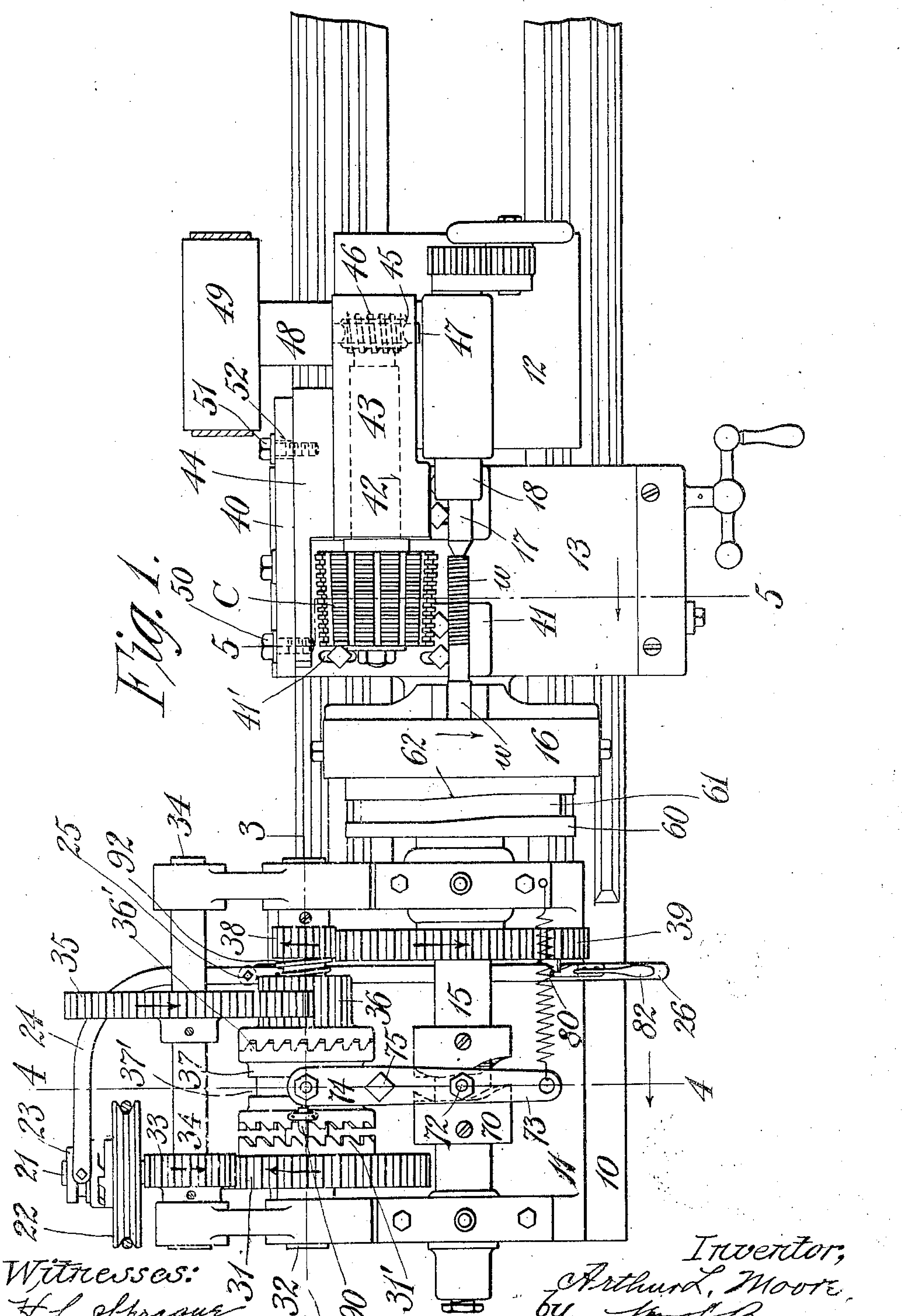
A. L. MOORE.

MACHINE FOR CUTTING THREADS ON SHANKS OF WRENCH JAWS.

APPLICATION FILED JAN. 30, 1908.

920,606. Patented May 4, 1909.

5 SHEETS—SHEET 1.



Witnesses:
H. L. Sprague
R. M. Mowry

Inventor,
Arthur L. Moore,
by W. J. Bellows,
Attorney.

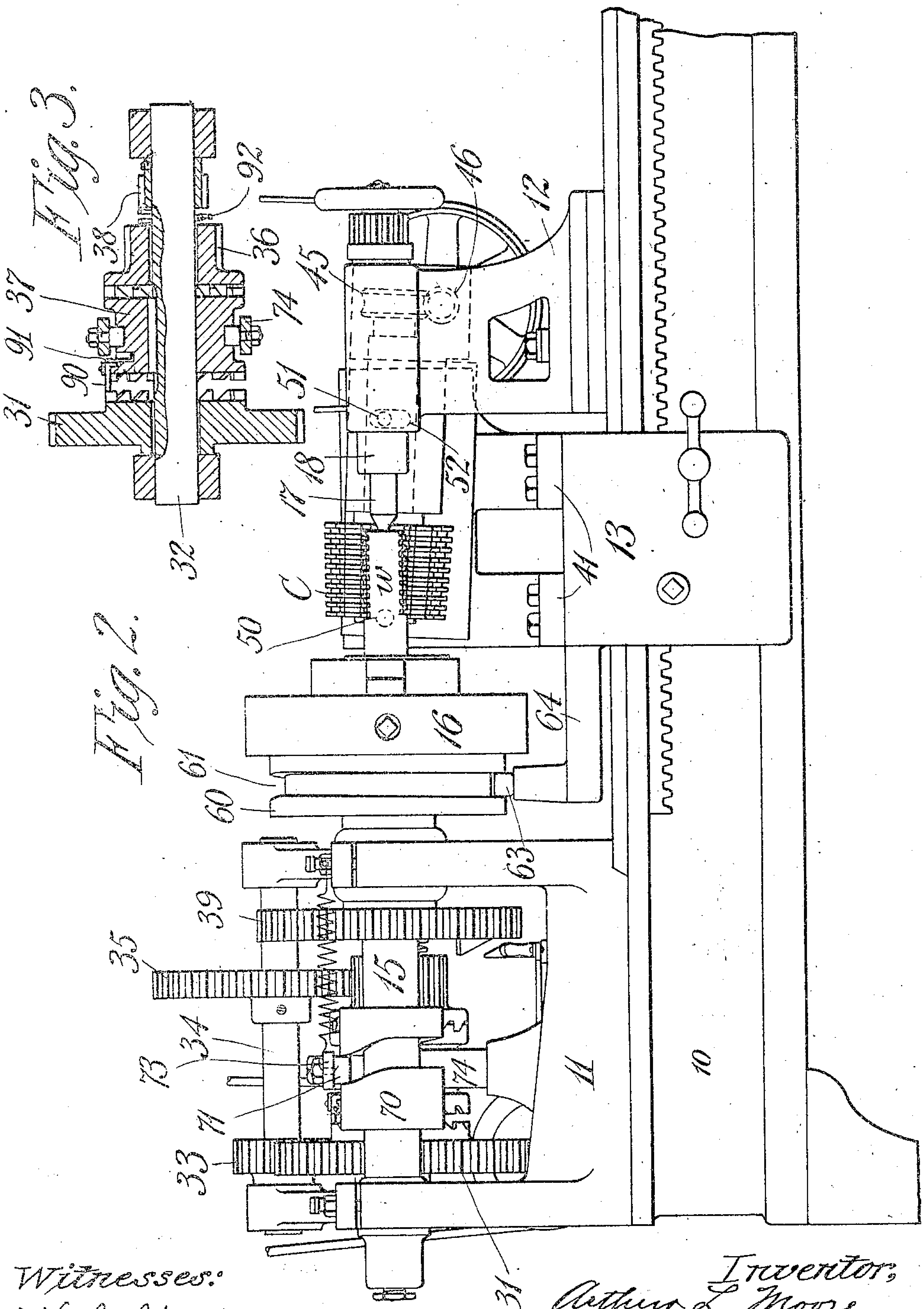
A. L. MOORE.

