

May 16, 1933.

G. H. HAGEMAN

1,909,055

TAPPING MACHINE

Filed Nov. 28, 1930

7 Sheets-Sheet 1

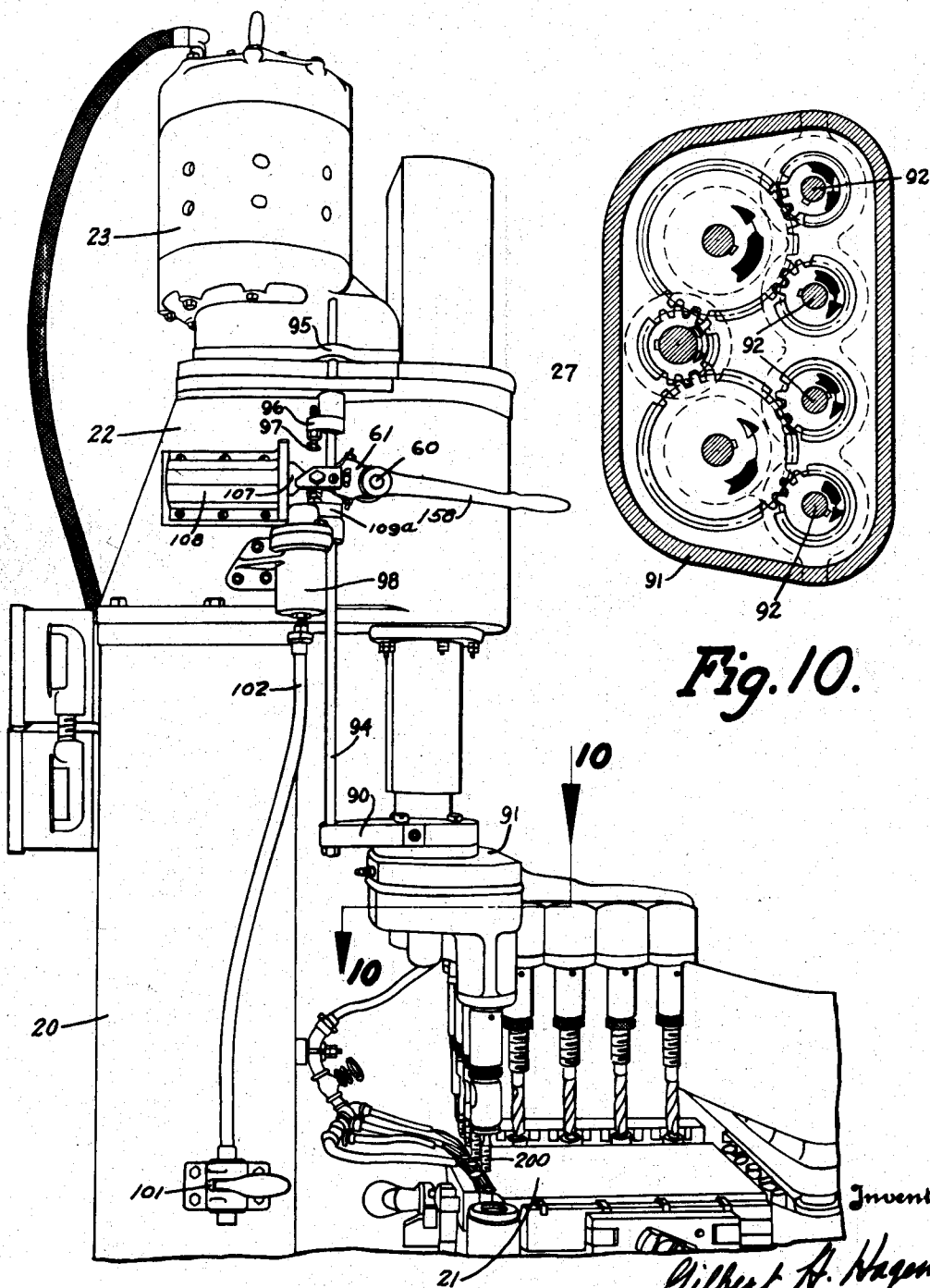


Fig. 10.

Fig. 1.

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TAPPING MACHINE

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7 Sheets-Sheet 2

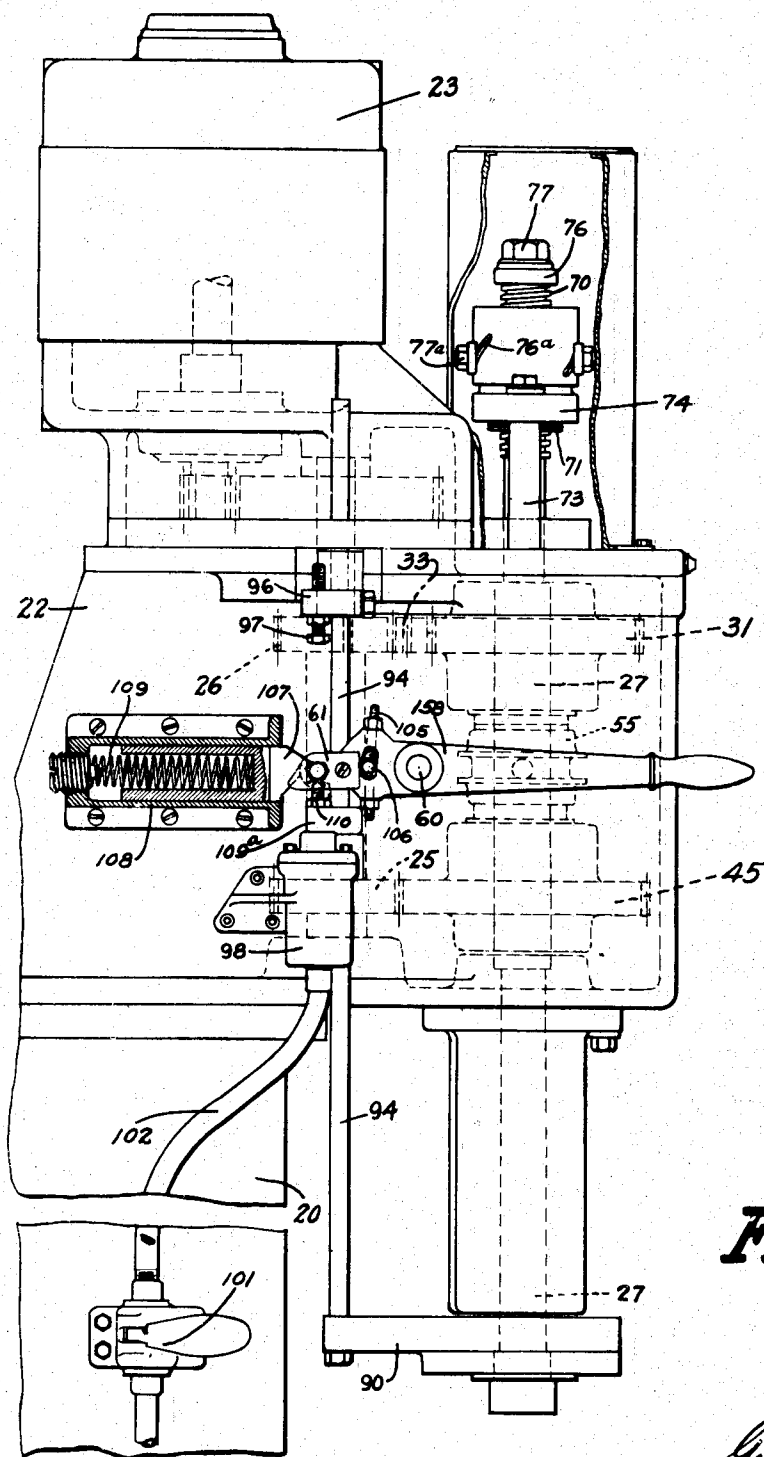


Fig. 2.

