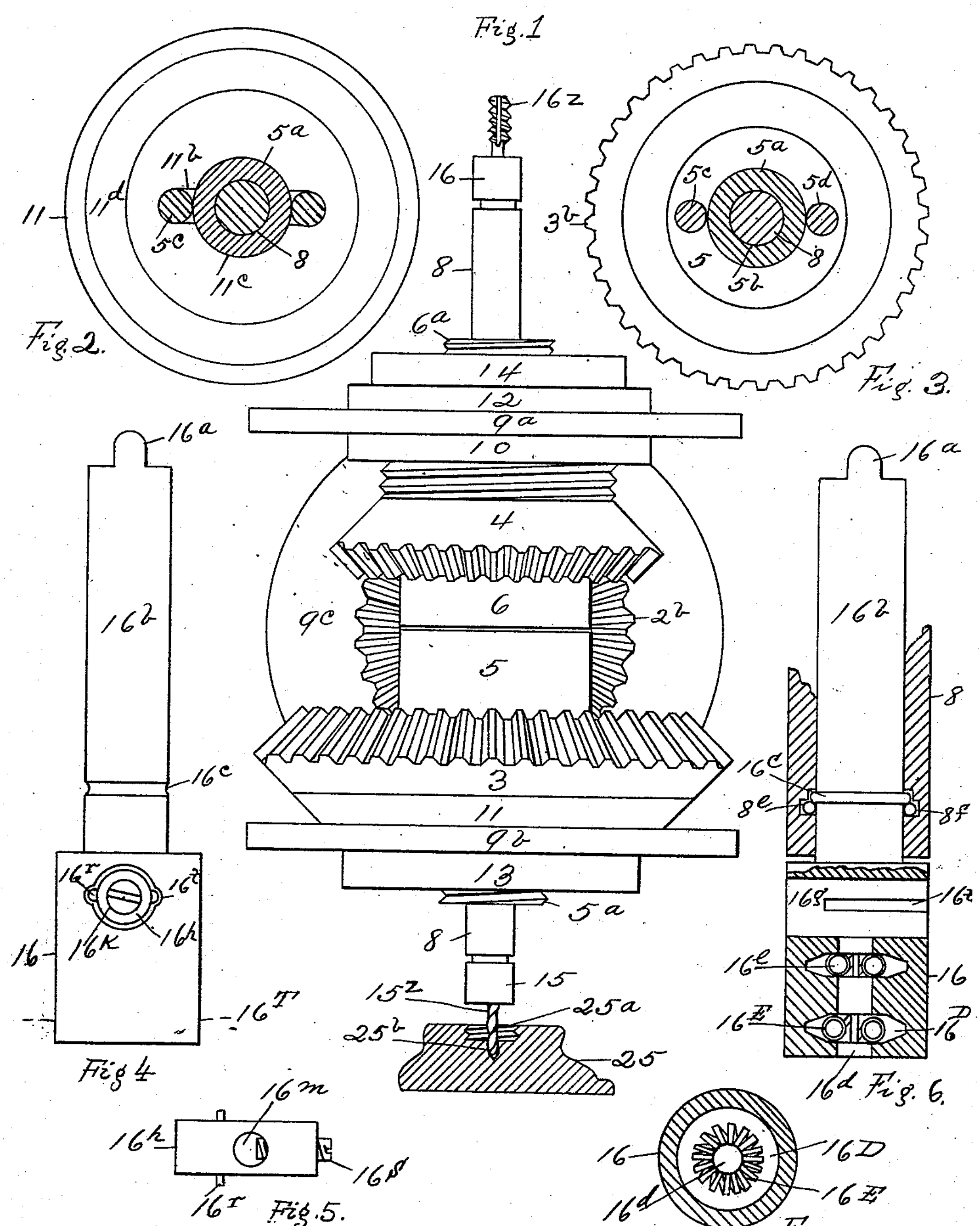
(No Model.)

2 Sheets—Sheet 1.

F. A. ERRINGTON.

CONCENTRIC DRILLING AND TAPPING MACHINERY.

No. 578,484. Patented Mar. 9, 1897.