MACHINE FOR CUTTING THREADS ON SHANKS OF WRENCH JAWS.

APPLICATION FILED JAN. 30, 1908.

920,606. Patented May 4, 1909.

5 SHEETS—SHEET 2.



Witnesses:
H. L. Sprague
R. M. Mowry

Inventor;
Arthur L. Moore,
by Wm. S. Bellows
Attorney.

A. L. MOORE.

MACHINE FOR CUTTING THREADS ON SHANKS OF WRENCH JAWS.

APPLICATION FILED JAN. 30, 1908.

920,606. Patented May 4, 1909.

5 SHEETS—SHEET 3.

Fig. 4.

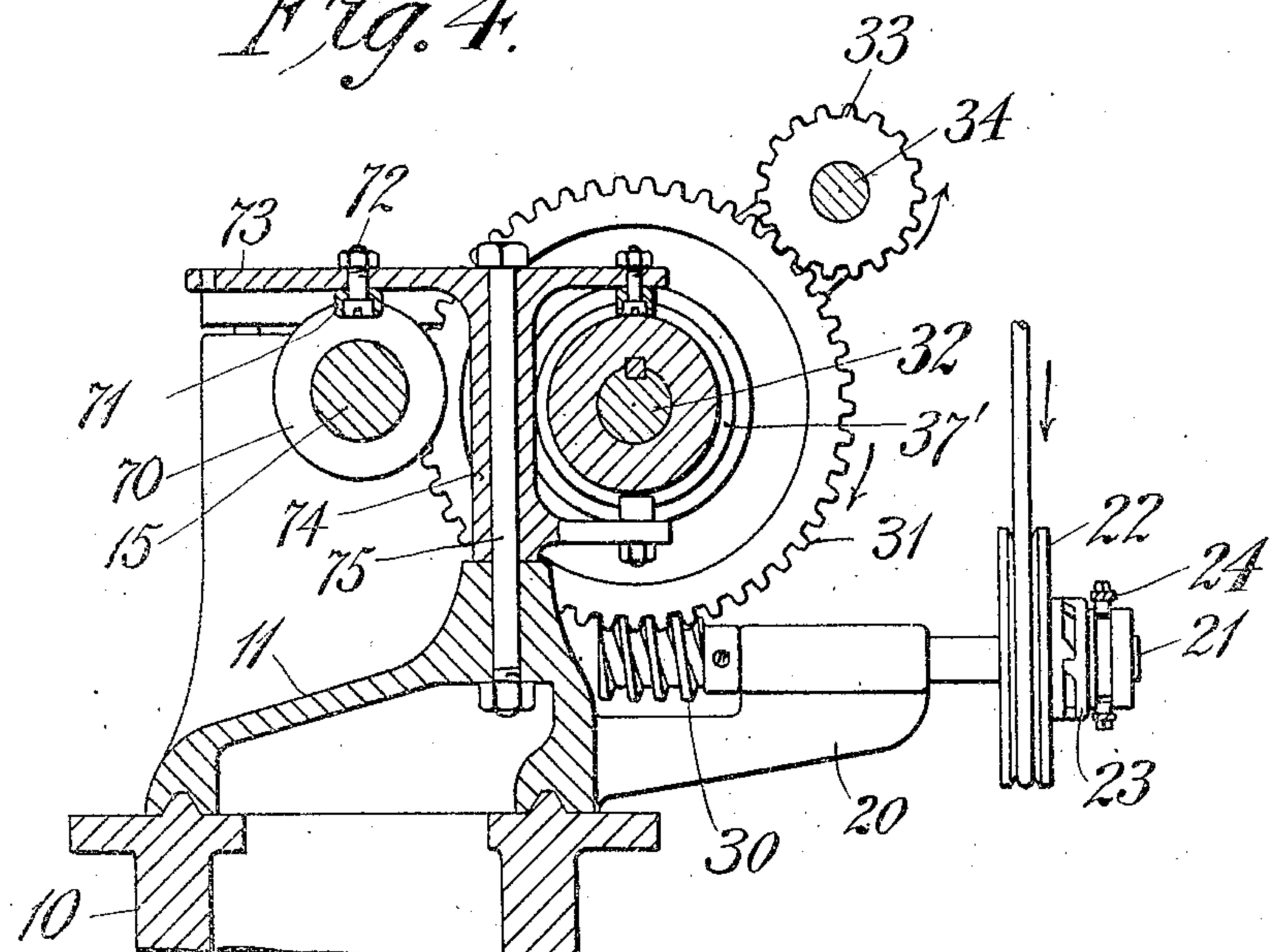


Fig. 5.

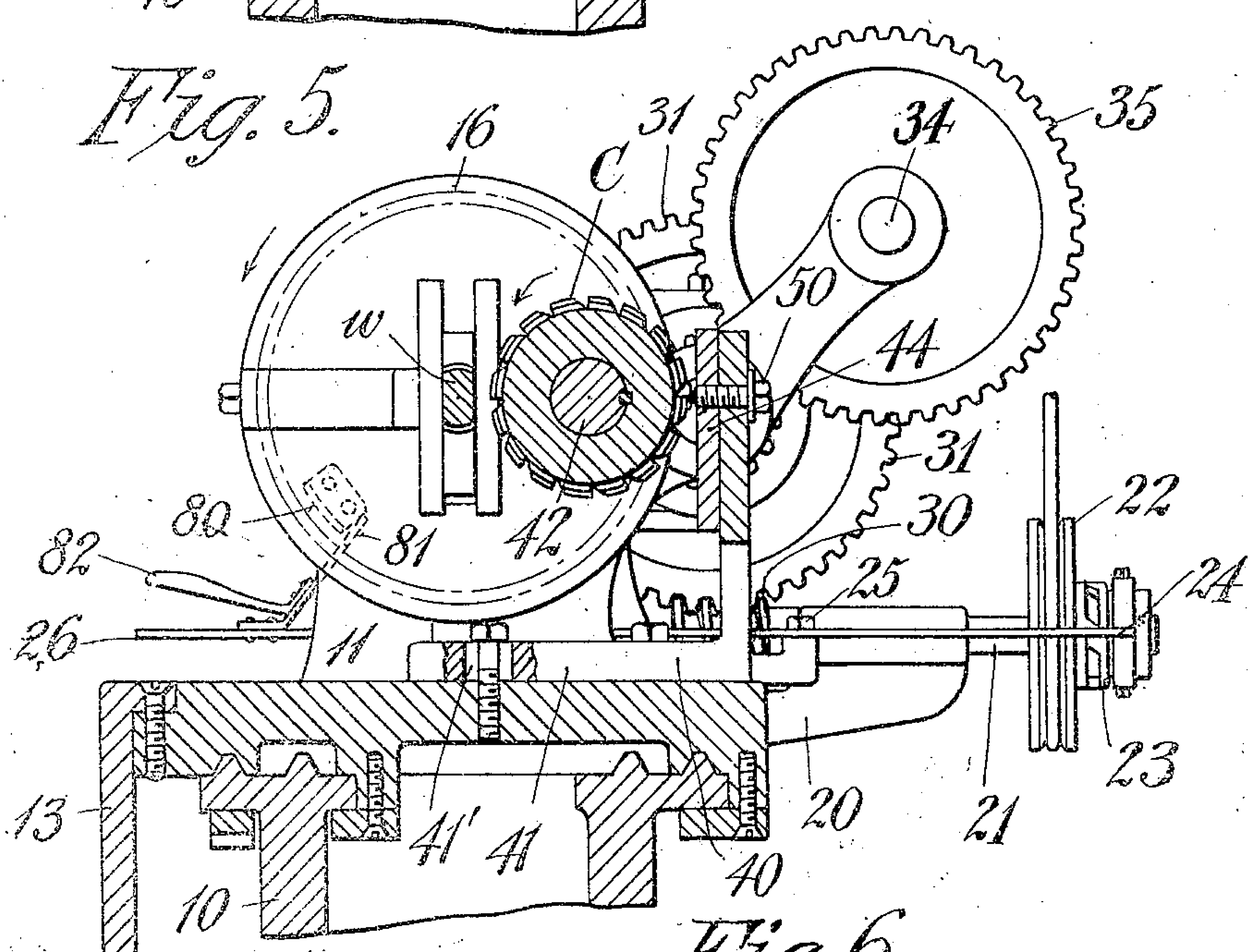
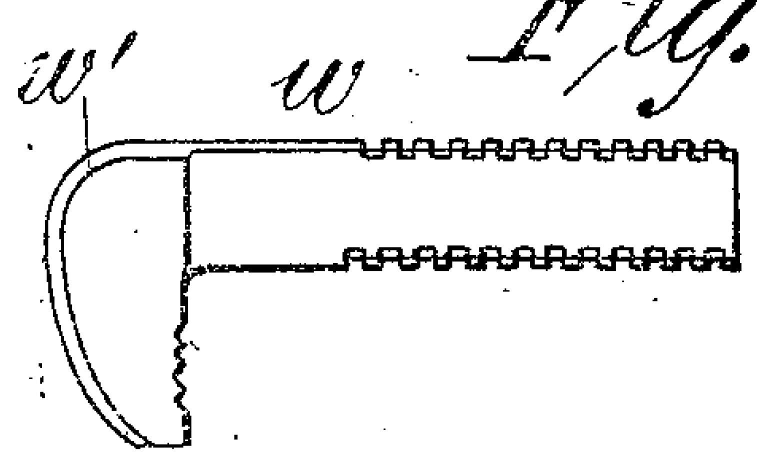


