon an axis parallel to the axis of the work spindle 15 within a portion of the oscillatory member 11. Means are provided for rotating this cam 32 by driving connections 33 extending from a gear 34 mounted on the work supporting spindle 15. The driving means for this cam 32 operate in timed relation to the rotation of the work. So long as the work spindle 15 is being rotated therefore the table 24 will be reciprocated.

In order to drive the mechanism controlling the rotation and longitudinal movements of the work supporting means on the table 24 driving connections are provided from the shaft 35 within the base 10 driven by the main motor 36. In rear of and adjacent this shaft 35 is a shaft 37 parallel thereto drivingly connected to shaft 35 by suitable gears 38. Preferably these gears 38 are mounted on the outside of the base 10 so that they may be readily changed for others having different ratio. On shaft 37 is a sleeve 39 on which is a belt pulley 40, as shown in Fig. 6. A clutch 41 surrounding this shaft 37 and adapted to be splined to the shaft 37 enables this sleeve 39 to be engaged and disengaged from the shaft 37 so that the belt pulley 40 may be quickly started or stopped. To control the clutch a lever 42 is provided, oscillation of which engages and disengages the clutch 41. A belt 43 passing over this driving pulley 40 extends up to and around a corresponding belt pulley 44 on the work rotating and supporting spindle 15. Preferably this driven pulley

44 is splined to the end of the work spindle 15 so that longitudinal movements of the table 24 can readily take place, a suitable support 45 being provided for the end of the work spindle 15 fixed securely to the oscillating member 11 and providing bearings for the spindle 15. By this means the work spindle 15 may be constantly rotated in the same direction at any predetermined rotative speed. Between the support 45 and the headstock 26 is a guard 45ª surrounding the spindle 15. This guard 45ª is formed of telescoping sections, thus permitting movement of the headstock 26 relative to the support 46 during operation. This guard forms a dust and water proof guard for the spindle 15 and its bearing surfaces.

Also mounted on this work spindle 15 and preferably splined thereto in a manner similar to the pulley is the pinion 34 previously mentioned. This pinion 34 is in engagement with a spur gear 46 on a shaft 47 extending to the left-hand end of the machine. A pinion forming one of the change gears 33 is mounted on this end of the driving shaft 47 for driving the shaft carrying the drum cam 32. These gears 33 are, as shown in Figs. 1 and 3, adapted to be readily changed so that the cam 32 can be rotated at any desired speed relative to the rotation of the work spindle 15. During operation of the machine the work spindle 15 and cam drum 32 are constantly rotated in the same direction, the only member being reversed being the table 24.

The supplemental cam 50 for effecting the relief upon the work W being ground is adapted to be constantly rotated by a gear 51 adjacent the pinion 34 on the work spindle 15. This gear 51 is in engagement with a pinion 52 on an auxiliary shaft 53 in rear of and parallel to the work spindle 15. The ratio between these two gears 51 and 52 is equal to the number of flutes in the tap being ground. That is, if there are five flutes in the tap, the ratio between the gear 51 and the pinion 52 will be five to one. On this shaft 53 is the spiral cam 50 shown clearly in Fig. 10, which is adapted to contact with the forward end of a lever 55 pivotally mounted within the base 10. The opposite end of this lever 55, which is very short, is adapted to contact with an abutment 56 on the rearwardly extending projection or arm 16 on the pivotal member 11. As shown in Fig. 5, this abutment 56 is slidably mounted and is adapted to be adjusted by means of the screw 57 to which it is attached. Rotation of the work spindle 15 and cam 50 will therefore oscillate the lever 55 which, in turn, will oscillate the pivotal member 11 and the work W toward and from the abrasive wheel 25.

In order to control the rotation of the engaging and disengaging cam 18 so that it will be rotated through one half a revolution at each end of the stroke of the table 24 movement, the following mechanism is provided. The cam 18 is mounted upon the rear end of a forwardly extending shaft 60 adapted to be rotated by a worm wheel 61 mounted rotatably upon it. By means of clutch mechanism, this worm wheel 61 is adapted to rotate the cam shaft 60 through one-half a revolution and always in the same direction.

