

April 18, 1933.

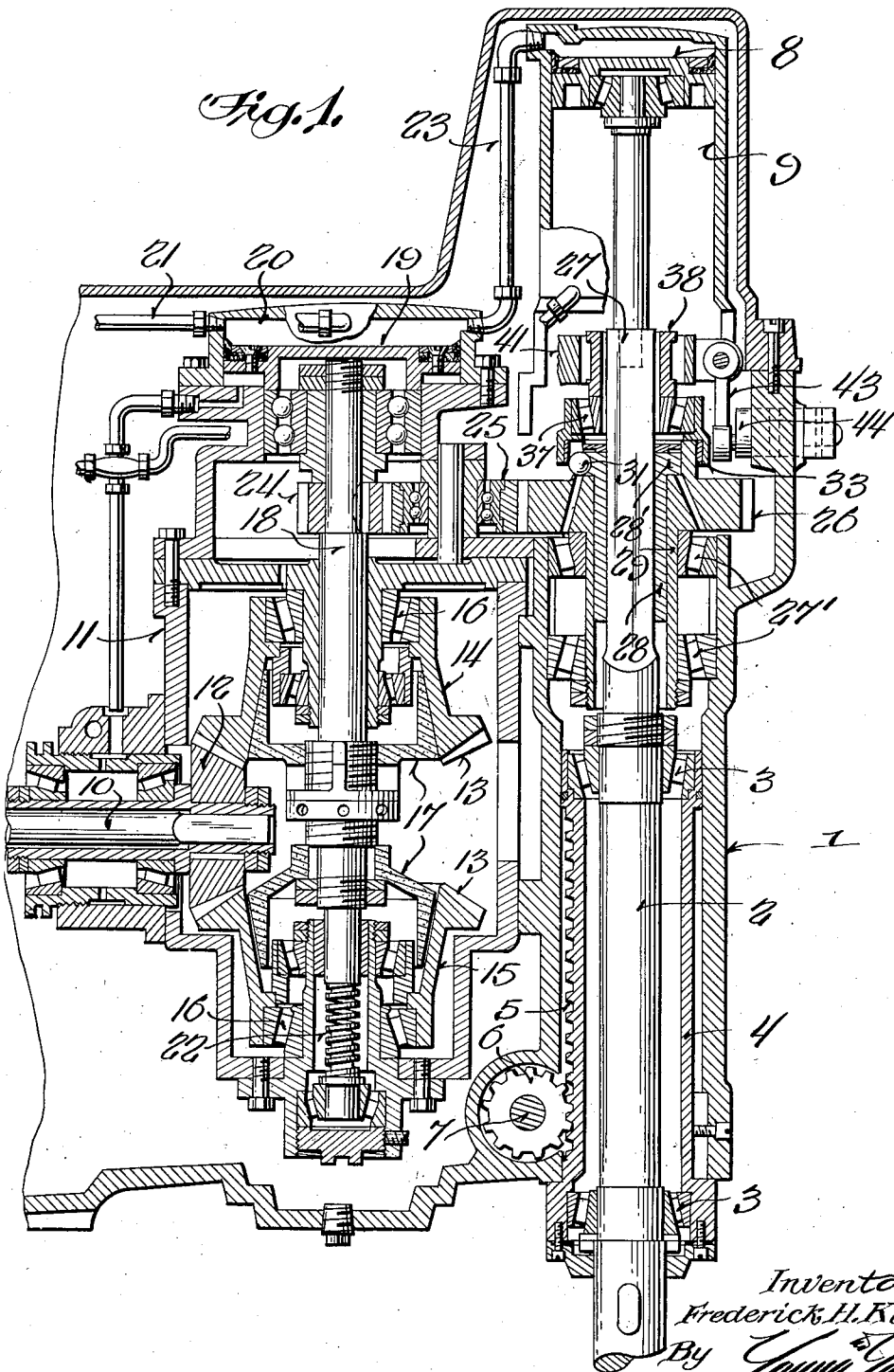
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TAPPING AND DRILLING MACHINE