Fig. 6.



Witnesses:

H. L. Sprague

R. M. Mowry

Inventor,

Arthur L. Moore,

by Wm. J. Bellows

Attorney.

A. L. MOORE.

MACHINE FOR CUTTING THREADS ON SHANKS OF WRENCH JAWS.

APPLICATION FILED JAN. 30, 1908.

920,606. Patented May 4, 1909.

5 SHEETS—SHEET 4.

Fig. 8.

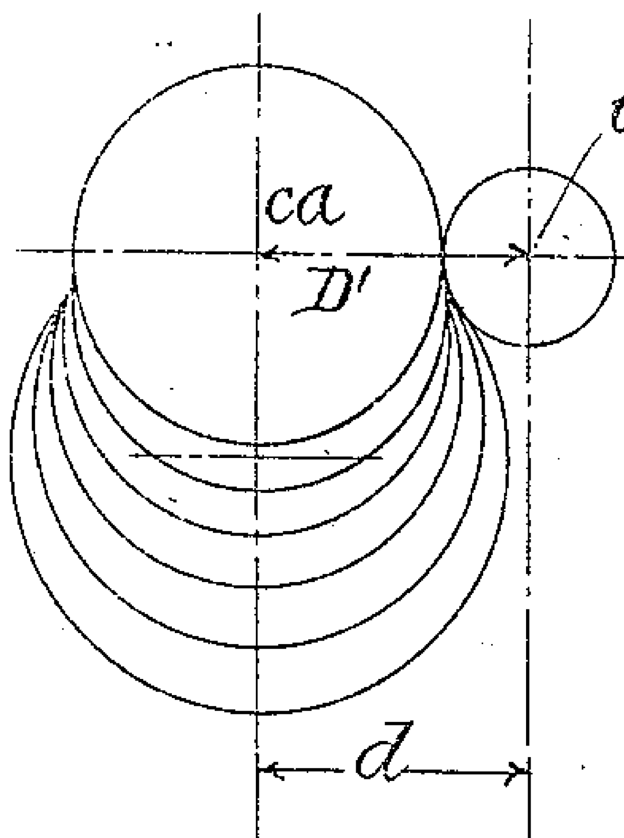


Fig. 7.

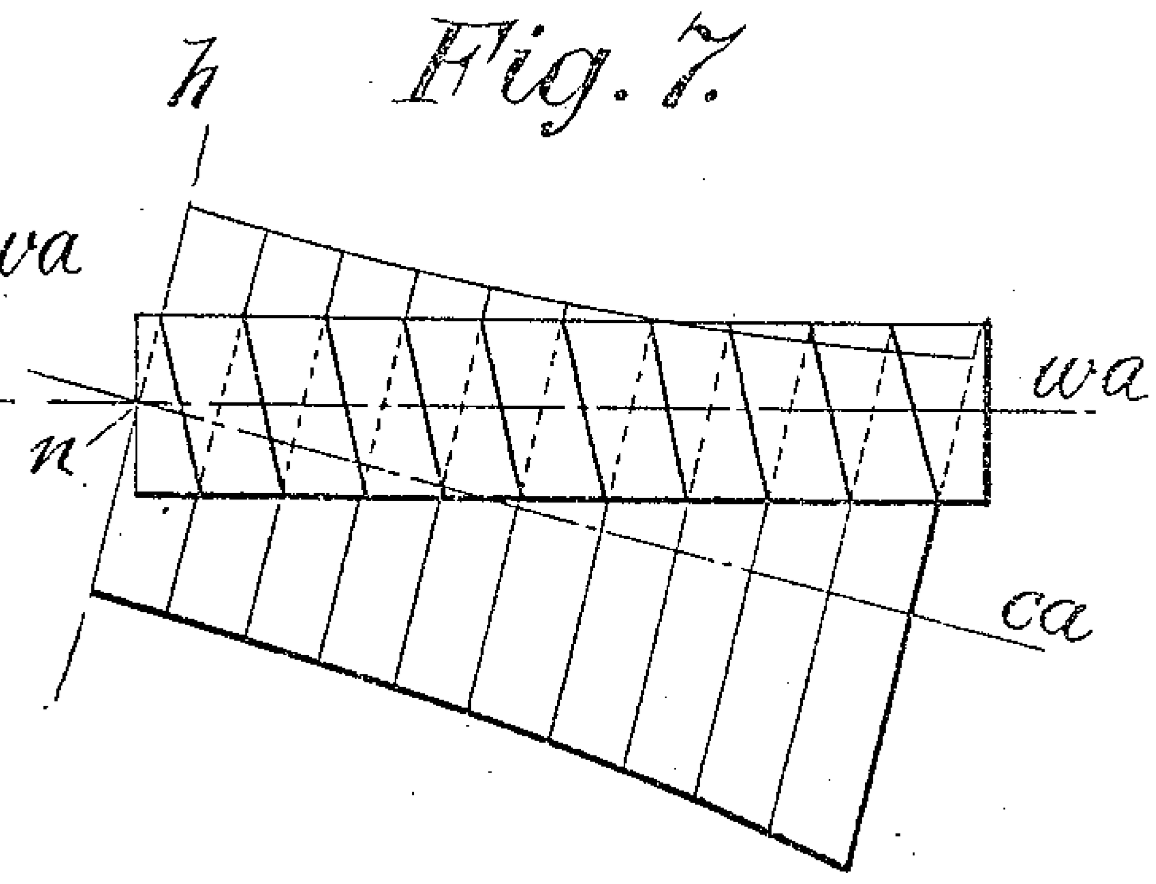


Fig. 9.