Witnesses

Inventor

F. A. Errington

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

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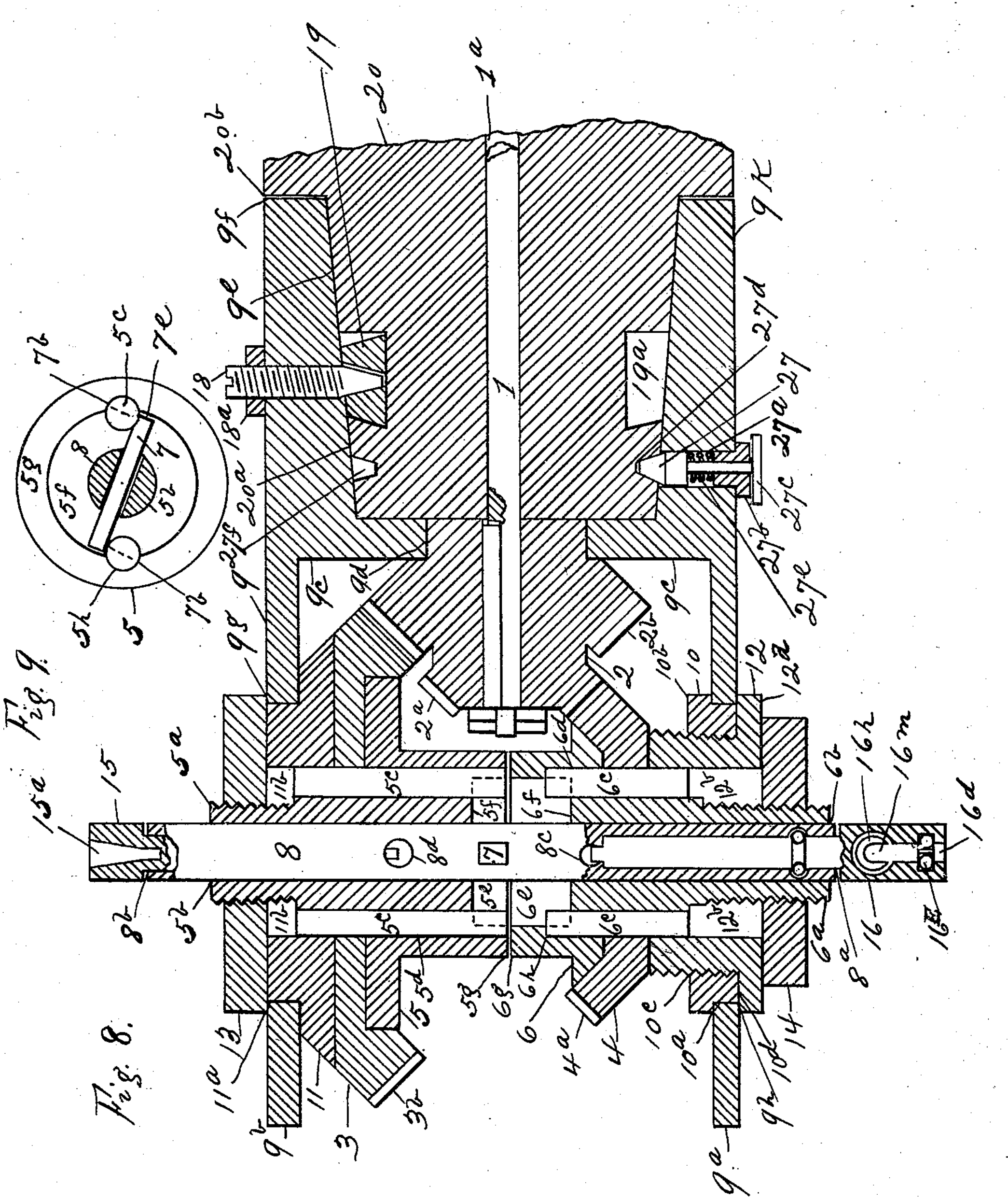

Fig. 8.

Fig. 9.

WITNESSES:

D. E. Roberts

Wm Whitlock

INVENTOR

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UNITED STATES PATENT OFFICE.

FRANKLIN A. ERRINGTON, OF EDGEWATER, NEW YORK.

CONCENTRIC DRILLING AND TAPPING MACHINERY.

SPECIFICATION forming part of Letters Patent No. 578,484, dated March 9, 1897.
Application filed October 25, 1895. Serial No. 566,803. (No model.)

To all whom it may concern:

Be it known that I, FRANKLIN ALFRED ERRINGTON, a citizen of the United States, residing in the village of Edgewater, (post-office, Stapleton,) county of Richmond, and State of New York, have invented certain new and useful Improvements in Concentric Drilling and Tapping Machinery, which I desire to secure by Letters Patent of the United States, as described and shown in the following specification and drawings and then pointed out in the claims.

My invention relates, broadly, to means for rotating a spindle in opposite directions or for turning the opposite ends of said spindle alternately in the same direction without reversing the direction of rotation of the primary driving member of the gear-train, means for bringing the opposite ends of said spindle to bear alternately upon the same point, and means for locking said spindle in position to preserve its axial alinement with said point, combined with means for readily connecting and disconnecting a cutting-tool with said spindle, means to avoid breakage of the cutting-tool when bottoming or under excessive strain, and gripping and centering means to avoid breakage of said cutting-tool under variation in the alinement of the driving-spindle and the point of operation.

The primary object of my invention is to perform in one handling of the work the two consecutive operations productive of one result at or in the same point, place, or bore, the first of said operations being a preparation for the second, and the second necessitating the automatic cessation of the rotation of the cutting-tool at the bottom of the hole or under an undue increase of strain and the reversal of its direction of rotation. However, these means are also useful as enabling both ends of the same spindle to be used for either one of said operations at the same point by swiveling the head or at two opposite points without swiveling the head, and in all cases without reversing the direction of rotation of the primary driving member of the gear-train; and to these ends the said invention consists in the novel details of improvement and the combination of parts herein shown and described.