Filed Nov. 18, 1929

2 Sheets-Sheet 1



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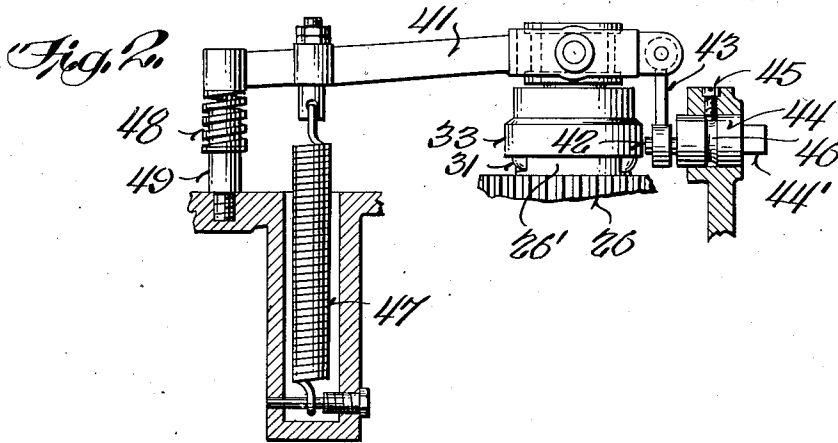


Fig. 3.

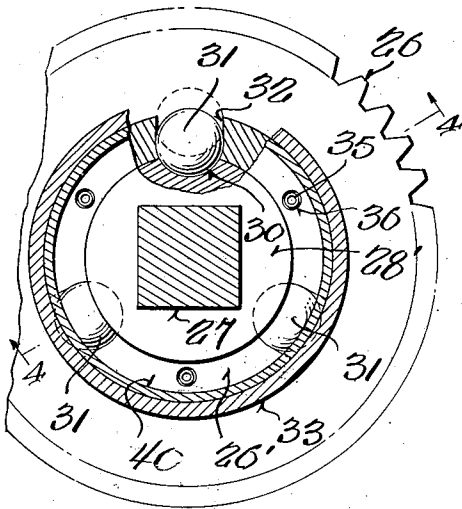
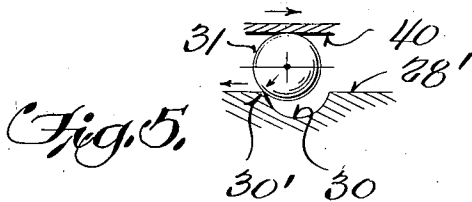
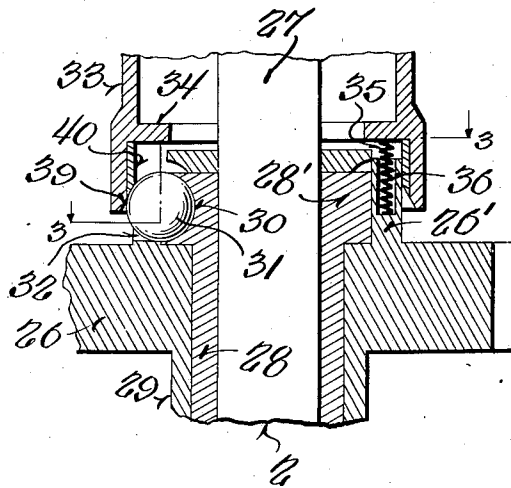


Fig. 4.



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UNITED STATES PATENT OFFICE

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TAPPING AND DRILLING MACHINE

Application filed November 18, 1929. Serial No. 408,040.

This invention pertains to tapping and drilling machines, and more particularly to the former.

The invention has primarily for its object to materially simplify and otherwise improve the structure disclosed in Letters Patent No. 1,403,170, issued January 10, 1922, which provides gear mechanism and positive actuated dogs for reversing the direction of rotation of the tool spindle, when the tool is subjected to predetermined torsional stress, due to hard spots encountered in the work material.