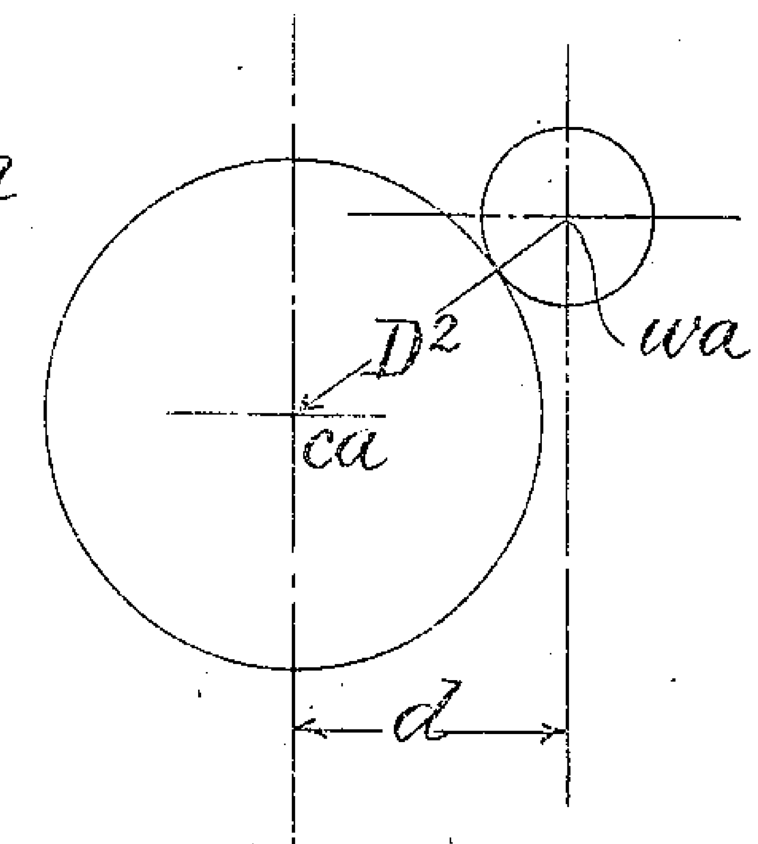


Fig. 11.

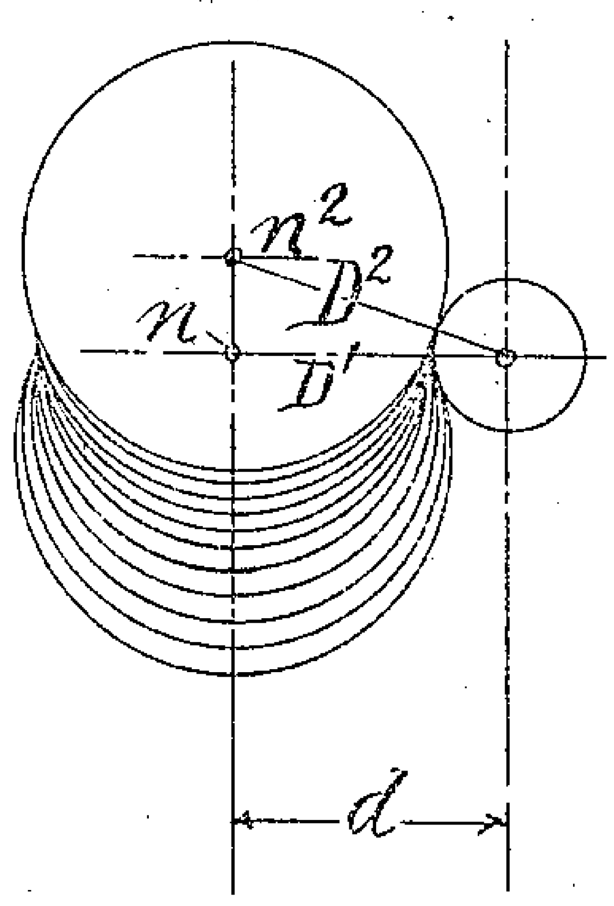


Fig. 10.

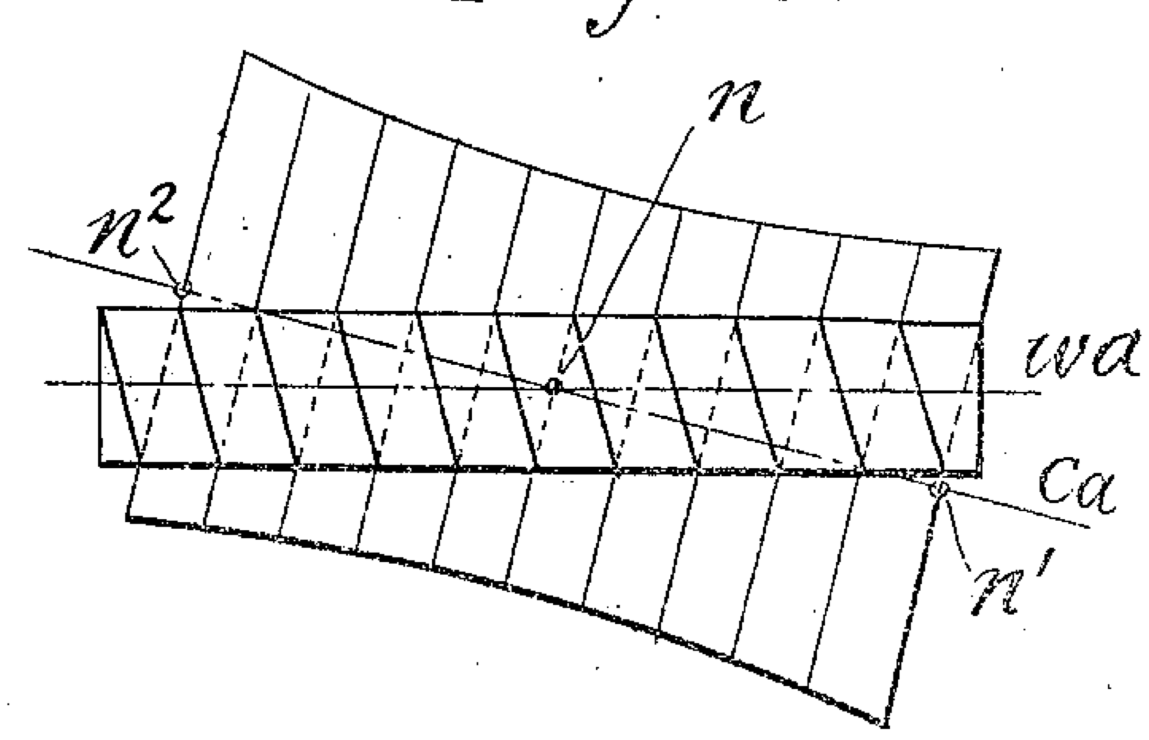


Fig. 12.