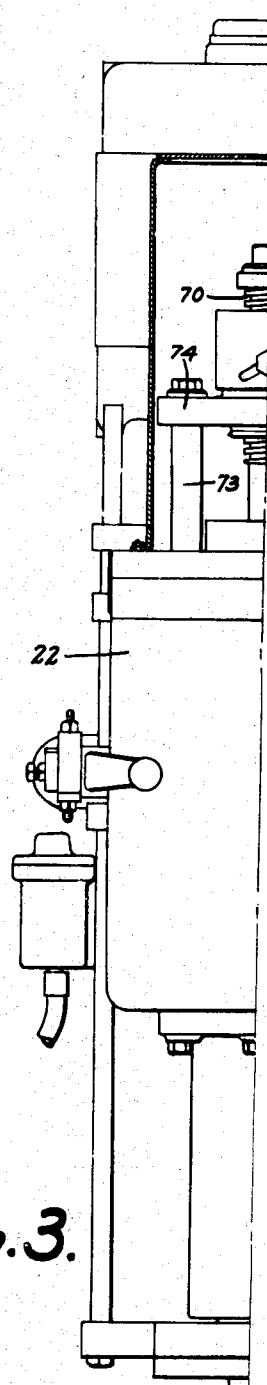


Fig. 3.

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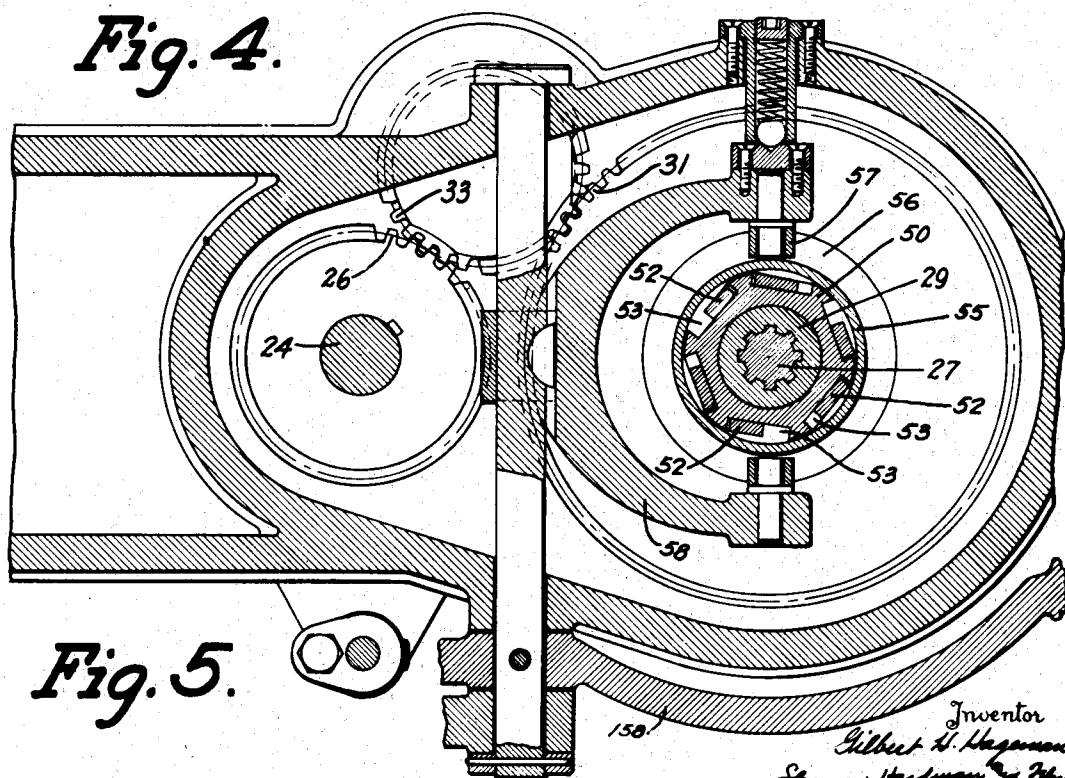
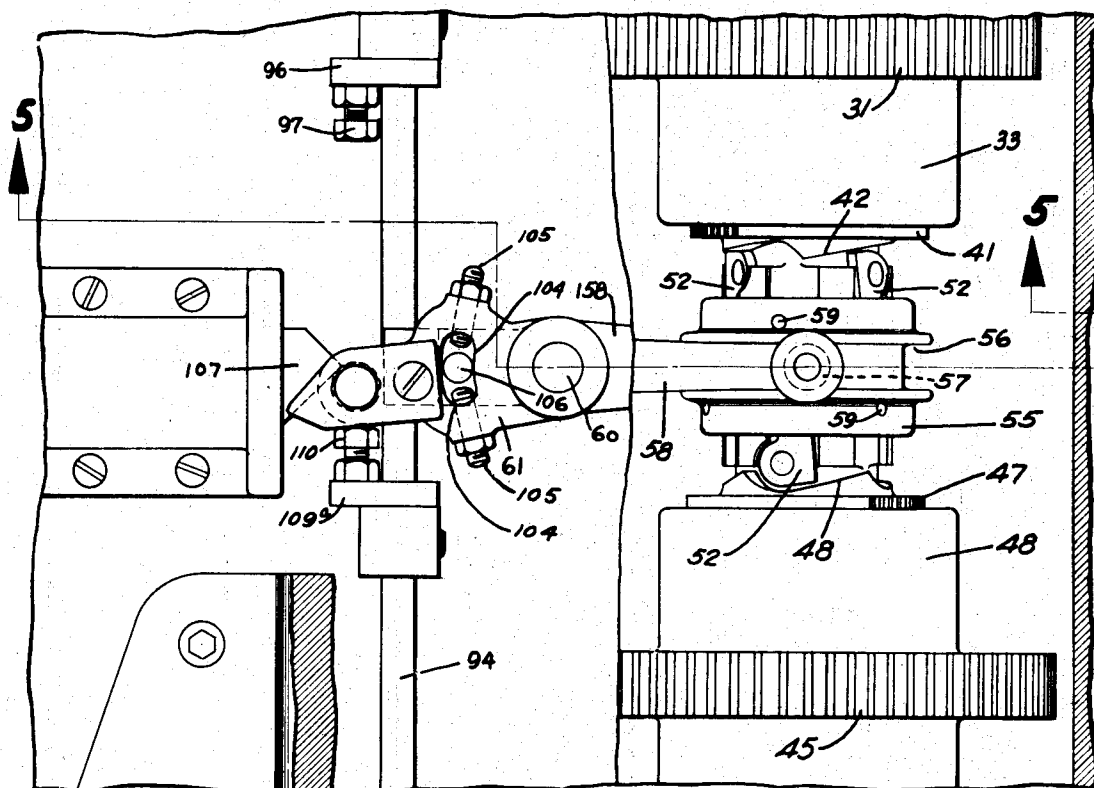
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TAPPING MACHINE