In order to constantly rotate the worm wheel 61, it is engaged by a worm 62 on the longitudinally extending shaft 35 within the base 10 and having a driving gear 64 at one end. In mesh with this driving gear is the pinion 65 on the armature of the motor 36 preferably housed, as shown, within the central portion of the base 10.

To engage and disengage the clutch between the sleeve 66 carrying the worm wheel 61 and the cam shaft 60, means are provided generally similar to those disclosed in the patent to Larsson No. 1,501,544 granted July 15, 1924. Rotatably surrounding the cam shaft 60 as shown in Fig. 8 is a ratchet wheel 67. This is keyed to the worm wheel 61 so that it is constantly being rotated upon the cam shaft. A pawl 68 mounted on the face of a member 69 keyed directly to the cam shaft 60 is adapted to be normally resiliently in engagement with one of the teeth of this ratchet wheel 67. In order to engage and disengage the pawl 68 so that the ratchet wheel 67 and cam shaft 60 will be rotated and stopped alternately, two levers 70 are provided pivotally mounted adjacent and on opposite sides of the cam shaft 60. These levers 70 are provided with abutments adapted to engage an outward extension of the pawl 68 to disengage the pawl from the ratchet wheel 67 and thus stop rotation of the cam shaft 60 while permitting continued rotation of the worm wheel 61. These levers 70 are adapted to be moved to their engaging and disengaging positions by the linkage shown in Fig. 1. Suitable dogs 71 adjustably positioned along the front surface of the table 24 are adapted to engage and oscillate a vertical lever 72. This lever 72, through a suitable link 73, oscillates a bell crank lever 74 which oscillates one or the other of the levers 70 by means of supplemental levers 75 oscillating therewith and mounted on the front surface of the machine.

It will be seen from the above that as soon as the lever 72 is oscillated in one direction by engagement with one of the dogs 71, one of the levers 70 will be moved from its operative position, thus disengaging that lever 70 from the pawl 68 and the other lever 70 will be permitted to move into operative position. The pawl 68 then moves into engagement with the ratchet wheel 67 so that the rotatable member 69 keyed to the cam

shaft 61 therefore rotates through one-half a revolution before the outward extension on the pawl 68 engages the opposite lever 70. As soon as this engagement takes place, the pawl 68 is again disengaged and the rotatable member 69, as well as the cam shaft 60 and cam 18, remain stationary until the opposite lever 70 is oscillated by engagement of the lever 72 with the opposite dog 71 when another half revolution of the cam shaft 60 can take place. These half turn movements of the cam 18 by means of the adjustable dogs 71 on the table 24 are therefore timed to occur at the ends of movement of the table 24 in either direction. The effect of this movement of the cam 18 and its shaft 60 is to alternately oscillate the pivotal member 11 toward and from the wheel 25 to engage and disengage the wheel 25 with the work W. By changing the link 73 from one side of the lever 72 to the other the work W may be moved to engage the wheel 25 at the end of the table movement in either direction as desired or called for by the operation being performed.

Mounted for adjustment toward and from the work spindle 15 on suitable ways provided on the upper surface of the base 10 is a wheel support 80. This support 80, as shown, is provided with a wheel head 81 mounted on its forward end. Preferably and as shown, this head 81 is adapted to be angularly adjustable about a horizontal axis normal to the axis of the work spindle 15 for positioning the wheel 25 for different types of thread.

As shown in Fig. 4 the wheel head 81 engages a slide 82 which is adjustable on the front vertical surface of the wheel slide 80. Adjusting means for oscillating the head 81 are provided comprising worm wheel teeth cut into the head and engaged by a worm 84. A hand wheel 85 on the upper end of the shaft carrying the worm enables this worm wheel and head 81 to be manually adjusted to any desired angle. Similarly the intermediate member 82 may be manually adjusted as by the screw 86 which has a worm wheel 87 on its outer end. This worm wheel 87 is engaged by a worm on a forwardly extending shaft having a hand wheel 88 on its end. Rotation of this hand wheel 88 will therefore laterally adjust the position of the head 81 to properly engage the wheel 25 with the work W. Within the head 81 are suitable bearings for the wheel spindle 89 on which is mounted the abrasive wheel 25 at one end. Also on this spindle 89 is a belt pulley 90.