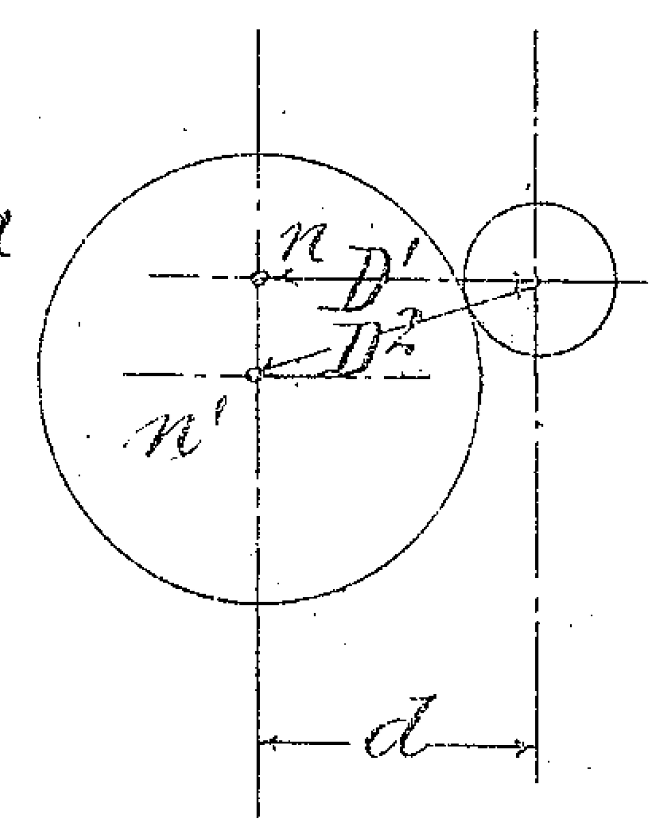
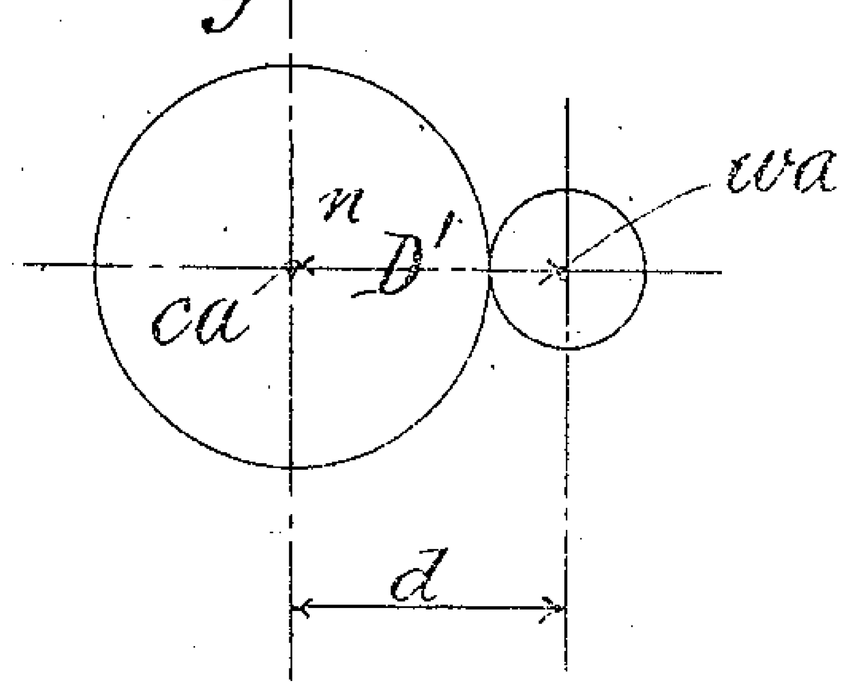


Fig. 13.



WITNESSES:
H. L. Sprague
R. M. Mowry

Arthur L. Moore INVENTOR,

BY Wm. S. Bellows

ATTORNEY.

A. L. MOORE.

MACHINE FOR CUTTING THREADS ON SHANKS OF WRENCH JAWS.

APPLICATION FILED JAN. 30, 1908.

920,606. Patented May 4, 1909.

5 SHEETS—SHEET 5.

Fig. 14.

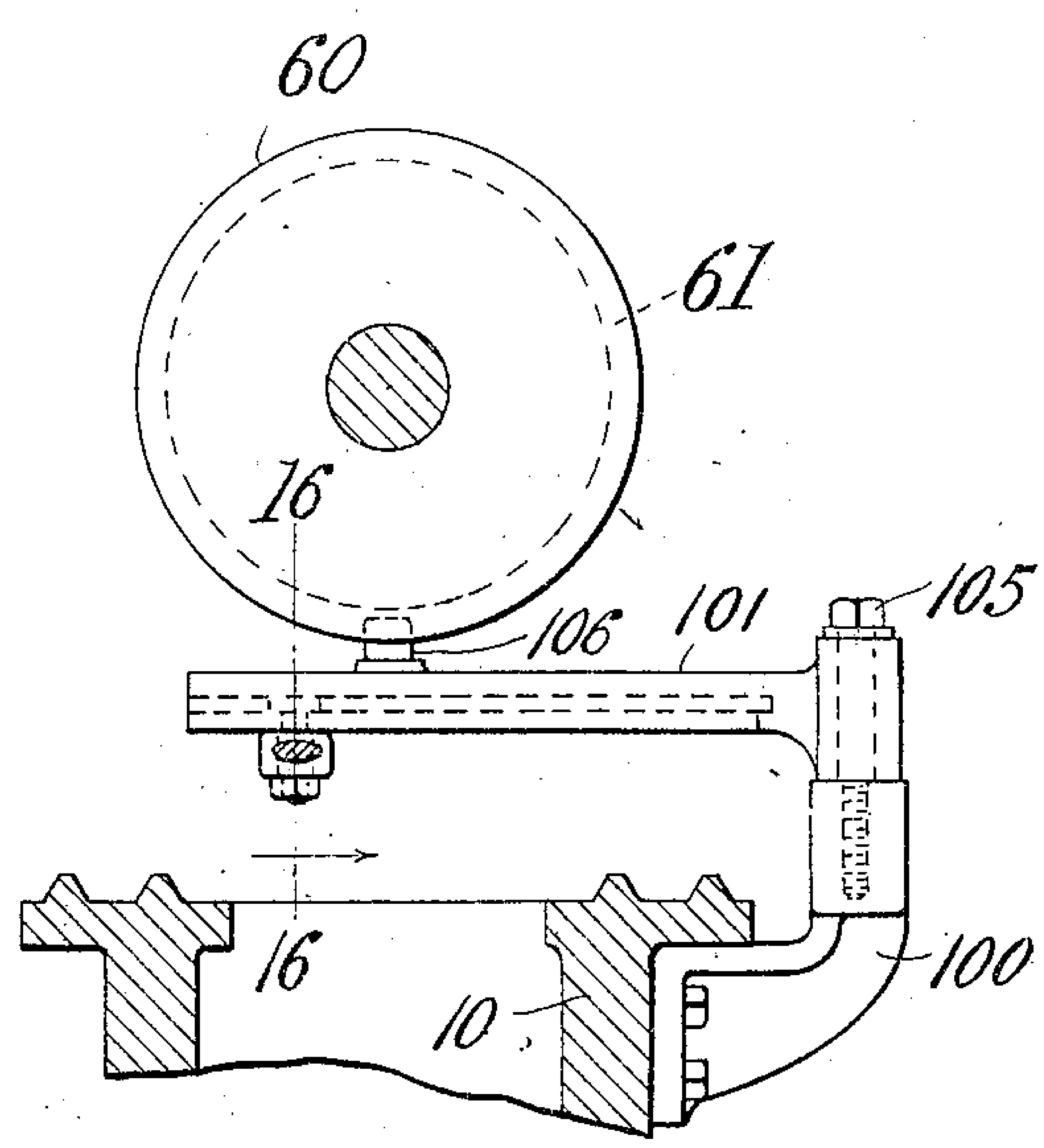


Fig. 15.