In general, the foregoing object is accomplished by the elimination of reverse gear mechanism and the provision of a novel type of automatic clutch, which not only releases the spindle when a predetermined torsional stress is placed upon the tool, but also effects the desired reversal of rotation of the spindle to release the tool.

Incidental to the foregoing, a more specific object resides in the provision of a novel type of clutch for operatively connecting and disengaging the tool spindle from the driving mechanism, and which is automatically released when the tool is subjected to a predetermined torsional stress, and which upon release, will cause an automatic, intermittent reversal of rotation of the spindle through a camming action between the clutch elements and the spindle, without reversal of the driving element.

A further object resides in the provision of a mechanism of the foregoing character which eliminates complicated electric actuating and timing mechanism, the timing of reversal of rotation of the spindle being controlled by the speed of the spindle drive mechanism.

Another important object of the present invention resides in the provision of a mechanism of the foregoing character which will operate in both directions, thus functioning upon withdrawal of the tool, as well as upon the feeding operation.

With the above and other objects in view,

which will appear as the description proceeds, the invention resides in the novel construction, combination, and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the herein disclosed invention may be made as come within the scope of the claims.

In the accompanying drawings is illustrated one complete example of the physical embodiment of the present invention constructed according to the best mode so far devised for the practical application of the principles thereof.

In the drawings, Figure 1 is a vertical sectional view through the head of a machine constructed in accordance with the present invention;

Figure 2 is a fragmentary detail view of the clutch mechanism between the drive and tool spindle.

Figure 3 is a detail section through the clutch taken on the line 3—3 of Figure 4;

Figure 4 is a vertical section taken on the line 4—4 of Figure 3; and

Figure 5 is a diagrammatic view illustrating the intermittent reversal action upon the spindle.

Referring now more particularly to the accompanying drawings, in which the invention is shown as applied to a conventional type of drilling and tapping machine, the numeral 1 designates a head in which a portion of the actuating mechanism is housed. Slidably mounted within the head 1 is a tool spindle 2 for receiving either a drill or tap (not shown), which may be secured within the spindle in any manner well known to those skilled in the art. The spindle 2 is journaled in anti-frictional bearings 3 carried by a slidable sleeve 4, which sleeve is provided at one side with rack teeth 5 engaged by a feed pinion 6, the pinion 6 being mounted upon a shaft 7 provided with the usual

hand lever (not shown), for manually feeding the spindle toward the work.

In addition to the manual feed described, the spindle may be automatically fed toward the work by means of a piston 8 secured to its upper end and mounted within a pneumatic cylinder 9.

The driving mechanism for the tool spindle comprises a drive shaft 10 journaled in anti-frictional bearings carried by a housing mounted within the head 1 and designated in general by the numeral 11. The drive shaft 10 is operatively connected with a bevel drive pinion 12, which meshes with bevel gears 13 carried by the cones 14 and 15, the latter being journaled upon anti-frictional bearings 16 mounted upon stationary parts of the housing 11. Cooperating with the cones 14 and 15 are a pair of cone clutches 17 secured upon a shaft 18, which shaft has a vertical reciprocative movement effected by a piston 19 secured to its upper end and mounted within the pneumatic cylinder 20. Pressure fluid entering the cylinder 20 through a supply pipe 21 will force the piston 19 downwardly to effect engagement between the lower cone clutch 17 and the cone 15, while the upper cone clutch 17 engages the cone 14 through the action of a spring 22 engaging the lower end of the shaft 18. Obviously, the pressure fluid employed to effect depression of the piston 19, and operative engagement between the lower clutch 17 and the cone 15, may be utilized for actuating the piston 8 to effect feed of the tool spindle 2, the cylinders 9 and 20 being connected through the communicating pipe 23.

Drive of the spindle 2 is accomplished through a gear train, including the pinion 24 keyed on the shaft 18 and engaging an idler gear 25 which, in turn, meshes with the gear 26.