A motor 91 mounted in rear of the base 10 and connected to the wheel spindle 89 within the head 81 provides means for rotating the wheel spindle 89 at high speed. As shown, a belt 92 drivingly connects the motor 91 and the wheel spindle 89 and passes over idlers 94 mounted on a pivotal arm 95 resiliently forced in a direction to maintain a suitable tension upon the belt 92. A counterweight 96 within the base 10, as shown in Fig. 3, is flexibly attached to the wheel support 80 by a chain 97 passing over the idler pulleys 98 shown. The counterweight 96 always acts to force the wheel support 80 as far away from the work spindle 15 as possible.

In order to adjust the position of the wheel 25 toward or from the work spindle 15 to compensate for the wearing away of the wheel to position it for operation upon different sizes of work, and to advance it during the grinding operation, the following mechanism is provided. Within the base 10 is rotatably mounted a screw 100 held rigidly from longitudinal motion within a sleeve 101 mounted in a projection 102 formed in the base 10. This screw 100 extends in the same direction in which the wheel support 80 is movable. A nut 103 secured to the lower surface of the wheel support 80 engages this screw 100 so that rotation of the screw 100 forces the wheel support 80 toward or from the axis of the work W. In order to rotate the screw 100 to adjust the position of the wheel support 80, a gear 104 is mounted on the forward end of the screw in mesh with a pinion 105 on the rear end of a forwardly extending shaft 106. This shaft 106, at its forward end in front of the machine, is provided with a relatively large gear 107 in mesh with a pinion 108 on a short shaft 109 having a ratchet wheel 110 and hand wheel 111 on its forward end and adapted to rotate therewith. Rotation therefore of the hand wheel 111 will quickly adjust the wheel 25 either toward or from the work spindle 15 depending upon which direction the wheel 111 and shaft 109 are rotated.

In order to very slowly feed the wheel 25 forward during operation, an oscillating arm 112 is mounted on the shaft 109 so that it may oscillate freely thereon and is provided on one arm with a pawl 113 adapted to engage the ratchet wheel 110. The opposite arm of this member 112 is attached by means of a link 114 to a pivotally mounted member 115 having a pinion 116 thereon concentric with the axis about which the member 115 oscillates. In mesh with this pinion 116 are rack teeth on a vertically arranged bar 117 normally spring pressed upwardly by means of a coil spring 118. The upper end of this bar 117 is provided with a roller adapted to contact with a dog 119 adjustable along the table 24. It will be seen from this construction that movement of the table 24 in each direction will force the vertical bar 117 downward by engagement of the roller with the dog 119 and therefore will oscillate the member 115 due to the engagement of the

pinion 116 with the rack teeth on the bar 117. This movement will therefore advance the ratchet wheel 110 through a very small angle and feed the wheel 25 correspondingly.

What I claim is:

1. A tap grinding machine comprising in combination, a base, a pivotally mounted member thereon, work supporting and rotating means on said pivotally mounted member, a support, a wheel rotatably mounted thereon, cam means to effect relative axial movement between said wheel and the work supporting means, means to actuate said cam means from said work rotating means, and means to oscillate said pivotally mounted member in timed relation to said movements to engage and disengage the work relative to the wheel.

2. A tap grinding machine comprising in combination, a base, a pivotally mounted member thereon, work supporting and rotating means on said pivotally mounted member, a support, a wheel rotatably mounted thereon, cam means to effect relative axial movement between said wheel and the work supporting means, cam means to oscillate said pivotally mounted member in timed relation to said movements, and adjustable means on said table to actuate said cam means for oscillating said pivotal member.

3. A tap grinding machine comprising in combination, a base, a pivotally mounted member thereon, work supporting and rotating means on said pivotally mounted member, a support having a rotatable wheel mounted thereon movable toward and from the work supporting means, a cam rotatably mounted in said pivotally mounted member, means on said work supporting member engaging said cam whereby the work supporting means is moved axially relative to the wheel, cam means to oscillate said pivotally mounted member, and means to control the oscillatory movement of the pivotally mounted member relative to the axial movements of the work rotating means.