Reference is to be had to the accompanying drawings, forming part hereof, wherein—

Figure 1 is a front elevation of the swivel-head 9 in the position for drilling. Fig. 2 is a reduced top view of check-nut 11, showing a method of connecting said check-nut with the driving-disk 5. Fig. 3 is a reduced top view of the driving gear-wheel 3, showing the central bore 3^a encircling the hub 5^a of the driving-disk 5, whereby said wheel is enabled to rotate independently of the parts it drives by frictional contact. Fig. 4 is an external view of the tap-holder, showing the end of the sliding nut, a set-screw meshing with its concentric screw-threaded bore, and the grooves in the transverse bore 16^g to receive the pins 16^r of the sliding nut that prevent its rotation and limit its traverse in said transverse bore of the tap-holder. Fig. 5 is a bottom view of the sliding nut, showing the transverse bore 16^m for admitting and the set-screw 16^s for gripping the head of the tap. Fig. 6 is a sectional view of the tap-holder, showing the slideway for the projecting pins of the sliding nut and for the nut itself, also the self-centering adjustable collet spring or springs to aline the tap with the spindle and yet allow of a limited deviation in the alinement of the hole with the driver of the tap without breaking the tap, also a variation in the construction of the groove in the socket of the driving-spindle and in the shank of the tool-holder. Fig. 7 is a horizontal section of the tap-holder on the line 16^T of Fig. 4, exposing the collet-spring, which is preferably shown endless in construction by joining the two ends together. Fig. 8 is a vertical cross-section of the parts in position for tapping, exposing the clutch-pins and general mechanism for driving and reversing the spindle 8 and adjusting the frictional contact of the disks and gear-wheels. Fig. 9 is an end view of the central portion of the inner face of disk 5, showing the spindle cross-bar in engagement with the clutch-pins, the lines of strain, and the method of supporting the clutch-pins and of limiting the longitudinal movement of the spindle while giving it the longest possible bearing.

For convenience in manufacture the swivel-head 9 is shown in one casting (see Fig. 1) having top and bottom arms 9^a 9^b and a back plate 9^c, forming a gear-case to receive the driving mechanism; and for convenience in showing a connection for said head by a swivel-joint with a supporting part I have shown tapered bore 9^e in the extension 9^k of the swivel-head casting to receive the tapered projection 20^a of a supporting-frame 20, said projection terminating in a shoulder 20^b. To hold the swivel-head firmly in alinement with said projection 20^a, the screw-threaded taper-pin 18 presses a tapered roller 19 against the outer walls of the groove 19^a, and thereby forces the rim 9^f toward the shoulder 20^b, which arrangement compensates for any wear in said bearing and preserves the alinement of the head with its supporting-frame. As the groove 19^a extends entirely around the projection 20^a, said swivel-head can rotate freely thereon.

The outer face of the friction-disk 5 is shown provided with an externally-screw-threaded hub 5^a. An axial bore 5^b runs through said disk 5 and its hub 5^a to form a bearing for the spindle 8, said spindle 8 being shown provided with a cross-bar 7, passing through its axis and projecting on both sides beyond its periphery, the length of said cross-bar 7 being greater than the diameter of the bore 5^b to prevent said spindle falling through its bearings. On either side of the bore 5^b I bore in the inner face of the disk 5 two clutch-bearings 5^d, which I preferably carry entirely through said disk, the centers of said clutch-bearings being located on the same diameter of the disk 5 and at an equal distance from the center thereof, said distance being proportionate to the length of the spindle cross-bar 7. I then recess the inner face of the disk 5 by forming a central bore 5^e therein, the diameter of the bore 5^e exceeding the length of the spindle cross-bar 7 sufficiently to permit the entrance of the latter into the recess thus formed in the inner face of the disk 5.

I preferably make the diameter of the bore 5^e equal to or slightly exceeding the distance between centers of the two clutch-bearings 5^d, which cuts away the inner walls of said clutch-bearings 5^d, leaving the clutch-bearings opening partly upon the bottom 5^f of the recess 5^e and partly upon the inner face 5^g of the disk 5. Having preferably shown the shortest distance between the inner walls of the clutch-bearings coinciding with the diameter of the hub 5^a, when I now drive the clutch-pins 5^c into the bores 5^d until their inner faces are even with the plane of the inner face of the disk 5 their outer extremities will project from the outer face of the disk 5 and form lugs projecting laterally from the periphery of the hub 5^a. As previously stated, the bore 5^e having cut away the inner walls of the clutch-bearings 5^d, the inner ends of the clutch-pins 5^c project longitudinally into said recess or clutch-chamber 5^e from the bottom or face 5^f thereof, and laterally from its walls, forming clutch teeth or faces in the inner face of the disk 5.

I do not restrict my invention to the distances I have preferably described and shown, as these may vary and still attain the object of this unique construction, which will be more clearly understood by reference to the parts shown in Fig. 9, where it is seen that while the clutch-pins are sufficiently exposed to act in their full capacity as clutches in either direction in accordance with the exacting requirements of the conditions, yet in the construction shown the peripheries of the clutch-pins opposite their clutch-faces remain embedded in the walls of the recess, thereby relieving the clutch-pins of all shearing strains, which strains they transmit to the supporting-walls of the recess to be distributed through the disk itself, leaving the clutch-pins subjected to a compression strain only, said clutch-pins acting as hardened and readily-removable clutch-faces between the spindle-clutch 7 and the disk 5 to relieve said disk from wear and to enable said disk to drive said spindle with the power of a solid ring or body, thus increasing the driving ability of the clutch-pins many times over that obtained by the use of clutch-pins not so supported, particularly when the strain is entirely exerted at or near their extreme ends, as occurs when the clutches are about to separate.