While a specific form of mechanism for effecting the drive and feed of the tool spindle has been described in considerable detail, it is to be understood that such mechanism is more or less conventional and, therefore, forms no specific part of the present invention, other than in the general combination as hereinafter embodied in the claims.

As set forth in the objects, the present invention consists primarily in the novel method of effecting an operative connection between the spindle drive and the spindle. In the present instance, this is accomplished through the novel means provided for effecting engagement between the gear 26 and the driving spindle.

As will be best seen in Figure 1, the spindle 2 is provided with a squared portion 27 upon which is mounted a sleeve 28 journaled within the hub 29 of the gear 26, the hub 29 being in turn journaled in anti-frictional bearings 27' mounted within the head 1. The upper face of the gear 26 is provided with an annu-

lar flange 26' which receives the annular head 28' of the sleeve 28. As best shown in Figure 3, the head 28' is provided with a plurality of spaced semi-spherical recesses 30 for reception of the ball clutch members 31, which in turn are carried in the radial slots 32 formed in the annular flange 26'. Obviously, as the balls 31 are forced into the recess 30, operative engagement between the gear 26 and the sleeve 28 will be effected, which in turn transmits rotation to the spindle 2, due to the fact that the sleeve 28 engages the square portion 27 of the spindle.

Normally retaining the balls 31 in operative engagement between the gear 26 and the sleeve 28 is a cup 33 provided with an internal flange 34 intermediate its upper and lower ends, which flange is engaged by the springs 35 mounted in spaced recesses 36 provided in the annular flange 26'. The cup 33 is journaled upon anti-frictional bearings 37 which in turn are carried by a sleeve 38. As best shown in Figure 4, the interior of the lower lip of the cup 33 is bevelled at 39 to engage the balls 31, and to relieve wear upon the cup, the interior lower wall being provided with a hardened sleeve 40.

Engaging the sleeve 38 is a spanner arm 41, the fulcrum end of which is connected to an eccentric pin 42 by a link 43. As best shown in Figure 2, the eccentric pin 42 is carried by a rotatably adjustable shaft 44 journaled in the head 1, and provided with a squared head 44' at its outer end for reception of a handle or suitable tool. The arm 41 is retained within the head 1 by means of a locking screw 45 engaged in an annular recess 46 formed in the shaft 44. The free end of the spanner arm 41 is connected with a stationary portion of the head by means of a contractile spring 47, and the same is cushioned by a spring 48 carried on the stud 49.

From the foregoing description taken in connection with the drawings, it is believed that the operation of the spindle drive and feeding mechanism will be quite apparent, in that the main drive is transmitted through the shaft 10 to the drive pinion 12, and from the gears 13 to the clutches 14 or 15, which are selectively engaged by either of the cones 17 to effect rotation of the shaft 18 in opposite directions.

Actuation of the piston 19 serves to engage the lower cone 17 with the clutch 15, and the spring 22 serves to effect engagement between the upper cone 17 and the member 14. From the shaft 18, power is transmitted through the idler 25 to the gear 26. In normal position, the contractile spring 47, acting upon the spanner arm 41, will force the sleeve 38 and the cup 33 downwardly, thus forcing the balls 31 into operative engagement between the gear 26 and the sleeve 28, keyed upon the squared portion 27 of the spindle 2. During operation, operative engagement between the

gear 26 and the sleeve 28 is maintained until such time as the tool is subjected to a predetermined torsional stress, as occurs when the same encounters hard spots in the work material. Thereupon, the sleeve 28 will have a tendency to lag, which will cam the balls 31 out of the recesses 30 against the tapered lip 39 of the cup 33, the latter being forced upwardly against the tension of the spring 47 exerted upon the spanner arm 41. Obviously, such action will disengage the sleeve 28 from operative connection with the gear 29, causing the balls 31 to rotate along the outer periphery of the head 28', and again effect operative connection between the gear 26 and the sleeve 28, as they drop into the following recesses. During the latter action, as the center of the balls 31 pass over the rear edge of the recess 30, the force exerted upon them by the spring-urged cup 33 will cause the balls 31 to effect a reverse relative movement between the gear 26 and the head 28' through the camming action of the balls 31 upon the rear edges 31' of the recesses 30, thus tending to break the tool loose from any bind in the work material. This action is best illustrated in Figure 5. Obviously, until such time as the torsional stress upon the tool is relieved, the balls 31 will continue to rotate around the head 28', intermittently dropping into the recesses 30, each time repeating the reverse camming action upon the head to break the tool loose.