4. A tap grinding machine comprising in combination, a base, a pivotally mounted member thereon, work supporting and rotating means on said pivotally mounted member, a support having a rotatable wheel mounted thereon movable toward and from the work supporting means, a cam rotatably mounted in said pivotally mounted member, means on said work supporting member engaging said cam whereby the work supporting means is moved axially relative to the wheel, cam means to oscillate said pivotally mounted member, means to control the oscillatory movement of the pivotally mounted member in timed relation to the axial movements of the work rotating means, and means to actuate said first mentioned cam from said work rotating means.

5. A tap grinding machine comprising in combination, a base, a pivotally mounted member thereon, work supporting and rotating means on said pivotally mounted member, a support, a wheel rotatably mounted thereon, cam means to effect relative axial movement between said wheel and the work supporting means, means to oscillate said pivotally mounted member in timed relation to said axial movements to engage and disengage the work relative to the wheel, and supplementary oscillating means for said pivotally mounted member adapted to oscillate said pivotally mounted member a plurality of times during each rotation of the work while the table is moving in one direction.

6. A tap grinding machine comprising in combination, a base, a pivotally mounted member thereon, work supporting and rotating means on said pivotally mounted member, a support, a wheel rotatably mounted thereon, cam means to effect relative axial movement between said wheel and the work supporting means, means to actuate said cam means from said work rotating means, means to oscillate said pivotally mounted member in timed relation to said movements to engage and disengage the work relative to the wheel, and supplementary oscillating means for said pivotally mounted member adapted to oscillate said pivotally mounted member a plurality of times during each rotation of the work while the table is moving in one direction.

7. A tap grinding machine comprising in combination, a base, a pivotally mounted member thereon, work supporting and rotating means on said pivotally mounted member, a support, a wheel rotatably mounted thereon, cam means to effect relative axial movement between said wheel and the work supporting means, cam means to oscillate said pivotally mounted member in timed relation to said movements, adjustable means on said table to actuate said cam means for oscillating said pivotal member, and supplementary oscillating means for said pivotally mounted member adapted to oscillate said pivotally mounted member a plurality of times during each rotation of the work while the table is moving in one direction.

8. A tap grinding machine comprising in combination, a base, a pivotally mounted member thereon, work supporting and rotating means on said pivotally mounted member, a support having a rotatable wheel mounted thereon movable toward and from the work supporting means, a cam rotatably mounted in said pivotally mounted member, means on said work supporting member engaging said cam whereby the work supporting means is moved axially relative to the wheel, cam means to oscillate said pivotally mounted member, means to control

the oscillatory movement of the pivotally mounted member relative to the axial movements of the work rotating means, and a supplementary cam driven by said work rotating means adapted to oscillate the pivotally mounted member a plurality of times during each rotation of the work while the table is moving in one direction.

9. A tap grinding machine comprising in combination, a base, a pivotally mounted member thereon, work supporting and rotating means on said pivotally mounted member, a support having a rotatable wheel mounted thereon movable toward and from the work supporting means, a cam rotatably mounted in said pivotally mounted member, means on said work supporting member engaging said cam whereby the work supporting means is moved axially relative to the wheel, cam means to oscillate said pivotally mounted member, means to control the oscillatory movement of the pivotally mounted member in timed relation to the axial movements of the work rotating means, means to actuate said first mentioned cam from said work rotating means, and a supplementary cam driven by said work rotating means adapted to oscillate the pivotally mounted member a plurality of times during each rotation of the work while the table is moving in one direction.

10. A tap grinding machine comprising in combination, a base, a pivotally mounted member thereon, work supporting and rotating means on said pivotally mounted member, a support having a rotatable wheel thereon movable toward and from the work supporting means, a cam rotatably mounted in said pivotally mounted member, means on said work supporting member engaging said cam whereby the work supporting means is moved axially relative to the wheel, cam means to oscillate said pivotally mounted member, and means to actuate the cam means for the oscillatory movement of the pivotally mounted member at the ends of the table movement in each direction, means to actuate said first mentioned cam from said work rotating means, and a supplementary cam driven by said work rotating means adapted to oscillate the pivotally mounted member a plurality of times during each rotation of the work while the table is moving in one direction.

In testimony whereof, I hereto affix my signature.

HENRY E. DURKEE.