As indicated in Fig. 9, the lines of strain 7^b vary in direction as the clutch-faces or points of contact 7^c between the cross-bar 7, and the periphery of the clutch-pins 5^c may vary from those I have preferably shown, the aim being to so proportion the bore 5^e to the distance between centers of the clutch-bearings 5^d as to have the clutch-pins 5^c receive the maximum support by their beds 5^h and still present an open clutch-face to mesh with the spindle-clutch. The round form of clutch-face in combination with the rectangular cross-bar also serves to give the maximum lateral bearing for rotating the spindle with the least frictional surface to resist the longitudinal movement of the cross-bar when the latter is sliding out of rotary engagement, which feature is an important factor in permitting the use of the readily-removable tool-holder provided.

The center of the gear-wheel 3 is bored out to afford a central passage-way to permit said gear-wheel 3 to be slipped over the hub 5^a and its projecting lugs 5^c, thereby bringing the inner face of said gear-wheel in contact with the outer face of the disk 5. The check-nut 11 is similarly provided with a central bore 11^c, but only of sufficient diameter to permit the free passage of the hub 5^a, the two lugs 5^c being received in separate slots 11^b, provided on either side of said bore for that purpose, the depth of said slots 11^b being sufficiently greater than the projection of the lugs 5^c into them to prevent the lugs 5^c from reaching the plane of the outer face of the check-nut 11, even under the maximum compression of the parts, as hereinafter provided for. The check-nut 11 being now slipped over the hub 5^a and its lugs, the inner face of said check-nut comes in contact with the outer face of the gear-wheel 3, and the lugs 5^c being a sliding fit in the slots 11^b the check-nut 11 and the disk 5 form two friction-disks placed on either side of the gear-wheel 3 and are positively connected to rotate together by a central connection which not only permits of their longitudinal movement independent of each other, but the independent rotation of the gear-wheel 3 should the frictional tension between the parts be unable to overcome the strain brought to bear upon the clutch mechanism connected with disk 5. The construction of such a slip-joint between the two disks to connect them to rotate together is broadly valuable as leaving the intermediate wheel 3 free to have gear-teeth 3^b or be otherwise used without interference. To form a journal for the parts, the check-nut 11 is provided with a hub 11^a, extending from the surface 11^d of said check-nut. The hub 11^a is now inserted in the bore 9^g of the arm 9^b of the swivel-head 9 and the screw-threaded adjusting-ring 13 screwed upon the hub 5^a, and said adjusting-ring being of greater diameter than the diameter of the bore 9^g the parts are held in position by the surface 11^d of the check-nut 11 on one side of the arm 9^b and the inner face of the adjusting-ring 13 on the other. The bevel-gear driving-pinion 2 is next placed in position by its hub engaging with the bore 9^d in the back plate 9^c of the swivel-head 9, its gear-teeth 2^b meshing with the gear-teeth 3^b of wheel 3, and the connecting driving-shaft 1 is run through the bearing 1^a in the supporting-frame 20, keyed to said driving-pinion by the usual feather and groove, and prevented from longitudinal movement by its screw-threaded ends meshing with the usual jam-nuts, which details may be of usual or approved construction for forming said connection.

The reversing-wheel 4 is to be turned at a higher velocity and less power is required of it than of the wheel 3. The driving bevel-pinion 2 is therefore preferably shown provided with an additional set of bevel-gear teeth 2^a, the two sets of teeth 2^a 2^b lying in parallel planes at the same angle to the axis of said pinion 2, the plane of the gear-teeth 2^b being within that of the gear-teeth 2^a. By this arrangement the gear-wheels 3 4 are rotated in opposite directions at the same time and at different velocities by pinion 2, the pinion 2 running at all times in the same direction, and each of the gear-wheels 3 4 having its direction of rotation reversed as its position is changed from above to below the pinion 2, or vice versa, which fact brings clearly to view that the clutch mechanism must be adapted to exert lateral pressure in either direction, as its driving-wheel happens to be on one side or the other of the driving-pinion or one end or the other of the spindle is being used in one or the other direction, and that the opposite ends of the spindle can be used in the same or opposite directions of rotation at the same point by swiveling or at opposite points without swiveling without in either case reversing the direction of rotation of the driving-pinion 2, and that the opposite ends of the same spindle cannot be used even in the same direction at the same or opposite points without reversing the driving member, except in the construction I have shown, which distinguishes my invention broadly from the previous state of the art as applied to using both ends of the same spindle, and also as applied to using one end of the spindle in opposite directions.

The duplication of the simple hub 11^a and the general construction of the check-nut 11 of wheel 3 being impracticable for the wheel 4 in the device shown, I have supplied the internally-threaded bearing-ring 10, having a smooth periphery 10^a and a flange or shoulder 10^b projecting therefrom and corresponding to the flange or shoulder 11^d and hub 11^a of the check-nut 11, and an externally-threaded check-nut 12, meshing with said internally-threaded bearing-ring 10 and terminating in a flange or shoulder 12^a. I first place the bearing-ring 10 in the bearing 9^h of the arm 9^a of the swivel-head 9. Then the reversing-disk 6 and the gear-wheel 4 are inserted therein by the hub 6^a passing loosely through the screw-threaded bore 10^c of the bearing-ring 10. The bearings 5^b 6^b are then brought in line, the spindle 8 is passed through them, and the cross-bar 7 inserted in the transverse bore 7^a. The screw-threaded check-nut 12 is now screwed through the bearing-ring 10 until its shoulder 12^a jams with the outer face 10^d of the bearing-ring 10, which arrangement raises the inner face of the disk 6 close to the corresponding face of the disk 5 and brings the gear-teeth 4^a of the wheel 4 into mesh with the gear-teeth 2^a of the pinion 2 and prevents any longitudinal variation of the gear-wheels with relation to their respective bearings. The screw-threaded adjusting-ring 14 is then screwed on the externally-threaded hub 6^a and adjusts the frictional tension between the parts, as heretofore explained with reference to adjusting-ring 13. The opposing surfaces of the disks 5 6 are shown relieved, thereby reducing the diameter of their inner faces, which preferably bear upon each other when the tension of the contact of the frictional surfaces is relaxed.