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7 Sheets-Sheet 3



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TAPPING MACHINE

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7 Sheets-Sheet 4

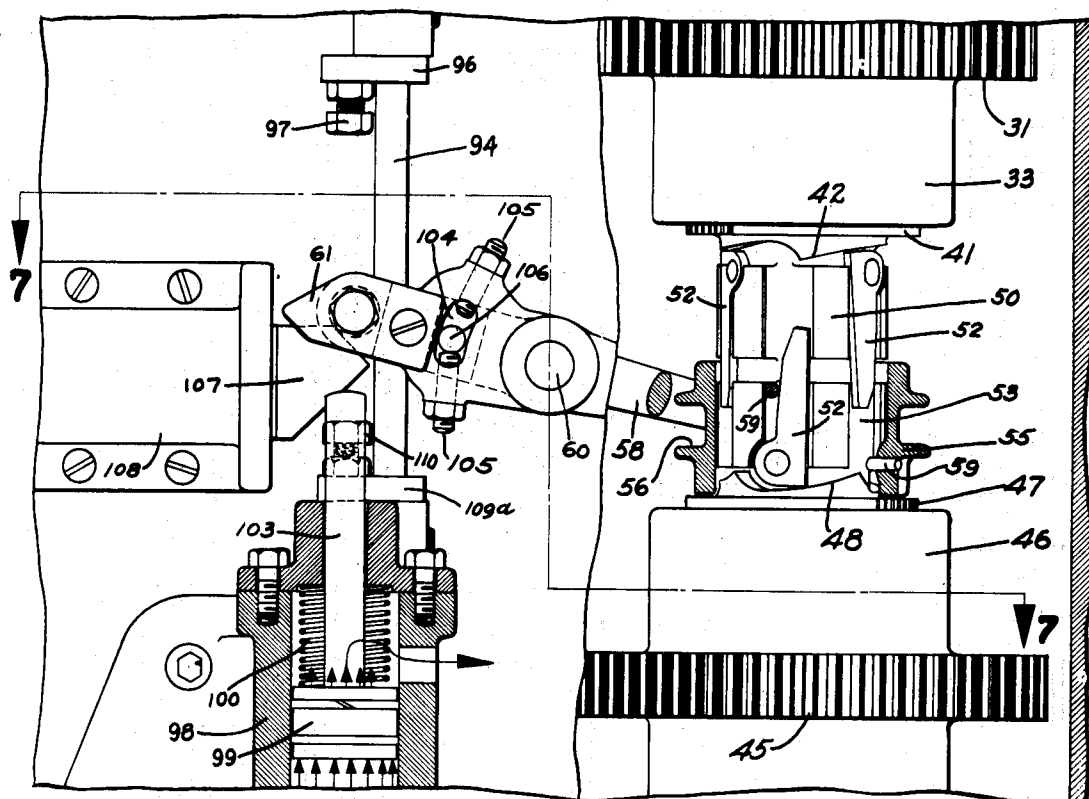


Fig. 6.

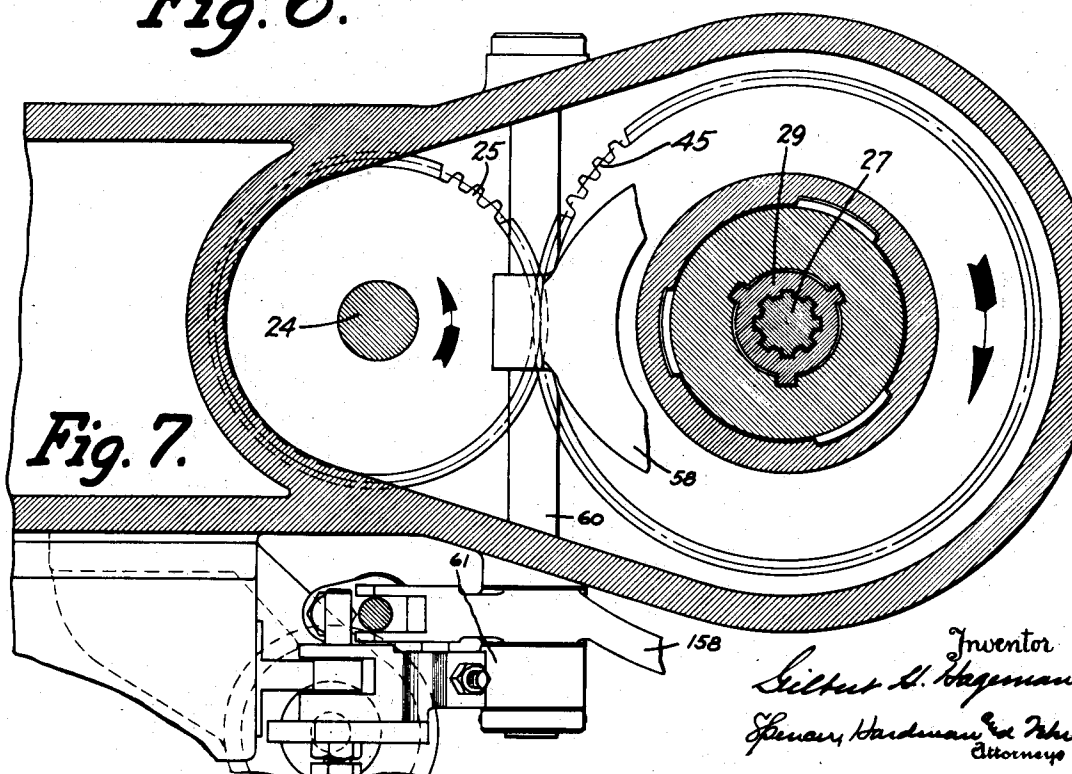


Fig. 7.

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7 Sheets-Sheet 5

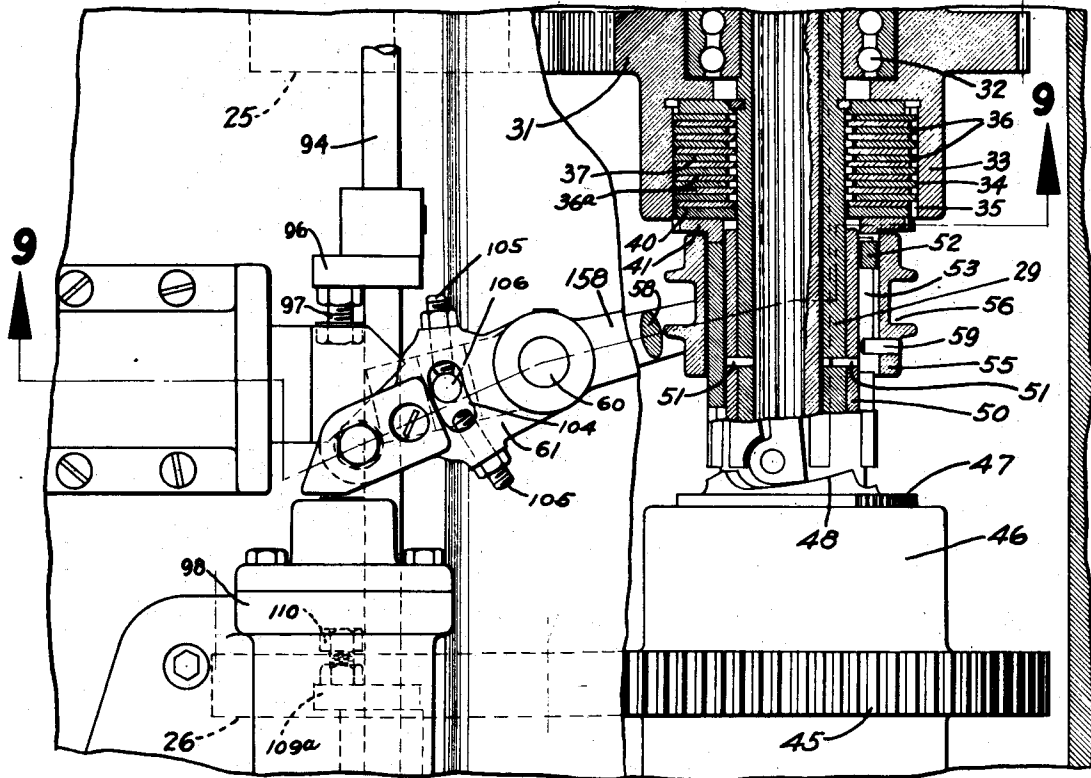


Fig. 8.