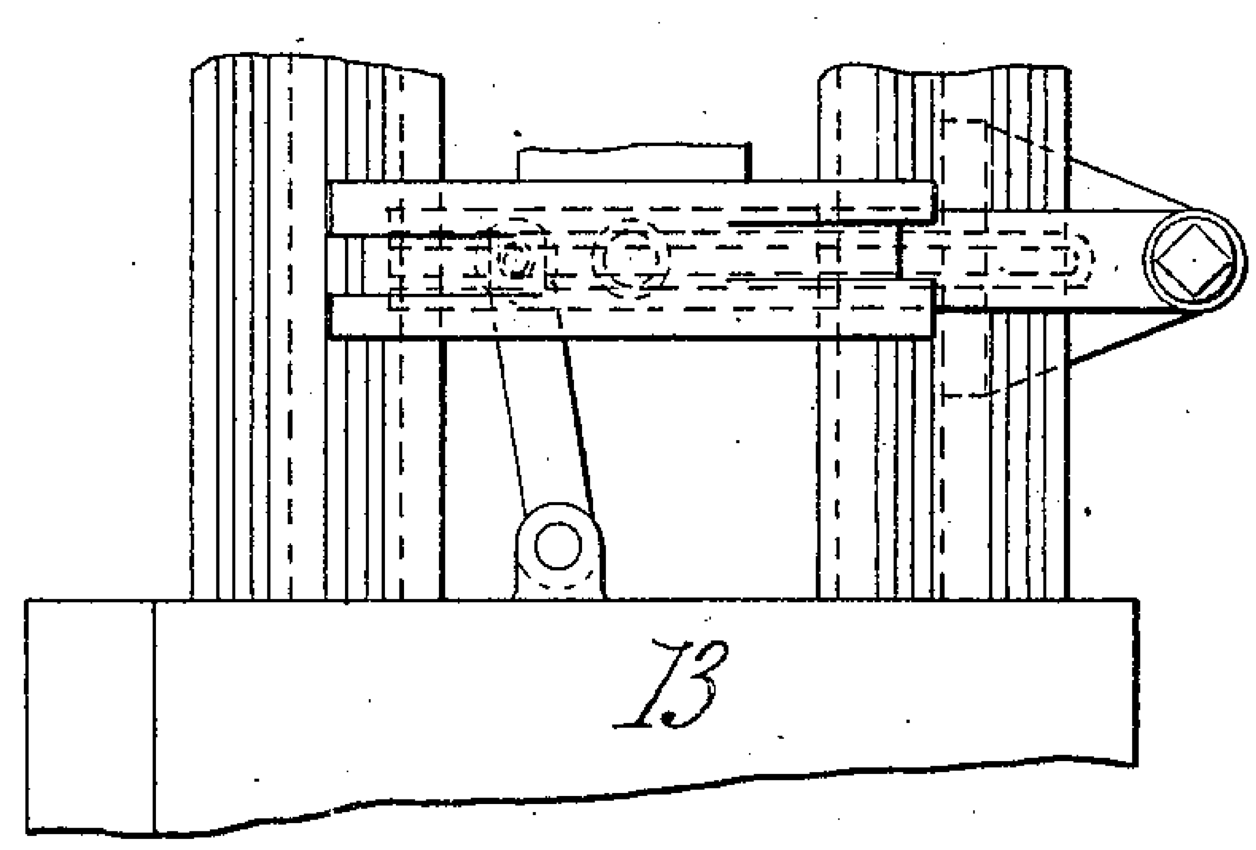
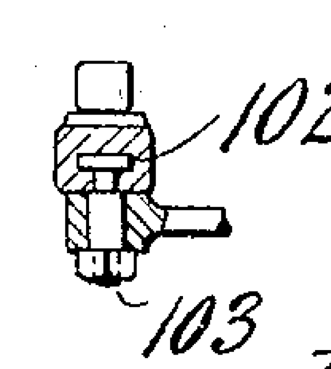


Fig. 16.



Witnesses:
H. L. Sprague
R. M. Mowry

Inventor,
Arthur L. Moore
by Wm. F. Bellows
Attorney.

UNITED STATES PATENT OFFICE.

ARTHUR L. MOORE, OF SPRINGFIELD, MASSACHUSETTS.

MACHINE FOR CUTTING THREADS ON SHANKS OF WRENCH-JAWS.

No. 920,606. Specification of Letters Patent. Patented May 4, 1909.

Application filed January 30, 1908. Serial No. 413,377.

To all whom it may concern:

Be it known that I, Arthur L. Moore, a citizen of the United States of America, and resident of Springfield, in the county of Hampden and State of Massachusetts, have invented certain new and useful Improvements in Machines for Cutting Threads on Shanks of Wrench-Jaws, of which the following is a full, clear, and exact description.

This invention relates to metal-working machines, and more especially to that class thereof in which the work to be operated upon is supported for rotation, and the tool is carried on a suitable support; and it has for one of its objects the provision of a machine of this character in which a series of screw-thread convolutions are cut in the work during a single rotation thereof.

My invention has, furthermore, for its object the provision of means for periodically increasing or decreasing the rotative speed of the work-support during the non-cutting and the cutting operation, respectively, of the tool.

A further object of the invention resides in the provision of a multiple or "gang" tool for cutting the work at a number of different places longitudinally thereof, simultaneously.

My invention has, also, for its object the combination, with the work support and the tool holder, of means for moving one of these elements relatively to the other longitudinally of the rotation-axis of the work in accordance with the "pitch" of the groove to be cut.

Another object of the invention is the provision of improved means for automatically arresting the rotative movement of the work at the end of each rotation.

My invention has, furthermore, for its object, the combination, with a rotatable tool-spindle, of means for varying the inclination of its axis relative to the rotation-axis of the work so as to conform to the angular pitch of the thread or groove to be cut.

Other objects of the invention will hereinafter appear, and the means for their attainment be particularly pointed out in the claim.

My invention has been clearly illustrated in the accompanying drawings, in which similar characters denote similar parts, and in which—

Figure 1 is the top view of a machine embodying my improvements; Fig. 2 is a front elevation thereof; Fig. 3 shows a section on line 3—3, of Fig. 1; Fig. 4 is a section on line 4—4, of Fig. 1; Fig. 5 represents a section on line 5—5, of Fig. 1; Fig. 6 shows a sample of the work adapted to be operated upon by the machine; and Figs. 7 to 13 inclusive are diagrammatic views for explaining the operation of the cutting tool. Figs. 14 to 16 inclusive illustrate a modification of the mechanism for shifting the tool support, which in the present instance can be adjusted for various throws, Fig. 14 being a cross section of the bed of the machine substantially in line with the shifting cam; Fig. 15 represents a top view thereof, and Fig. 16 is a section on line 16—16, Fig. 14.

Briefly stated, the present machine is designed particularly to cut the screw-threads on the shank of a wrench-jaw, such as illustrated in Fig. 6, and which has flat or plain sides, so that when the shank is being operated upon by the tool, a great waste of time during the ordinarily slow rotation of the shank would necessarily result.

In the present machine the wrench-jaw is placed into a chuck, which is rotated at a slow speed while the cutters are forming the threads in the edges of the shank; and this speed is changed into a rapid one as soon as the cutters have ceased cutting and are non-operative. The organization of the machine is such that ~~all the~~ threads are cut into the shank at the same time, and one rotation thereof is sufficient to finish the work.

In view of the fact that the jaw shank has two flat sides, the chuck spindle has two feed or slow-speed movements, and two idle or fast-speed periods alternating with the slow speeds, during each complete rotation, and the change from one speed to the other is automatically effected and controlled by a member on the chuck spindle. After each complete rotation of the latter, the power-driven pulley is disconnected, thus leaving the spindle at rest and permitting the finished or threaded jaw to be replaced by another to be cut.

Referring to the drawings, 10 denotes the bed of the machine which, in general, is preferably similar to an ordinary engine lathe, and has a head-stock 11, a tail stock 12, and a slide rest 13. The head stock 11 has suitable bearings for the main spindle 15 which is provided at its inner end with a two-jaw chuck 16, adapted to engage the head w' of the jaw-blank or work w (see Fig. 6); while the center 17 of the tail-spindle 18 serves to support the other and free end of the blank.