Instead of boring the clutch-bearings 6^d from the inner face of the reversing-disk 6 I bore them from its outer face in a similar manner and at the same distance between the centers as in the case of the clutch-bearings 5^d; but as the bores 5^d were carried through to the inner face of disk 5 the bores 6^d are not carried through to the inner face of disk 6, being terminated at a shoulder 6^h, which gages the distance between the ends of the clutch-pins 5^e 6^e to bring the inner ends or opposing surfaces of one of said sets of clutch-pins within the plane of the inner face of its respective disk. The inner face of the disk 6 is now recessed by a bore 6^e of the same diameter but of greater depth than the bore 5^e in disk 5, said bore 6^e opening the clutch-bearings 5^d upon the bottom 6^f of the recess 6^e in a similar manner as previously explained in relation to disk 5. The clutch-pins 6^c are now driven into their bearings 6^d until their inner ends abut against the shoulders 6^h, when the distance between the inner ends of the clutch-pins 6^c 5^c should be greater than the height of the clutch 7 of the spindle 8 to permit said clutch to clear one set of clutch-pins before engaging the other; and the inner ends of the clutch-pins 6^c project longitudinally beyond the bottom or face 6^f of the recess or clutch-chamber 6^e and laterally from its walls in the same manner as previously explained with reference to the clutch-pins 5^c, the clutch-pins 6^c being similarly relieved from shearing strain by being similarly embedded in the outer walls of their bearings 6^d through the whole extent of their projection beyond the bottom 6^f of the recess 6^e. The outer extremities of the clutch-pins 6^c form lugs upon the periphery of the hub 6^a, pass through a central bore in the wheel 4, and mesh with slots 12^b, all as previously explained for clutch-pins 5^c. The faces or bottoms 5^f 6^f of the recesses 5^e and 6^e limit the longitudinal movement of the spindle-clutch 7, the bores 5^e 6^e being of sufficient diameter to permit of its free rotation, and the walls of said bores hold said spindle-clutch 7 from longitudinal movement through its transverse bore 7^a, permitting said cross-bar 7 to be a loose fit therein, if desired.

To bring each end of the spindle 8 to register with the same point, I have shown a tapered locking-pin 27 carried in a screw-threaded bore 27^a in the extension 9^k of the swivel-head 9, said locking-pin 27 being adapted to mesh with a tapered bore or bores 27^d 27^f, shown in the projection 20^a of the supporting-frame 20; and to press said pin into said bore a screw-threaded cover 27^b is screwed into said bore 27^a and a spring 27^e inserted between said cover and the outer face of the locking-pin 27. To withdraw said locking-pin from the bore 27^d, the rod and button 27^c are connected with said locking-pin, and by pulling the button and rod 27^c the locking-pin 27 is withdrawn from the bore 27^d, and as the swivel-head is swung around it will press against the periphery of the projection 20^a until the tapered bore 27^f is reached, when it will slide into said bore, its taper fitting firmly against the tapering sides of said bore, bringing the other end of the spindle 8 to register with the same point that the opposite end was formerly working upon.

It being desirable in a tool or machine of this kind to connect and disconnect the cutting-tool with the spindle 8 while said spindle is rotating, I provide axial bores or sockets 8^a 8^b in the respective ends of said spindle, running well up toward the center cross-bar 7, but terminating at a sufficient distance therefrom to avoid weakening the spindle unnecessarily. A short distance beyond the end of the said socket 8^a 8^b I bore transverse holes 8^c 8^d of smaller diameter than that of the sockets 8^a 8^b, and connect said transverse holes 8^c 8^d with the sockets 8^a 8^b by punching through the intervening metal preferably with a rectangular punch of about the length of the diameter of the sockets 8^a 8^b and the transverse thickness of the diameter of the transverse bores 8^c 8^d, whereby the bores 8^c 8^d are connected with the sockets 8^a 8^b by a transverse slot affording a plane bearing-surface. I now hollow out the inner walls of the sockets 8^a 8^b by concentric grooves 8^e, running entirely around said sockets, and in this groove I place an elastic member which gives the greatest possible concentric bearing-surface, expands readily longitudinally, but resists lateral pressure, and which in expanding longitudinally reduces its diameter laterally. These conditions I meet by using a spiral retaining-spring 8^f, which I preferably join at its ends. The upper and lower walls of said concentric groove hold said retaining spiral spring in position longitudinally. The tool-holders 15 16 (see Fig. 4) are provided at their upper extremities with a teat 16^a, the diameter of the shank 16^b of each being varied at 16^C 16^c to coact with the retaining-spring 8^f in the sockets 8^a 8^b of the spindle 8.

