Jan. 18, 1944. P. VAN SITTERT ET AL 2,339,530

ROTARY TOOL

Filed Aug. 27, 1941 2 Sheets-Sheet 1

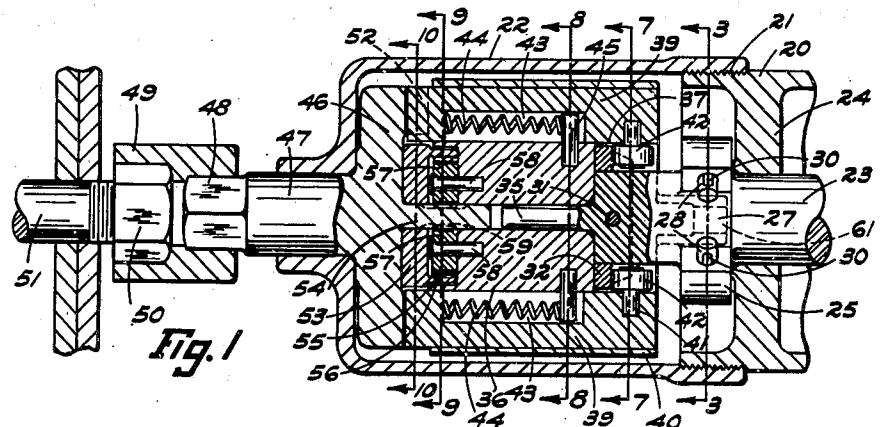

Fig. 1

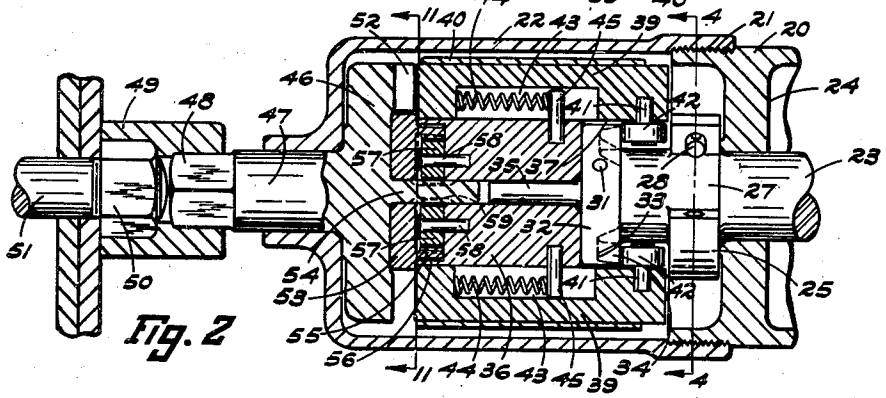

Fig. 2

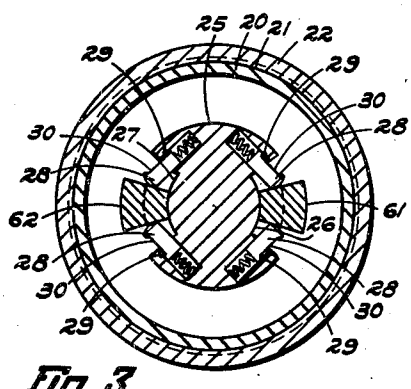

Fig. 3

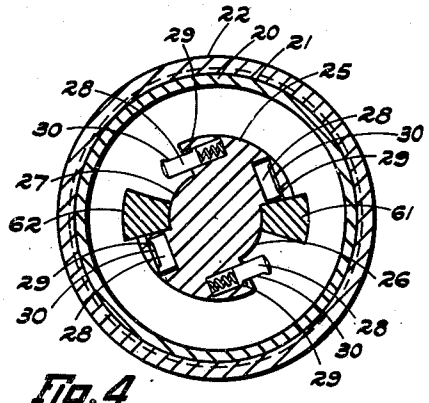

Fig. 4

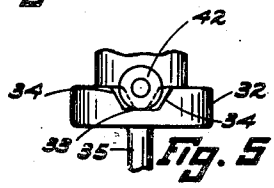

Fig. 5

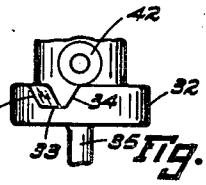

Fig. 6

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Jan. 18, 1944. P. VAN SITTERT ET AL 2,339,530

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Filed Aug. 27, 1941 2 Sheets-Sheet 2