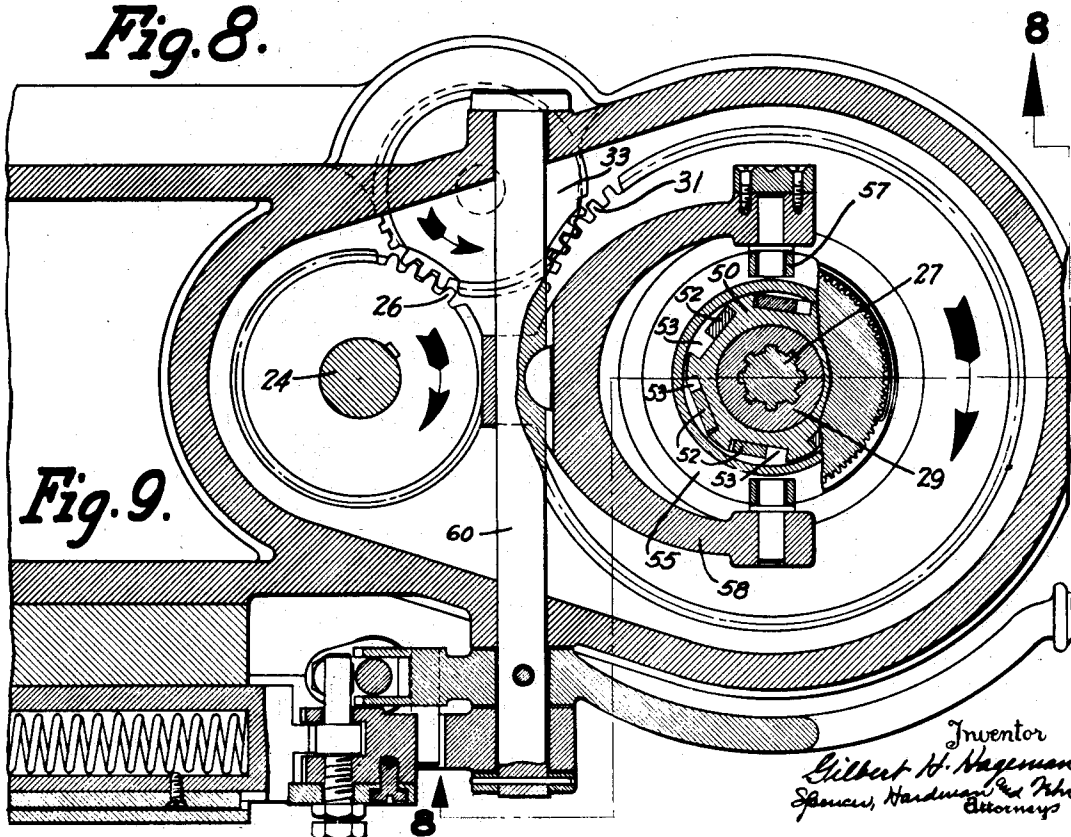


Fig. 9.

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TAPPING MACHINE

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7 Sheets-Sheet 6

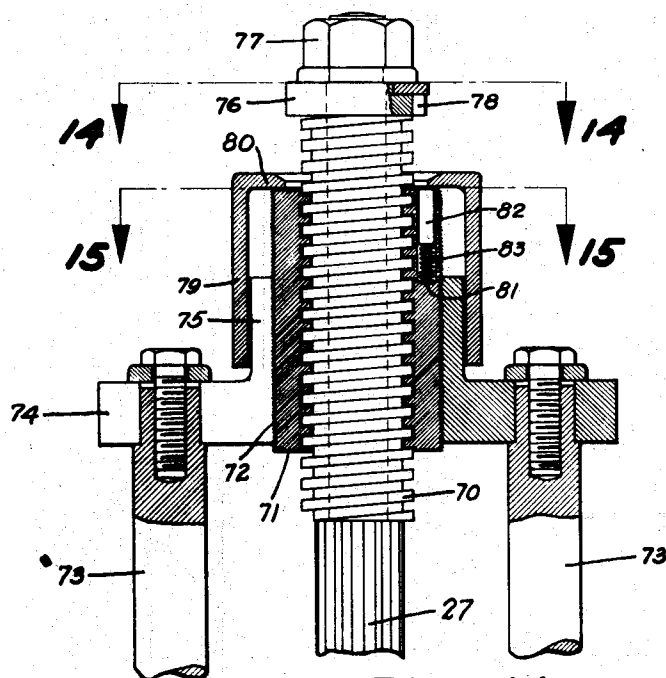


Fig. 11.

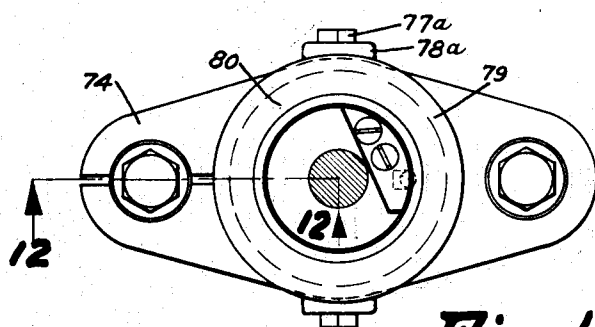


Fig. 14.

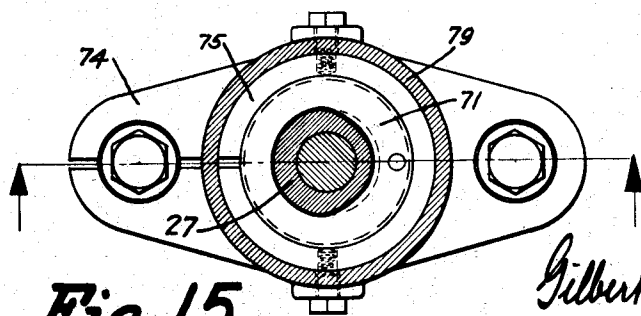


Fig. 15.

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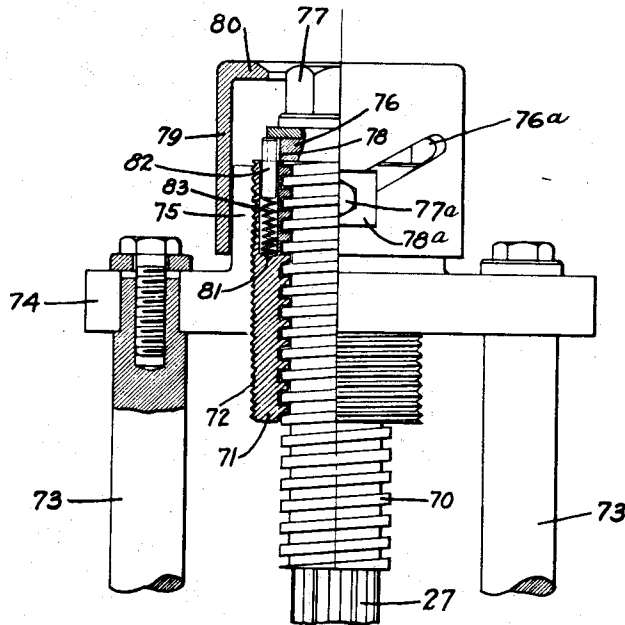


Fig. 12.