Among the many advantages of the use of a concentric retaining-spring is that it will permit of a projection on the shank of a tool-holder and not weaken it by grooving. The shanks of the tool-holders are thrust up into the sockets of the spindle, their teats 16^a slip into the slots 8^c 8^d to drive them, and the springs 8^f sink into their grooves 16^c, or under their projections 16^C, to retain the teats of said shanks in rotary engagement with the transverse bores 8^c 8^d, which arrangement permits the shanks also to be readily removed by simply pulling them out of the spindle-socket. This method is superior to the locking-pin system in general use, particularly when used in a device of this kind, as the spring can be put up into the spindle-socket without enlarging the diameter of the spindle or decreasing its strength at a vital point, whereas the locking-pin would be too bulky for a reversing mechanism and less positive and above all less sensitive in its action, as the spiral spring has a bearing all around the shank.

The tool-holder 15 I have shown arranged with a tapered socket to receive a tapered-shank drill, but the tap-holder 16 is of unique construction. It being undesirable in practice to hold the tap in rigid alinement with its holder and yet necessary to have it run truly therewith, and a collet that will take only one or two sizes being both expensive and liable to be lost, I have provided the tool-socket 16^d with a concentric groove 16^D, in which I place a spiral self-centering spring 16^E, the ends of the spring being preferably joined together so that the spring contracts and expands evenly. Said spring permits of considerable freedom in the movement of the tap, such as might be required if the hole it was working on should not be in line with the spindle 8. Above said self-centering collet-spring 16^e I bore a transverse hole through the tool-holder, said transverse bore 16^g being of greater diameter than the tool-socket 16^d. In the transverse bore 16^g I insert a sliding nut 16^h and provide said nut at one end with a concentric screw-threaded bore 16^k, and at about the center of the length of said sliding nut I make a transverse bore 16^m, which meets the screw-threaded bore 16^k. To avoid the expensive construction of a rectangular sliding nut, I preferably use a circular sliding nut and make a small transverse bore preferably at right angles to the bore 16^m, in which I insert a cross-pin 16^r, its ends preferably projecting beyond both sides of the periphery of the nut 16^h. In the screw-threaded bore 16^k I now insert a set-screw 16^s. I then slide the nut 16^h into the transverse bore 16^g of the tool-holder 16, the ends of the pins 16^r meshing with grooves 16^t provided in the sides of the bore 16^g, which only run part way through said bore 16^g to hold said sliding nut 16^h from rotating when turning the set-screw 16^s and from sliding all the way through the bore 16^g when pressing on said screw for that purpose. By these means the hole 16^m is brought in alinement with the tool-socket 16^d. A tap may now be inserted through and alined by the spring-collet 16^e, passed into bore 16^m, and gripped by a set-screw 16^s, pressing its square head against the opposite wall of the bore 16^m. I have preferably shown two centering-springs, so that the two concentrically-elastic points of leverage thus formed will slide the nut 16^h longitudinally in the transverse bore 16^g, said nut 16^h being preferably loosely fitted in bore 16^g, whereby the tap will be firmly held from turning by the sliding nut 16^h and loosely centered by said springs 16^E 16^e, the sliding of the nut compensating for any difference in the size of the taps successively inserted.

The parts being in the position shown in Fig. 8, a drill 15^z is inserted in the tapered tool-socket 15^a and a tap in the tap-socket 16^d, when the locking-pin 27 is withdrawn from the bore 27^d, the head swung around until the locking-pin slides into the bore 27^f, and the parts will be in the position for drilling, as illustrated in Fig. 1. By raising the work 25 or depressing the swivel-head 9 by any usual or approved means the cross-bar 7 is brought into rotary engagement with the clutch-pin 6^c and the face 6^f of the recess 6^e. Assuming that the longitudinal movement of the work or head is not continued until the drill passes through the work, the drill on being withdrawn, by raising the head or lowering the work, leaves what is termed a "bottom" or "blind" hole 25^b in the work 25. The locking-pin 27 is now withdrawn from the bore 27^f and the head swung around until said pin slides into the bore 27^d, and the tap 16^z at the other end of the spindle 8 is brought in line with the hole just drilled. The work or head is then again advanced one toward the other, the spindle 8 rises in its bearings, and the parts assume the positions shown in Fig. 8, with the cross-bar in rotary engagement with the clutch-pins 5^c. The continued rotation of the wheel 3—say to the right hand—drives the tap into the hole, the continued advance of the work to the head, or vice versa, compensating for the spiral action of the teeth of the tap until the end of the tap engages the bottom of the hole, when the resistance of the cross-bar to the rotation of the clutch-pins 5^c becomes so great as to hold the disk 5 and its positively-connected parts from rotating with the wheel 3, and the rotation of the disk 5, check-nut 11, and adjusting-ring 13 is consequently arrested, while the rotation of the wheel 3 continues without interruption, the frictional surfaces of said wheel slipping past the frictional surfaces of said friction-disks on both sides of said wheel. The raising of the head 9 or lowering of the work 25 with the tap fast in it pulls the cross-bar 7 longitudinally out of engagement with the clutch-pins 5^c, (which immediately renew their rotation with wheel 3,) past the intervening space between the ends of the clutch-pins, and into rotary engagement with the clutch-faces of the oppositely-rotating clutch-pins 6^c, which back the tap out of the work and complete the series of consecutive operations necessary to perform the work contemplated at the point of operation and for which this machine is designed particularly.