Rotary movement is imparted to the spindle 15 by the following mechanism: Secured to the rear of the head-stock 11, is a bracket 20 which constitutes a bearing for a shaft 21 carrying, near its outer end, a normally-loose pulley 22, the hub of which is provided with clutch teeth adapted to be engaged by similar teeth on a slip-collar 23 which is keyed to the shaft 21 and is adapted to be moved longitudinally thereon by means of a shipper lever 24 fulcrumed at 25 and having at its forward end a handle 26 for hand manipulation. The inward end of the shaft 21 carries a worm 30 in engagement with a gear 31 which is loosely supported on a spindle 32 and in mesh with a pinion 33 fixed on the rear spindle 34, both spindles being journaled in ears projecting from the head stock 11. Also firmly secured to the spindle 34, is a gear 35 meshing with a pinion 36 which is loose on the spindle 32, and is provided with clutch teeth 36; while the gear 31 above mentioned has clutch teeth 31′. Interposed between these clutch teeth 31′, 36′, is a clutch collar 37 keyed to, and slidably supported on, the spindle 32, so that by this means either one or the other of the loose gears 31, 36, may be coupled to the spindle 32.

It will now be seen that, by virtue of the gear train above described, the pinion 36 will be constantly driven by the movement of the shaft 21 but at a great deal higher rate of speed than the gear 31. From this it follows, that by shifting the clutch collar 37 either to the right or the left, the speed of the spindle 32 will be high or low, respectively, and consequently operate the main spindle 15 at a proportionate rate through a pinion 38 fast on the spindle 32 and in engagement with the main gear 39 secured upon the spindle 15.

The tool whereby the threads are cut into the edges of the blank, consists substantially of a series of cutters similar to those employed in connection with milling machines, these cutters being spaced to conform with the required "pitch per inch"; and, in order to give to them the necessary "lead" longitudinally of the axis of the work so as to cut a uniform and true helix, means are provided for shifting the cutters longitudinally for a space equal to one pitch-distance, during one complete rotation of the work. This organization is preferable in the present instance, inasmuch as it is more convenient to permit the head and tail-stock of the machine to remain stationary, while the tool carrier can readily be mounted on the slide rest. On the other hand it should be distinctly understood that this construction may be reversed, viz: that the tool spindle may be stationary and the work may be properly advanced as is the usual practice in milling machines.

Referring to the drawings, it will be seen that the slide-rest 13 carries at its rear end a knee or bracket 40, the feet 41 of which are slotted, as at 41′ to permit adjustment of the cutter relative to the work so as to vary the depth of the cut as required.

The cutter consists in the present instance of a multiple or gang miller, designated in general way by C, and rigidly secured upon a spindle 42 which is journaled in a bearing 43 of a plate 44, and carries at its other end a worm gear 45 engaged by a worm 46. This worm is secured to a power shaft 47, journaled in a bearing 48 of the plate 44 above mentioned, and carrying a pulley 49 to which power may be imparted from any convenient source.

The position of the axis of the cutter-spindle 42 relative to the rotation-axis of the work spindle 15 is such as to permit the cutters to cut the thread-grooves according to the required angular pitch, a feature which is especially illustrated in the diagrams of Figs. 7 to 13 inclusive. The thread which is, in the present instance, to be cut into the work, is of the "square" variety, in contra-distinction to the common V thread. Hence the working face of the cutter is also formed square, and the cutter-axis and the work axis are consequently disposed in parallel planes, as can be seen in Fig. 1. On the other hand, the position of each cutter-disk must necessarily conform to the angular pitch of the thread-helix which is to be cut; in other words: the plane of rotation of the cutter must conform and correspond to the amount of inclination of the groove-helix indicated by dotted lines *h* in Fig. 7., so that consequently, the rotation axis of the cutter (which needs be at right angles with the side plane of the disk) will be disposed at an angle relatively to the rotation axis of the work, as can readily be seen in Figs. 2 and 7. I have, therefore, a pair of coördinate axes which are oblique relative to each other, inasmuch as they are transverse, but non-intersecting.

In Fig. 8 I have shown an end view diagram of the first cutter and the work, and in Fig. 9 a diagram of the last cutter and the work is shown. By a comparison of these two figures it will be seen that the distance *d* between the planes of the cutter-axis *c a* and the work-axis *w a*, is the same; while the actual and direct distance between these axes, indicated by D^2 in Fig. 9 is greater than that indicated by D′ in Fig. 8. Now, inasmuch as the diameter of the work naturally must remain the same, it follows that the last cutter (in order to cut the work properly) must necessarily be greater in diameter than the first. In other words, we find that the cutter located at the "point of closest approach" between the two axes, is the smallest, this point being in the present instance on a level plane with the axis of the work (see Figs. 2 and 7.) It is, of course, evident that the same principle applies, whether the end-cutter axis is on a plane with the work-axis (as above described), or whether the "point of nearest approach" is disposed intermediate the end limits of the threads of the work, this latter condition being illustrated in Figs. 10 to 13 inclusive. Here the "point of nearest approach" is at n, and the cutters increase in size toward the ends, in both directions, the only difference being that in the end view (Fig. 11) the axis point n^2 is disposed above the level of the point n while in Fig. 12 the point n' is below the same, so that in this instance the cutters form a double cone instead of a single one as above. Means are provided for variably positioning the cutter-axis relative to the work-axis so as to adapt the machine for cutting different angular pitches, these means consisting substantially in pivotally supporting the plate 44 on the knee 40, as at 50, this point being on line with the "point of nearest approach" between the two axes, and the plate 44 carries a clamping bolt 51 (see Figs. 1, 2) which passes through a concentric slot 52 in the knee 40 and whereby the entire device may be firmly held in position.

In the operation of milling a screw thread into a non-shiftable but rotating piece of work, two factors must be taken into consideration for the proper operation and adjustment of the cutter, viz, firstly: the "pitch distance" which is determined by the "number of threads per inch", and secondly: the "angular pitch" which depends upon the "pitch distance" taken in connection with the diameter of the work, it being evident that, (the "pitch distance" being the same) the larger the diameter of the work is, the less will be the angular pitch of the thread, and vice versa. Of these two factors, the second one (the angular pitch) has been disposed of as above; while the first-named factor (the pitch distance) as far as it concerns the operation of the cutter, yet remains to be dealt with.

The object of the cutter is: to cut a helical groove, the advancing travel of which, longitudinally of the work-axis, is constant and uniform during each and all of the several consecutive rotations of the work. In the present instance where the work does not shift longitudinally, it follows, therefore, that some means must be provided to shift the cutter for an amount equal to one pitch-distance during each revolution of the work, and, inasmuch as I employ a "gang" cutter whereby all the thread-convolutions are cut to a finish at one and the same time, I have provided a mechanism whereby the work is rotated only once, during which time the slide-rest, with the cutter, is shifted in automatic and constantly-progressive manner and at the prescribed ratio. This mechanism includes a cam 60 having a helical groove 61 and a quick-return movement section 62, (see Fig. 1) and secured to the main spindle 16. Entering said groove 61 is a roller 63 (see Fig. 2) which is journaled on a stud held on extension 64 of the slide rest 13. The quick-return movement is rendered possible by virtue of the fact that the cutter is not actively engaged during the entire rotation of the work, which as has been above stated, has two flat sides (see Fig. 5) so that the peripheral travel of the work will be approximately one-sixth cut, two-sixths idle, one-sixth cut, and two-sixths idle, in the order named; and it is during one of the idle periods that the return takes place, and the machine brought to a stop for the purpose of allowing the operator to remove the cut blank, and put in a new one to be cut.