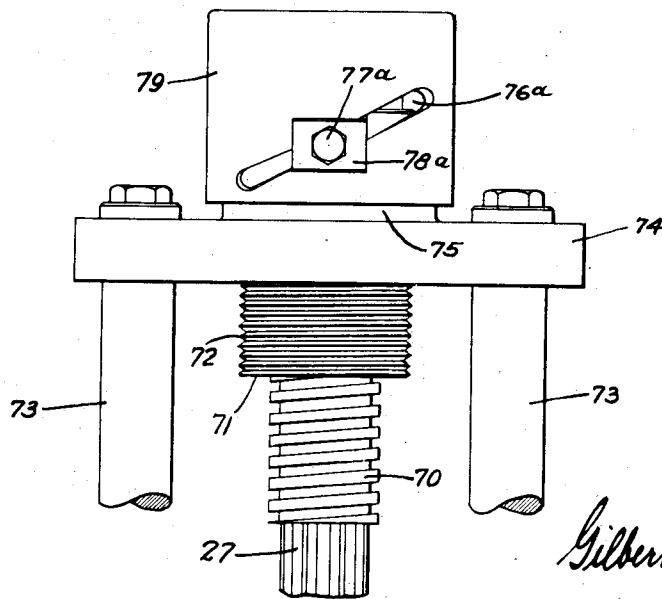


Fig. 13.

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UNITED STATES PATENT OFFICE

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TAPPING MACHINE

Application filed November 23, 1930. Serial No. 498,626.

This invention relates to improvements in tapping machines and particularly to the control mechanism for such machines.

It is among the objects of the present invention to provide a tapping machine in which the longitudinal movement of the spindle, which operates the tapping tool, is obtained through the medium of a lead screw mechanism.

A further object of the present invention is to provide a tapping machine which is adapted to reduce the time, required for tapping a hole in a work-piece, to a minimum.

This last mentioned object is attained by providing mechanism in the tapping machine which will move the spindle, which operates the tapping tool comparatively, quickly toward and away from the work-piece, said spindle being moved longitudinally at the proper speed during the time the tapping tool is in operative engagement with the work-piece.

A still further object of the present invention is to provide an improved tapping machine, having a lead screw for moving the operating spindle longitudinally, with mechanism adapted to reverse the movement of the spindle in response to the longitudinal movement of said spindle toward the work-piece.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of one form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a perspective view of the improved tapping machine, the base portion of the machine being broken away so that the more important part of the machine may be shown at a larger scale.

Fig. 2 is a side view of a portion of the tapping machine, certain parts being broken away to show interior mechanism.

Fig. 3 is a fragmentary front view of the portion of the machine shown in Fig. 2.

Fig. 4 is a fragmentary detail view of the control mechanism of the machine.

Fig. 5 is a fragmentary sectional view taken along the line 5—5 of Fig. 4.

Fig. 6 is a view similar to Fig. 4, the control mechanism being shown in one of the operating positions, parts being shown in section more clearly to illustrate the interior structures.

Fig. 7 is a fragmentary sectional view taken along the line 7—7 of Fig. 6.

Fig. 8 is a view similar to Fig. 6 the control mechanism being shown in another operating position. In this view one of the power transmitting devices is shown in section. The view in Fig. 8 is taken substantially along the line 8—8 of Fig. 9.

Fig. 9 is a fragmentary sectional view taken substantially along the line 9—9 of Fig. 8.

Fig. 10 is a fragmentary sectional view taken along the line 10—10 of Fig. 1 showing the train of driving gears provided between the operating spindle and the four tapping gears of this machine.

Fig. 11 is a fragmentary sectional view of the lead screw mechanism of the machine.

Fig. 12 is a fragmentary sectional view taken substantially along the line 12—12 of Fig. 14 and shows the spindle in its one extreme operating position.

Fig. 13 is a side elevation of the lead screw mechanism.

Fig. 14 is a view taken substantially along the line 14—14 of Fig. 11.

Fig. 15 is a view taken substantially along the line 15—15 of Fig. 11.

Referring to the drawings, a tapping machine is illustrated having a spindle for operating the tapping tools, said spindle being moved longitudinally by a lead screw mechanism. A feature of this invention resides in this lead screw mechanism which is adapted to move the spindle so that its tapping tools are moved into close proximity of the work-piece at comparatively great speed, the longitudinal movement of the spindle while the tapping tool is in operating engagement with said work-piece being at a speed in which the proper tapping of the work-piece may obtain.

The machine comprises a body 20 supporting a work-holding mechanism 21. On this body there is supported a gear case 22 and upon the gear case a motor 23, which provides

the motive power for the machine. The motor 23 has a shaft 24 extending through a bearing in the gear case 22 into the interior of said gear case. Upon this shaft 24 and within the gear case 22 there are attached two gears 25 and 26. A tubular shaft 29, parallel with the motor shaft 24 but spaced therefrom, has its ends journaled in the upper and lower walls of the gear case 22. This tubular shaft 29 is provided with longitudinal splines in its interior, peripheral surface which operatively engage the splined spindle 27 fitting into the tubular shaft 29, thus spindle 27 must rotate with the tubular shaft 29, but may be moved longitudinally relative thereto. Two gears 31 and 45 are rotatively supported at opposite ends of the tubular shaft 29 within the gear case 22. Ball bearings 32 are interposed between each gear 31 and 45 and the tubular shaft 29. It is necessary that these gears be rotated in opposite directions, therefore gear 31 is operatively engaged with an idler gear 33 which in turn meshes with the driving gear 26 on the motor shaft 24. This connection rotates gear 31 in the same direction as gear 26. Gear 45, however, is directly connected with the driving gear 25 on the shaft 24 and is thus operated in an opposite direction to the rotation of the motor shaft 24. The direction indicated by the arrow in Figs. 7 and 9 is the same because the first view is taken downwardly, the latter upwardly.

Referring particularly to the Fig. 8, gear 31 is shown having a hub 33, recessed to provide a clutch chamber 34. The inner peripheral surface of the clutch chamber 34 has spaced, longitudinal grooves 35 for receiving tongues extending from the outer edge of alternate clutch plates 36. Thus clutch plates 36 are attached to and must rotate with the gear 31. The multiple disc clutch designated by the numeral 37 has in addition to plates 36, a plurality of plates 36a which are operatively connected to the tubular shaft 29 by tongues extending from said shaft into notches in the plates, these tongues on the outer peripheral surface of said shaft are confined within the clutch chamber 34 of the gear 31. From this it may be seen that alternate plates 36 and 36a of the clutch 37 may normally rotate with the tubular shaft 29 and the gear 31 respectively. An end thrust collar 40 is slidably supported upon the tubular shaft 29, said collar engaging the outermost clutch plate as shown in Fig. 8. A pressure sleeve 41 is carried upon the tubular shaft 29 so as to engage the thrust collar 40, the outer edge of said pressure sleeve as shown in the Fig. 6 having a camming surface 42 for purposes to be described.

Gear 45 has a hub portion 46 recessed to provide a clutch chamber as in the case of gear 31. The clutch in the gear 45 is constructed similarly to the clutch 37, that is, certain of the plates of said clutch being operatively

connected with the gear while other clutch plates are operatively connected with the tubular shaft 29. A pressure sleeve 47 having an outer camming edge 48 is provided with the clutch of the gear 45.