It will be readily seen that as the longitudinal movement of the spindle through its bearings, or vice versa, disengages and reëngages the cross-bar from and with the clutch-pins, and as the space between the clutches is greater than the height of the cross-bar, the rotation of the spindle is changed in direction or stopped by simply moving the spindle longitudinally as desired. This longitudinal movement of the spindle-clutch 7 past the clutch-pins 5^c, under strain, would endanger the pulling out of the tool-holder or necessitate so powerful a grip of the retaining-spring 8^f as to counteract the ability to readily remove the tool-holder while the spindle 8 is rotating; but it will be remembered that, while the cross-bar and clutch-pins have a maximum of lateral bearing-surface, the round peripheries of the clutch-pins against the flat sides of the cross-bar offer a minimum resistance to this longitudinal movement of the clutches past each other, and thereby coact in reducing the grip required of the retaining-spring 8^f.

As the use of both ends of a longitudinally-movable spindle in combination with a reversing clutch mechanism is not adaptable to a turret-head containing several spindles, and there may be several different-sized holes to drill and tap in the same place (as illustrated by holes 25^a 25^b) or piece of work, this readily-removable tool-holder is the nearest approach deemed practicable to a greater number of spindles and avoids the complications that such a construction would necessarily involve. Again, in large work the chief difficulty is in getting the tap in line with the hole that has previously been drilled, which is the object of my using a swivel-head; and should the work not be such as would stand firmly on its own base (as in the case of a cylinder tapped through its side) any slight deviation in the alinement would be compensated for by the self-centering adjustable collet spring or springs shown.

Having now described my invention, what I claim is—

1. The combination of a swivel-head, a spindle carried thereby and having each of its ends provided with means for connection with a tool or tool-holder, and a reversing mechanism also carried by said swivel-head to rotate said spindle in opposite directions, substantially as described.

2. The combination of a spindle having each of its ends provided with means for connection with a tool or tool-holder, means to turn said spindle in opposite directions, means to swivel said spindle to bring its ends to register alternately with the same point, and an automatic locking mechanism to lock said spindle automatically in axial alinement with said point, substantially as described.

3. The combination with a supporting-frame of a swivel-head connected therewith by a swivel-joint, a pinion projecting into said swivel-head, two concentric wheels journaled in said swivel-head and meshing with said pinion, two clutch formations one of said clutch formations being connected with one of said wheels and the other of said clutch formations with the other of said wheels, a spindle, the axis of said spindle being concentric with the axes of said wheels, and a third clutch formation located between said wheel clutch formations and connected with said spindle, substantially as described.

4. The combination with a supporting-frame, of a swivel-head connected therewith by a swivel-joint, one of said parts having an index bore or bores and the other of said parts having a locking pin or pins to mesh with said index bore or bores, to lock said swivel-head at certain intervals to said supporting-frame, a pinion projecting into said swivel-head, two wheels journaled in said swivel-head and meshing with said pinion, two clutches, one of said clutches being connected with one of said wheels, and the other of said clutches with the other of said wheels, and a spindle provided with a clutch or clutches for engagement with said wheel-clutches, substantially as described.

5. The combination of a swivel-head adapted for connection by a swivel-joint with a supporting part, a pinion projecting therein, two concentric wheels journaled in said swivel-head and meshing with said pinion, one of said wheels being of greater diameter than the other, two clutch formations one of said clutch formations being connected with one of said wheels and the other of said clutch formations with the other of said wheels, and a spindle provided with a clutch or clutches for engagement with said wheel-clutches, substantially as described.

6. The combination of a bevel-pinion carrying two sets of driving-faces, the pitch-cone of one of said sets of driving-faces lying within that of the other, two concentric bevel-wheels meshing respectively with said sets of driving-faces of said pinion, a spindle, means for connecting said spindle alternately with either of said wheels, and means for swiveling said spindle, substantially as described.

7. The combination of a friction-disk, a screw-threaded hub projecting therefrom, a wheel surrounding said hub, a screw-threaded adjusting-ring to mesh with said screw-threaded hub to move one of said parts longitudinally, a check-nut to hold said adjusting-ring in position when adjusted and a pinion meshing with said wheel, substantially as described.

8. The combination of a friction-disk having a screw-threaded hub, another disk surrounding said hub, one of said disks being provided with a positive clutch, a screw-threaded adjusting-ring meshing with said screw-threaded hub to move one of said disks longitudinally, a check-nut to hold said adjusting-ring in position when adjusted, and a spindle having a clutch adapted to engage said disk-clutch, substantially as described.

9. The combination of a friction-disk having a screw-threaded hub, a check-nut surrounding said hub, one of said parts having an indenture and the other a projection meshing therewith to connect said disk and said check-nut to rotate together by a slip-joint permitting of their independent longitudinal movement, another disk also surrounding said hub and located between said first-mentioned disk and said check-nut and capable of rotation independent thereof, a screw-threaded adjusting-ring meshing with said hub to adjust the tension of the frictional contact of said parts, one of said disks being provided with a positive clutch, and a spindle having a clutch adapted to engage said disk-clutch, substantially as described.