From the foregoing it will be understood that, when a thread of a different pitch is to be cut, the cam 60 may be replaced by another having the required helical groove. It is, furthermore, obvious that, in view of the fact that one revolution of the work is, in the present instance, sufficient to finish the threads to their full depth, the peripheral speed of the work must needs be very slow so as to afford to the milling cutter an opportunity to do its work without liability of breakage, and, inasmuch as a space of only about two-sixths of the periphery of the work is operated upon, it follows that during its idle travel considerable time would be wasted, and the capacity or output of the machine be naturally and unnecessarily decreased. For this reason I have provided means whereby the rotative movement of the work will be accelerated during the idle periods, these means preferably including the high-speed gear train 31, 33, 35, 36, and the clutch collar 37 above described, which latter is shifted to operate the main-spindle 15 either at the high or the low speed, by a cam 70 properly positioned on the spindle 15 and preferably of the grooved variety to render the shifting of the collar 37 positive and at the proper time, the cam acting upon a roller 71 (see Fig. 4) journaled on a stud 72 held on an arm 73 of a bifurcated shipper lever 74, in engagement with the groove 37' of the collar 37, and pivoted on a stud 75 secured to the head stock 11.

In the drawings the machine is shown in a position in which the main spindle is run under high speed, the cutter is non-operative, and the power-drive is about to be disconnected. This latter function is accomplished by a "knock-out" member or cam plate 80 secured to the side of the main spindle-gear 39 and adapted to actuate a leaf 81 which is attached to the end of the shipper lever 24, and may, when desired, be swung backward and out of the way of the cam 80 by a handle 82. Now it will be noticed that the operation of the main spindle 15 depends entirely upon the shaft 32 which carries the clutch-collar and is, in itself, free from both of the actuating gears 31, 36, which, as above stated, are loose upon it, but are running as long as the power pulley 22 is running and operatively connected with the shaft 21. Under these conditions it is evident that, when the clutch collar 37 is in its central or neutral position, the gear 31 and pinion 36 are both running idle, and the shaft 32 is, therefore, not driven, and consequently the main spindle 15 is liable to be also at rest, so that the clutch cam 70 becomes useless as far as causing a shift of the clutch collar 37 is concerned. In order to avoid this difficulty, and to throw the burden of stopping the machine entirely upon the shipper lever 24, I provide means for rotating the clutch collar at all times, at least under slow speed, these means consisting of a pilot member or bolt 90 which is carried by the clutch collar and is adapted to engage the clutch teeth 31′ of the gear 31 even before the clutch teeth 36′ of the pinion are free from the clutch collar, and the latter is still driven under high speed. In order to permit the bolt 90 to "click by" the teeth 31′ while the collar is yet running under high speed, the bolt 90 is brought into contact with said teeth by a yielding force, as for instance a spring 91.

It has been above stated that the cam 70 operates to shift the collar 37 in a positive manner, and, inasmuch as it may happen that when this collar is shifted to the right, (into contact with the high speed pinion), its clutch teeth may strike on top of the teeth 36′. In order to obviate breakage of the mechanism under such causes, I deem it advantageous to provide a spring 92 so that the pinion 36 may first yield and then quickly return to its engaged position.

In Figs. 14 to 16 inclusive, I have shown a modification of the mechanism actuating the tool support slide 13, the construction in the present instance permitting a variation of the throw or movement of said slide to correspond to different pitch distances or threads to be cut into the work *w*. In this case the bed 10 has at its rear side a bracket 100 on which is fulcrumed a lever 101 provided with a **T**-slot 102 for the reception of a clamp bolt 103 which may be moved relatively to the fulcrum bolt 105. The cam 60, the groove 61 of which is in engagement with a roller 106 journaled on a stud which is carried by the lever 101, will for this reason be enabled to shift the slide for distances which vary in accordance with the position of the stud 103 relative to the fulcrum stud 105, so that in this instance the helix cam 16 need not be replaced by another to vary the movement of the slide for different pitch distances of the thread in the work.

I claim:—

1. The combination, with a rotatable work-carrier and a tool support, of a pair of normally loose gears each having clutch teeth, means for rotating one of said gears at a slow rate of speed, means actuated by this gear for rotating the second gear at a higher rate of speed, a shiftable clutch sleeve operatively connected with the work-carrier and having teeth adapted to engage the clutch teeth of either of said gears, means controlled by the carrier-movement and for shifting said clutch sleeve into engagement with said gears alternately to drive the work-carrier at different speeds during each rotation thereof, and means for rotating the clutch sleeve during the shifting movement and non-driving period thereof.

2. The combination, with a rotatable work-carrier and a tool support, of means for driving the work-carrier at different speeds during one rotation thereof, said means including a pair of normally loose gears each having clutch teeth, means for rotating one of said gears at a slow rate of speed, means for rotating the second gear at a higher rate of speed, a shiftable clutch sleeve rotatively connected with and for driving said work-carrier and having teeth adapted to engage said gears alternately, means controlled by the rotative movement of the sleeve and for shifting the same in opposite directions during one rotation of the work carrier, and yielding means controlled by the clutch sleeve for rotating said sleeve during the shifting movement and non-driving period thereof.

3. The combination with a rotatable work-carrier and a tool support, of means for driving the work-carrier at different speeds during one rotation thereof, said means including a pair of normally loose gears each having clutch teeth, means for rotating one of said gears at a low rate of speed, means for rotating the second gear at a higher rate of speed, a clutch sleeve having teeth adapted to engage said gears alternately, means controlled by the carrier-movement and for shifting said clutch in opposite directions, and a yielding bolt carried by said sleeve and for engaging the clutch teeth of the slow gear during the shifting movement of said clutch sleeve from the high speed gear to the slow speed gear.

4. The combination, with a rotatable work-carrier, and a tool support, a shaft operatively connected with the carrier, a pair of clutch members loose on said shaft, means for driving said members at high and low speeds, respectively, a clutch device interposed between said clutched members and rotatively held on and with said shaft, means for automatically shifting said device alternately into engagement with said clutch members, and a yielding device for connect-

ing said clutch device with the slow speed member during its partial disengagement from the high-speed member.

5. The combination, with a rotatable work-carrier, and a tool support, of a clutch sleeve connected with and for rotating the carrier, a pair of normally loose clutch members, means for driving the same at slow and high speeds, respectively, positive means controlled by the work carrier for shifting said clutch sleeve into engagement with either of said clutch members, and a pilot-bolt carried by the clutch sleeve and adapted to engage the slow-speed member before its complete disengagement from the high-speed member.

6. The combination, with a rotatable work-carrier and a tool support, of a clutch sleeve rotatably connected with the carrier, a pair of normally loose clutch members, means for driving the same at slow and high speeds, respectively, positive means controlled by the work-carrier for shifting said clutch sleeve into engagement with either of said clutch members, and a pilot-bolt carried by the clutch sleeve and adapted to be engaged by the slow-speed member to actuate said clutch sleeve, and before its complete disengagement from the high-speed member, and means for permitting the high-speed member to yield during its reëngagement with the clutch sleeve.

7. The combination, with a rotatable work-spindle, of a normally dle shaft operatively connected with the work-spindle, means for driving said shaft at different speeds during one rotation thereof, a power shaft for actuating said driving means and comprising a clutch pulley, a lever for connecting and disconnecting said pulley with and from said mechanism, and a cam carried by the work spindle for moving said lever to disconnect the pulley from the power shaft near the end of each complete rotation of the work spindle.

8. The combination, with a rotatable work-carrier, a rotatable spindle, and a series of cutters mounted thereon and for cutting helical grooves in the work in the carrier, of means controlled by the work-carrier for imparting one complete reciprocation to the cutter for the amount of one pitch distance during one complete rotation of the carrier.

9. The combination, with a rotatable work-carrier, a rotatable spindle, and a series of cutters mounted thereon for cutting helical grooves in the work in the carrier, of a cam on the work spindle and directly connected with the cutter support for imparting a complete reciprocation to the cutter for the amount of one pitch distance during one complete rotation of the carrier.

Signed by me at Springfield, Mass., in presence of two subscribing witnesses.

ARTHUR L. MOORE.

Witnesses:

WM. S. BELLOWS,

G. R. DRISCOLL.