A sleeve 50 is secured to the tubular shaft 29 by pins 51 so that the sleeve must rotate with said shaft and cannot move longitudinally relative thereto. This sleeve 50 has a plurality of spaced longitudinal channels 53 provided therein as shown in the Figs. 6, 8 and 9. A camming arm 52 is pivotally supported in each of said longitudinal channels 53. Alternate arms are pivoted at opposite ends of the sleeve 50. This is clearly shown in the Figs. 4 and 6. A camming collar 55 is slidably supported upon the sleeve 50, this camming collar having an annular groove 56 for receiving the rollers 57 on the yoked end of operating lever 58 which is adapted to shift said camming collar 55 longitudinally of the sleeve 50. The camming collar 55 carries inwardly extending pins 59, one for each camming arm 52. These pins 59, when moved longitudinally of the sleeve 50 by the camming collar 55, engage the edges of the respective arms 52 and the longitudinal channels 53 in the sleeve 50, so that when moved in one direction, for instance toward the gear 31, the pins 59 of collar 55 will engage the camming arms 52 pivoted at the end of the sleeve more adjacent the multiple disc clutch 37 and thus one corner of said arms 52 adjacent their pivoted ends will engage the camming edge 42 of the pressure sleeve 41 and move said pressure sleeve against the end thrust collar 40 to cause engagement of the plates 36 and 36a of the multiple disc clutch 37 whereby the gear 31 and the sleeve 29 are operatively connected and the former will thus rotate the latter. At this time the clutch plates of the clutch in gear 45 are still disengaged, thus permitting the tubular shaft 29 and its plates to rotate relative to the gear 45 and its clutch plates. Reversal of the movement of the camming collar 55 will permit the upper arms 52 of collar 55 to return to normal position, said reversed movement, if sufficient, will cause the lower arms 52 to move the pressure sleeve 47 whereby the clutch plates within the gear 45 are engaged and thus the tubular shaft 29 is drivingly connected with the gear 45 which will rotate said tubular shaft 29 in a direction opposite that in which it was rotated by gear 31. When the camming collar 55 is in a position as shown in Fig. 4, all the arms 52 will be inoperative and thus pressure sleeves 41 and 47 will be maintained in positions in which the plates of their respective clutches are entirely disengaged and consequently shaft 29 is not connected with either of the gears 31 or 45.

The yoke lever 58 which operates the camming collar 55 longitudinally of the sleeve 50

is pivoted on a rod 60. A hand lever 158 is secured to an end of shaft or rod 60 extending outside the gear casing 22 whereby the rod 60 and thus the lever 58 may be operated manually. Rod 60 rotatably carries an operating link 61 at its outside and a lost motion connection being provided between the link and the hand lever.

It has been shown how the spindle 27 may be rotated in opposite directions and the description will now be confined to the mechanism for moving the spindle longitudinally relative to its driving shaft 29, whereby the tapping tools, operated by the spindle, may be moved toward and into engagement with the work-piece and, after the tapping operation, be withdrawn and moved away from the work-piece.

Referring particularly to the Figs. 2, 11, 12, 13, 14 and 15, the spindle 27 is shown provided with screw threads 70 at its upper end, or more particularly, the end extending beyond the upper wall of the gear case 22. These screw threads, as shown in the Figs. 11 and 12 are comparatively coarse and if desired may be of the double or triple threaded type which will give the spindle comparatively fast longitudinal movement. A collar 71 interiorly threaded to fit upon the threaded end 70 of the spindle 27, also has screw threads 72 provided on its outer peripheral surface, said screw threads being of considerably lesser pitch than the screw threads 70 of the spindle or more particularly corresponding to the pitch of the threads of the tapping tool 200. Posts 73 are supported upon the gear casing 22 in proper spaced relation, said posts in turn supporting a stationary member 74 having a hub portion 75 interiorly threaded to receive the collar 71.

At the end of the threaded portion 70 of spindle 27 there is provided a head member 76 of substantially greater transverse dimensions than the diameter of the threaded portion 70 of said spindle, this head member being secured to the spindle in any suitable manner, such as by a nut 77 as shown in the drawings. In the head member a notch 78 is provided, this notch clearly being shown in the Figs. 11 and 12.

A cap 79, of cylindrical formation, fits upon the hub portion 75 of the stationary member 74, said cap having a spiral slot 76a in its annular wall, as shown in Fig. 13. A screw 77a provided with a retainer plate 78a adjacent its head has its shank portion extending through the spiral slot 76a of the cap 79 and threadedly engages the hub 75. When the screw 77a is released the cap 79 may be rotated relative to the hub 75, this spiral slot 76a moving the cap 79 longitudinally relative to the hub 75 due to said rotation. This adjusts the internal extending, annular flange 80 of the cap member 79 rela-

tive to the end of the hub 75. Tightening of the screw 77a will maintain the cap in properly adjusted position on the hub 75. As shown in the Figs. 11 and 12, the screw threaded end 70 of the spindle extends through the opening provided by the annular flange 80 of cap 79, this opening being sufficiently large to admit the head 76 of the said spindle. A longitudinal hole 81 is provided in the end of the collar 71 adjacent the flange 80 of the cap 79, a plunger 82 being slidably supported within this hole, said plunger being urged outwardly by a spring 83.

When the machine is in normal position in which the spindle 27 is in its extreme upper position, the head member 76 of said spindle will be spaced from the upper end of the collar 71 and be located outside the confines of the cap 79 as shown in the Fig. 11. In this instance collar 71 will be held in the stationary member 74 so that its upper end engages the annular flange 80 of the cap 79, this engagement being frictional and sufficient to prevent rotation of said collar with the spindle. Spring pressed plunger 82 engaging the flange 80 is moved completely into the opening 81 and by gripping the said flange 80 assists in holding the collar 71 against rotation.

If the operator now causes the multiple disc clutch of gear 45 to be thrown into engagement by the operation of the lever 58 clockwise about its pin 60, then the motor drive shaft 24 through the gears 25 and 45 will rotate the tubular shaft 29 so that the spindle 27 is also rotated. The collar 71 being held non-rotatable by its frictional engagement with the annular flange 80 of the cap 79 now acts as a nut for the threaded end of spindle 70, and, due to the characteristics of the threads on said spindle, the spindle will be moved downwardly at a comparatively high speed, causing the tapping tool 200, operated by said spindle, to be moved to approach the work-piece. Shortly before the tool engages with the work-piece, the head 76 on the spindle will engage with the collar 71, breaking its frictional engagement with the flange 80 and thus causing the collar to rotate with the spindle, thereby moving the end of the collar away from the annular flange 80. In this instance the stationary member 74 now acts as a nut for the collar 71 which forms a portion of the spindle. As the collar moves from the flange 80, the spring pressed plunger 82 is moved from its opening 81 and enters into the notch 78 in the head 76, thereby positively locking the spindle and collar together. The spindle is now moved by threads 72 in a longitudinal direction into engagement with the work-piece and, due to the fact that threads 72 corresponding in pitch to the threads of the tapping tool 200, the speed of the longitudinal movement of spindle 27 is proper for the tapping operation.

The present machine is provided with means for automatically shifting the driving connections at a proper point in the longitudinal movement of the spindle so that when the thread cutting operation is completed the rotation of the spindle will be reversed. The reversed rotation of spindle 27 causes the collar 71, threadedly engaging stationary member 74, to withdraw the tapping tool from the work-piece at the proper speed. When collar 71 first approaches the annular flange 80 of cap 79 on its upward travel, said flange will engage the plunger 82 and push it into its opening 81 so that the latch will unlock or disconnect the spindle from the collar. As soon as the collar itself engages the flange 80 it will cease to rotate and begin to act as a nut for the spindle and continued rotation of the spindle 27 in this reversed direction then causes the head 76 to break away from the collar. Now the threads 70, with the collar 71 acting as a nut, will move the spindle and its tool away from the work-piece to the normal position at a comparatively high speed. From this it may be seen that the lead screw mechanism controlling the longitudinal movement of the spindle is of such a character that the tool is comparatively quickly moved toward and away from the work, the longitudinal movement of the spindle being at the proper tapping speed while the tool is in engagement with the work-piece.

The mechanism for automatically controlling the power transmitting mechanism will now be described. As shown in Fig. 1, the longitudinally movable spindle has a laterally extending arm 90 attached thereto, said arm being in turn secured to the housing 91 in which the gears shown in Fig. 10 are provided. These gears transmit rotative motion from the spindle 27 to the various shanks 92 of the tapping tools 200. Plate or arm 90 has a rod 94 attached thereto, this rod being slidably supported in an extension 95 provided in the gear case cover. Rod 94 has a lug 96 secured thereto, said lug carrying an adjustable screw 97.