10. The combination of a disk having a recess or clutch-chamber in its face and an ec-

centrically-located longitudinal bore opening partly on the face of said recess or clutch-chamber and indenting the side wall thereof, a clutch-pin located in said bore and projecting longitudinally from the face of said recess or clutch-chamber, part of the periphery of said clutch-pin being embedded in the supporting-indenture thus provided in the side wall of said recess or clutch-chamber and part thereof extending laterally into said recess or clutch-chamber, whereby said clutch-pin is relieved from shearing strain, and a spindle provided with a clutch for engagement with said clutch-pin, substantially as described.

11. The combination of two disks and means for rotating said disks in opposite directions, one of said disks having a recess or clutch-chamber in its face and an eccentrically-located longitudinal bore opening partly on the face of said recess or clutch-chamber and indenting the side wall thereof, a clutch-pin located in said eccentrically-located bore and projecting longitudinally from the face of said recess or clutch-chamber, part of the periphery of said clutch-pin being embedded in the supporting-indenture thus provided in the side wall of said recess or clutch-chamber and part thereof extending laterally into said recess or clutch-chamber, a clutch connected with the other of said disks, and a spindle having a clutch located between said disk-clutches and adapted to engage with either thereof to turn said spindle, substantially as described.

12. The combination of two disks and means for rotating said disks in opposite directions, each of said disks having a central bore or bearing, one of said disks having a recess or clutch-chamber within the plane of its inner face, a clutch-pin connected with said disk and projecting from the face of said recess or clutch-chamber, the inner end of said clutch-pin also lying within the plane of the inner face of said disk, another clutch connected with the other of said disks, a spindle journaled in said bores or bearings of said disks, and a clutch connected with said spindle for engagement with either of said disk-clutches, substantially as described.

13. The combination of a bearing-piece having two bores, one of said bores extending through an arm of said bearing-piece, a pinion journaled in the other of said bores, said bores being bored at an angle to each other, a bearing-ring having a smooth periphery fitting into said bore in said arm and terminating in a shoulder or flange, said bearing-ring also having a screw-threaded bore, a wheel journaled concentrically with said bore in said arm, an elevating-screw meshing with said screw-threaded bore of said bearing-ring to raise said wheel into mesh with said pinion, and having a shoulder or flange to jam against the abutting surface of said bearing-ring, said flanges of said bearing-ring and of said elevating-screw being of greater diameter than said bore in said arm, whereby said flanges form a bearing on both sides of said arm to prevent longitudinal movement of said parts in said bore in said arm, substantially as described.

14. The combination of a spindle having an axial socket, said spindle being provided with a clutch formation to enable it to impart rotary motion, the walls of said axial socket being indented by a concentric groove, and a spring extending along said groove, and extensible into said socket, substantially as described.

15. The combination of a spindle having an axial bore or socket, a smaller transverse bore passing through the axis of said spindle, the center of said transverse bore being located farther along said spindle than said axial bore or socket extends into said spindle, said axial bore or socket and said transverse bore being connected together, a concentric groove cut in the walls of said bore or socket, and a spiral spring inserted in said groove, substantially as described.

16. The combination of a spindle provided with a clutch formation and having an axial socket, the walls of said socket being indented by a concentric groove, a spiral spring placed along said concentric groove, and a shank adapted to enter said socket and provided with a clutch to engage said spindle clutch formation, said shank having a shoulder to coact with said spring to connect said shank longitudinally with said spindle, substantially as described.

17. The combination of a tool-holder provided with transversely-movable gripping means and having an axial socket whose side walls are indented by a concentric groove, and a spiral spring placed along said groove, substantially as described.

18. The combination of a tool-holder having an axial bore meeting a transverse bore, a sliding nut adapted to enter said transverse bore, one of said parts having an indenture extending through part of its length and the other a projection meshing therewith to limit the traverse and prevent the rotation of said sliding nut in said transverse bore, said sliding nut having a transverse bore meeting a screw-threaded bore, and a set-screw meshing with said screw-threaded bore in said sliding nut, substantially as described.

19. The combination of a tool-holder having an axial bore meeting a transverse bore, a sliding nut meshing with said transverse bore and having a transverse bore meeting a screw-threaded bore, and a set-screw meshing with said screw-threaded bore in said sliding nut, substantially as described.

20. The combination of a tool-holder having an axial socket meeting a transverse bore, said axial socket being provided with a plurality of elastic centering-pieces, a sliding nut adapted to enter said transverse bore in

said tool-holder, said sliding nut having a transverse bore meeting a screw-threaded bore, and a set-screw meshing with said screw-threaded bore in said sliding nut, substantially as described.

21. The combination of two disks, a casing carrying gearing to rotate said disks in opposite directions, a spindle, a clutch connected therewith, one of said disks having an eccentrically-located clutch-pin bearing extending longitudinally through from the inner to the outer surface of said disk, a clutch-pin located in said clutch-pin bearing and adapted to engage said spindle-clutch, and another clutch connected with the other of said disks, whereby said clutch-pin can be readily adjusted longitudinally in its bearing, substantially as described.

Stapleton, Staten Island, New York, October 21, 1895.

F. A. ERRINGTON.

Witnesses:
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