Heretofore complicated means have been employed for timing the reverse rotation of the spindle to break the tool loose and, therefore, particular attention is here directed to the fact that such mechanism is entirely eliminated, in that the action of the novel type of clutch is entirely automatic and, therefore, the intermittent rotation of the spindle is controlled entirely by the speed of rotation of the gear 26, and the spindle will only be reversely rotated a minimum number of times sufficient to break the tool loose and overcome the excessive torsional stress upon the same.

Here it is important to note that the clutch between the gear 26 and the sleeve 28 will function equally as well in both directions of drive of the gear 26. Thus, should the tool be subjected to excessive torsional stress, upon withdrawal of the same from the work the clutch will function in the manner as heretofore described, to disengage the spindle from the drive until such time as the stress upon the tool is relieved.

Naturally, when light drills or taps are being used, it is desired to release the spindle drive when the tool is subjected to lighter torsional stress than in instances where heavy tools are used.

In the drawings, the clutch is set to function in connection with the maximum size tool, and referring particularly to Figure 2, it will be noted that the eccentric pin is ad-

justed to its lowermost position, which lowers the fulcrum point of the arm 41 and thus increases the tension exerted upon the cup 33 and the balls 31. Where lighter tools are employed, the shaft 44 is rotated by means of a handle or tool (not shown) fitted on the head 44', which action raises the fulcrum end of the lever 41, and also the cup 33. Naturally, due to engagement of the tapered lip 39 of the cup 33, releasing action will take place more readily than when the cup is adjusted to its lowermost position, due to the fact that shorter movement is required to cam the cup upwardly sufficiently to permit release of the clutch balls. The springs 35, engaging the internal flange 34 of the cup 33, serve to take up play between the cup and spanner arm 41, thus insuring a sensitive action of the clutch.

From the foregoing, it will be readily seen that an exceedingly simple and efficient mechanism has been provided which automatically controls the drive of the tool spindle to release the spindle when the tool encounters excessive torsional stress, and to reverse rotation of the spindle sufficiently to break the tool loose from any bind in the work material, thus preventing breakage of tools and eliminating the necessity of skilled labor.

I claim:

1. In a machine of the character described, a tool carrying spindle, driving means for rotating the spindle comprising an annular member carried by said spindle and provided with a semi-spherical pocket in its periphery, a driven sleeve surrounding said annular member and provided with an opening for alignment with said pocket, a ball normally positioned within said opening and pocket, and a spring-urged sleeve having an internally tapered face for engagement with said ball.

2. In a machine of the character described, a tool carrying spindle, driving means for retaining the spindle comprising an annular member carried by said spindle and provided with spaced radial semi-spherical pockets, a driven sleeve surrounding said annular member and provided with openings for alignment with said pocket, a shiftable sleeve having an inner peripheral tapered face for engagement with said balls, and a spring-urged spanner connected with said shiftable sleeve to urge the same into engagement with said balls.

3. In a machine of the character described, a tool carrying spindle, driving means for retaining the spindle comprising an annular member carried by said spindle and provided with spaced radial semi-spherical pockets, a driven sleeve surrounding said annular member and provided with openings for alignment with said pocket, a shiftable sleeve having an inner peripheral tapered

face for engagement with said balls, a
spring-urged spanner connected with said
shiftable sleeve to urge the same into en-
gagement with said balls, and means con-
5 nected with said spanner for varying the
tension thereon.

In testimony that I claim the foregoing I
have hereunto set my hand at Manitowoc, in
the county of Manitowoc and State of Wis-
10 consin.

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