Upon the side of the gear case 92 there is mounted an air cylinder 98 having a piston 99 therein which is yieldably urged into normal position by a spring 100. The portion of the cylinder beneath piston 99 is connected to an air control valve 101 by a pipe 102. This valve 101 is manually operable to control the air from any suitable source of supply flowing to the cylinder 98 whereby said piston may be operated in the direction of the arrows shown in Fig. 6 to move the piston rod 103 toward the operating link 61 which normally is in a position as shown in Figs. 2 and 4. Operating link 61 is, as has been mentioned before, pivotally supported on pin 60. It has an elongated slot 104, into each end of which extends an adjustable screw 105. The

lever 158 secured to rod 60, has a pin 106 which extends into the elongated slot 104 of link 61, so that a lost motion connection is provided between link 61 and lever 158, whereby after said link 61 is operated through a predetermined distance it will carry with it the lever 158.

As shown particularly in Figs. 2 and 4, the operating link 61 with its lever 158 is maintained in normal position by a spring-loaded dog 107 slidably supported in the housing 108 attached to the side of the machine.

Assuming that the operator wishes to set the machine in operation to tap a hole in a work-piece, the air valve 101 is operated to permit air from the air supply to flow through the valve and pipe 102 into the cylinder 98 whereby the piston 99 will be moved against its spring 100 to cause its shaft 103 to engage with the operating link 61, tending to move said operating link upwardly against the dog 107. The link 61 moves a distance in this direction without shifting the lever 158 due to the lost motion connection between said link and lever. Moving upwardly, link 61 moves the dog 107 into its housing 108 against the effect of spring 109, and, when said member 61 reaches a predetermined point on the dog 107, a sloping cam surface on the upper side of said dog will tend to shift the link 61 upwardly very suddenly. In the meantime pin 106 will have been engaged by the lower screw 105 of link 61, and thus lever 158 rotates rod 60, which causes lever 158 to be moved quickly toward the gear 45 whereby its contained multiple disc clutch will connect the driving motor shaft 24 with the spindle 27 through gears 25 and 45 and the tubular shaft 29.

Now the spindle is being rotated so that its thread 70 engaging collar 71 as a nut will move quickly to approach the work-piece. While the spindle is so moving, rod 94 is also being moved downwardly with the spindle so that the block or lug 96 thereon with its adjustable screw 97 will engage the operating link 61 at a proper point in the operation of the machine, this downward longitudinal movement of rod 94 thus moving the link 61 downwardly against the effect of spring-pressed dog 107. When the lower slanting cam surface of this dog engages the link 61, said link will be moved downwardly very suddenly by said spring-loaded dog and thus pin 106 will be engaged by the upper screw 105 of the link 61 so that the lever 158 is moved upwardly whereby the clutch of gear 45 is quickly released and the clutch of gear 31 is caused to be engaged. This connects the spindle with the motor drive shaft 24 through the gears 26, 33 and 31, thereby rotating the spindle in a direction opposite that in which it has previously been rotated. Now the lead screw mechanism will with-

draw the tapping tool from the work-piece at the proper speed, and after such withdrawal the tool will more quickly be returned to its normal position by the screw threads on the spindle. As the spindle moves upwardly, an abutment member 109 with an adjustable screw 110 will engage the link 61 and return it to normal position as shown in Figs. 2 and 4, this return to normal position moving the collar 55 so that the clutches of the respective gears 31 and 45 are both disengaged.

It will be seen that a plurality of adjustments may be made in the machine properly to time its operation. These adjustments comprise the screws 105 on the operating member 61, the adjustable screws on the extensions or abutment blocks 96 and 109a carried by the rod 94, the adjustment of the cap 79 on the stationary member 74 and the adjustment of pressure sleeves 41 and 47 rotatably to vary the position of the angular edges thereof relative to the camming arms 52. This last adjustment is provided for by having notches in the outer peripheral surface of the said pressure sleeves, these notches engaging similar notches in the recessed hubs of their respective gears.

From the foregoing it may be seen that the present invention provides a tapping machine of simple design and sturdy structure, capable of reducing the time of tapping operations to a substantial minimum due to the elimination of time waste in the moving of the tool to approach the work-piece. It will clearly be understood that if the same thread is used for moving the tool toward the work as that for moving the tool into the work, very slow advance by the tool is made, such slow advance requiring considerable time to be wasted by the operator.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle for operating said tool; a power shaft; driving connections between the shaft and spindle; screw-threadedly engaging members on the spindle for moving said spindle longitudinally at different rates of speed in response to rotative motion thereof; one of said members having a screw-threaded engagement with the spindle of a different pitch than its screw threaded engagement with the other member; and means provided on said members for rendering them successively operative.

2. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable

spindle for operating said tool; a power shaft; driving connections between the shaft and spindle; screw-threadedly engaging members on the spindle for moving said spindle longitudinally at different rates of speed in response to rotative motion thereof, one of said members having a screw-threaded engagement with the spindle of greater pitch than its screw threaded engagement with the other member; and means provided on the said members for causing the one having a screw threaded engagement of a greater pitch to move the spindle longitudinally a predetermined distance before the member having threads of lesser pitch becomes effective to move said spindle.

3. In a machine for tapping holes in a work-piece the combination with a tapping tool; a rotatable and longitudinally movable spindle for operating said tool; a power shaft; driving connections between the shaft and spindle; screw-threadedly engaging members on the spindle adapted, in response to rotation of said spindle, to act successively to move the spindle and its tool longitudinally at different rates of speed; and means provided on said members for rendering one of said members inoperative while the other is moving the spindle longitudinally.

4. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle for operating said tool; a power shaft; driving connections between the shaft and spindle; screw-threadedly engaging members on the spindle adapted to move said spindle longitudinally at different rates of speed in response to its rotation, one of said members having a screw threaded engagement with the spindle of greater pitch than its screw-threaded engagement with the other member; and means on said members for rendering them successively operative whereby the spindle and its tool is moved to approach the work-piece at a greater speed than its longitudinal movement while the tool is operatively engaging the work-piece.

5. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle for operating said tool; a power shaft; normally disengaged driving connections between the shaft and spindle adapted to rotate said spindle in one or the other direction; means for engaging one or the other of said driving connections; screw-threadedly engaging members on the spindle all of which are adapted, in response to rotation of the spindle in one or the other direction, to move said spindle longitudinally at different rates of speed in one or the other direction, respectively; and means provided on said members for rendering them successively operative.

6. In a machine for tapping holes in a

work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle for operating said tool; a power shaft; normally disengaged driving connections between the shaft and spindle adapted to rotate said spindle in one or the other direction; means for engaging one or the other of said driving connections; screw-threadedly engaging members provided on the spindle which are adapted to act successively, in response to rotation of said spindle in one or the other direction, to move the spindle longitudinally at different rates of speed in one direction or the other dependent upon the direction of rotation of said spindle; and means provided on said members for rendering one of said members inoperative to move the spindle longitudinally while the other member is effective to so move the spindle.

7. In a machine for tapping holes in a work-piece the combination with a tapping tool; a rotatable and longitudinally movable spindle for operating said tool; a power shaft; driving connections between the shaft and spindle; screw-threadedly engaging members on the spindle adapted to move said spindle longitudinally in response to its rotative movement, one of said members having a screw-threaded engagement with the spindle of greater pitch than its screw-threaded engagement with the other member; and means on said members for rendering the members successively operative.

8. In a machine for tapping holes in a work-piece the combination with a tapping tool; a rotatable and longitudinally movable spindle for operating said tool; a power shaft; driving connections between the shaft and spindle; a member screw-threadedly engaging the spindle; a stationary member screw-threadedly engaging said first-mentioned member; means for holding said first-mentioned member stationary while the spindle is being moved longitudinally in response to its rotative movement and due to its screw-threaded connection with said member; and means for drivingly connecting the first-mentioned member with the spindle for unitary longitudinal movement after a predetermined longitudinal movement of the spindle and in response to its continued rotative movement.

9. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle for operating said tool; a power shaft; driving connections between the shaft and spindle; a collar threaded both interiorly and exteriorly, said collar screw-threadedly receiving one end of the spindle; a stationary member threadedly receiving said collar; means for holding said collar stationary while the threaded connection between the collar and spindle moves said spindle longitudinally in response to its rotation; and means for

drivingly connecting the collar with the spindle for unitary longitudinal movement after a predetermined longitudinal movement of the spindle and in response to its continued rotative movement.

10. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle for operating said tool, a power shaft; driving connections between the shaft and spindle; a collar provided with interior threads of a certain pitch and exterior threads of a pitch differing from the interior threads, said collar receiving the threaded end of the spindle; a stationary member threadedly receiving the said collar; and cooperating means provided on said collar and member for rendering the inner and outer threads of said collar successively operative to move the spindle longitudinally in response to its rotation.

11. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle for operating said tool; a power shaft; driving connections between the shaft and spindle; a collar screw-threadedly mounted upon the one end of the spindle, said collar having screw-threads provided on its outer peripheral surface of comparatively lesser pitch than the inner screw-threads; a stationary member threadedly receiving the collar; means on said member for engaging said collar and preventing its rotation during the initial rotation of said spindle whereby the threads on the spindle and collar will move said spindle longitudinally in response to its rotation; and means for drivingly connecting the collar with the spindle for unitary longitudinal movement after a predetermined longitudinal movement of the spindle and in response to continued rotation of the spindle.

12. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle, screw-threaded at one end and adapted to operate the tapping tool; driving connections between the shaft and spindle; a collar screw-threadedly mounted upon the threaded end of the spindle, said collar being exteriorly provided with threads of a comparatively lesser pitch than its interior threads; a stationary member threadedly receiving the collar; and means carried by the said member for controlling the operation of the collar whereby the engaging threads on the spindle and collar move the spindle longitudinally in response to its rotation, only to cause its tapping tool to approach the work piece, the lesser pitch threads of the collar and stationary member moving the spindle longitudinally during the tapping operation.

13. In a machine for tapping holes in a

work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle, screw-threaded at one end and adapted to operate the tapping tool; an enlarged head secured upon the threaded end of the spindle; a collar having threads provided on its inner and outer peripheral surfaces threadedly mounted upon the threaded end of the spindle; a stationary member threadedly receiving said collar; a cap on said member, having a central opening through which the threaded end of the spindle extends, the annular edge of said cap normally engaging the collar to hold it against rotation whereby, when said spindle is rotated, the engaging threads of the spindle and collar will move the spindle longitudinally until its head engages the collar at which time the collar is disengaged from the cap and the engaging threads of said cap and stationary member then become effective to move the spindle longitudinally.

14. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle, screw-threaded at one end and adapted to operate the tapping tool; a head member attached to the threaded end of the spindle; a collar having interior and exterior threads the former being of comparatively greater pitch than the latter, said collar screw-threadedly receiving the threaded end of the spindle; a stationary member threadedly receiving the collar; a cap on said member, having an inwardly extending, annular flange adapted to engage the collar to hold it against rotation, whereby, when said spindle is rotated, the greater pitch threads on said spindle and collar will move said spindle longitudinally to approach the work-piece at a greater rate of speed than the lesser pitch threads between the collar and stationary member which become effective only after the head member of the spindle has engaged the collar and moved it away from the cap.

15. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle adapted to operate said tool; a power shaft; normally disengaged driving connections between the shaft and spindle, one of said connections being adapted to rotate the spindle in one direction, the other in the opposite direction; means adapted to engage first one then the other of said connections; screw-threads provided at one end of the spindle; a collar having its interior and exterior peripheral surfaces provided with screw-threads, said collar receiving the threaded end of the spindle; a stationary member threadedly receiving the collar; a cap on said stationary member having an inwardly extending annular flange adapted to engage the collar to prevent its rotation with the spindle; a notched head on the end of

the spindle adapted to engage the collar and move it out of engagement with the cap; and a spring pressed latch in the collar adapted to enter a notch in the head of the spindle to lock the spindle and collar together to assure their rotation in unison while said collar is disengaged from the cap.

16. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle adapted to operate said tool; a power shaft; normally disengaged driving connection between the shaft and spindle, one of said connections being adapted to rotate the spindle in one direction, the other in the opposite direction; means adapted to engage first one then the other of said connections; screw-threads provided at one end of the spindle; a collar having screw threads in its inner peripheral surface so that said collar may threadedly be mounted upon the end of the spindle, said collar having screw-threads of comparatively lesser pitch than its inner threads provided in its outer peripheral surface; a stationary member threadedly receiving the collar; a cap on the stationary member having an inwardly extending annular flange normally engaged by the collar releasably to hold said collar against rotation with the spindle; a notched head on the spindle, normally spaced from the collar, but adapted to engage the collar when the spindle moves longitudinally and relatively to the held collar, in response to its rotation by one of the driving connections, said head when engaging the collar, releasing the collar from the cap and gripping it to cause it to turn with the spindle whereby said spindle is moved longitudinally at a slower rate by the threads between the collar and stationary member; a spring pressed latch in the collar released by the disengagement of the collar and cap, and adapted to enter a notch in the head of the spindle to lock the collar and spindle together to assure their unitary rotation, said spindle being reversely rotated when the first mentioned driving connection is disengaged and the other rendered effective whereby the threads between the collar and stationary member will move the spindle longitudinally until the spring latch is disengaged from the spindle head by engagement of the latch with the flange of the cap, at which time said collar is held against rotation by said cap and the threads between the collar and spindle are effective to move the spindle longitudinally at an increased rate of speed.

17. In a machine for tapping holes in a work-piece, the combination with a tapping tool; a rotatable and longitudinally movable spindle adapted to operate said tool; a power shaft; normally disengaged driving connections between the shaft and spindle, one of said connections being adapted to rotate the

spindle in one direction, the other in the opposite direction; means adapted to engage first one then the other of said connections; screw-threads provided at one end of the spindle; a collar having screw threads in its inner peripheral surface so that said collar may threadedly be mounted upon the end of the spindle, said collar having screw-threads of comparatively lesser pitch than its inner threads provided in its outer peripheral surface; a stationary member threadedly receiving the collar; a cap on the stationary member having an inwardly extending annular flange normally engaged by the collar releasably to hold said collar against rotation with the spindle a notched head on the spindle, normally spaced from the collar, but adapted to engage the collar when the spindle moves longitudinally and relatively to the held collar, in response to its rotation by one of the driving connections, said head, when engaging the collar, releasing the collar from the cap and gripping it to cause it to turn with the spindle whereby said spindle is moved longitudinally at a slower rate by the threads between the collar and stationary member; a spring pressed latch in the collar released by the disengagement of the collar and cap, and adapted to enter a notch in the head of the spindle to lock the collar and spindle together to assure their unitary rotation, said spindle being reversely rotated when the first mentioned driving connection is disengaged and the other rendered effective whereby the threads between the collar and stationary member will move the spindle longitudinally until the spring latch is disengaged from the spindle head by engagement of the latch with the flange of the cap, at which time said collar is held against rotation by said cap and the threads between the collar and spindle are effective to move the spindle longitudinally at an increased rate of speed; and means automatically operated by the longitudinal movement of the spindle as it moves to complete the tapping operation for disconnecting the one driving connection and engaging the other whereby the rotation of the spindle is reversed after the said tapping operation for purposes of withdrawing the tapping tool from the work-piece.

In testimony whereof I hereto affix my signature.

GILBERT H. HAGEMAN.

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