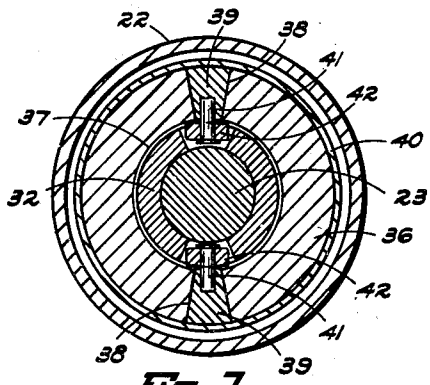

Fig. 7

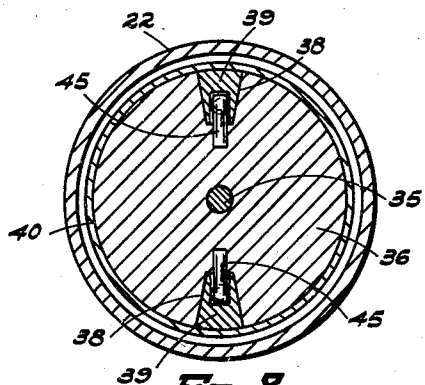

Fig. 8

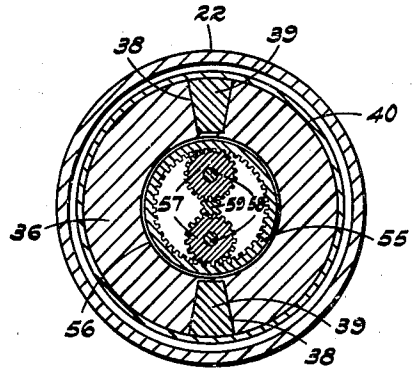

Fig. 9

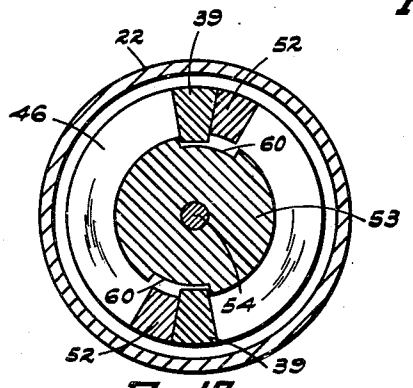

Fig. 10

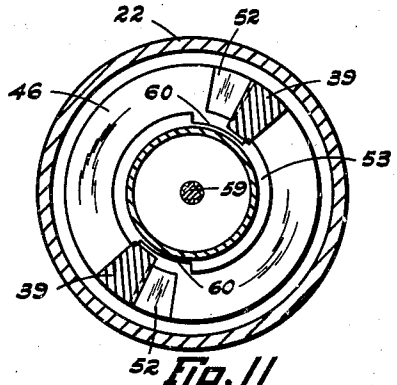

Fig. 11

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UNITED STATES PATENT OFFICE

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ROTARY TOOL

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Application August 27, 1941, Serial No. 408,546

14 Claims. (Cl. 192—30.5)

This invention relates broadly to a portable rotary impact tool, but more particularly to an impact producing mechanism for such a tool.

One object of this invention is to produce a rotary impact tool with an improved impact delivering mechanism capable under certain conditions of operation of remaining inoperative while uninterrupted rotation is transmitted to the work, and under other conditions of operation capable of automatically delivering powerful rotary impacts to the work in rapid succession.

Another object of this invention is to provide such a tool with a rotary impact producing mechanism capable of delivering impacts of an intensity materially greater than that heretofore delivered by portable rotary impact tools of similar size and power consumption.

Another object of this invention is the provision in a rotary impact tool of means enabling positive engagement of the impact delivering member with component driven parts, thereby allowing for the provision of adequate impact delivering and receiving surfaces adapted to resist premature wear and breakage.

Another object of this invention is to produce an improved rotary impact delivering mechanism for use with a reversible rotary motor.

Still another object of this invention is to produce a portable reversible rotary impact tool which is compact, strong, durable and efficient.

Other objects and advantages more or less ancillary to the foregoing reside in the specific construction and aggroupment of the elements peculiar to this structure, as will become apparent from a more complete examination of this specification.

In the drawings:

Fig. 1 is a longitudinal sectional view of a portion of the front end of a tool embodying the invention.

Fig. 2 is a view similar to Fig. 1 but showing some of the parts in another position.

Fig. 3 is a cross sectional view taken in a plane indicated by 3—3 in Fig. 1.

Fig. 4 is a cross sectional view taken in a plane indicated by line 4—4 in Fig. 2.

Fig. 5 is a side view of some of the parts in their relative position assumed in the mechanism shown in Fig. 1.

Fig. 6 differs from Fig. 5 in that it shows the position the parts assume in Fig. 2.

Fig. 7 is a cross sectional view taken on a plane indicated by line 7—7 in Fig. 1.

Fig. 8 is a cross sectional view taken in a plane indicated by line 8—8 in Fig. 1.

Fig. 9 is a cross sectional view taken in a plane indicated by line 9—9 in Fig. 1.

Fig. 10 is a cross sectional view taken in a plane indicated by line 10—10 in Fig. 1.

Fig. 11 is a cross sectional view taken in a plane indicated by line 11—11 in Fig. 2.

Referring to the drawings, there is shown the front end of a motor housing 20 having mounted therein a fluid actuated rotary motor of the reversible type. Since the motor forms no part of the present invention, no illustration or description thereof is thought necessary other than pointing out that the motor may be of any suitable type and of a size and weight adaptable for use with the device to be described so as to form therewith a portable tool. The front end of the motor housing 20 is externally threaded as at 21 to receive a substantially cup shaped casing 22 having housed therein the mechanism to be hereinafter described.

A driving shaft 23 operatively associated with the motor within the housing 20 is journaled within a housing partition 24 and, on the left side of the partition in Fig. 1, is formed with an integral collar 25, which collar is provided with two diametrically opposed longitudinally extending and open ended grooves 26 and 27, each groove having slidably mounted within its side walls a spring pressed plunger 28 having its outward slidable movement limited by a cross pin 29 engaging the end of a flat 30 provided on the pin 28 intermediate its ends. From the collar 25, the shaft 23 extends into the casing 22 and has secured thereon by a cross pin 31 a ring 32 formed with two diametrically opposed notches 33, each notch being of a predetermined width and having outwardly inclined side walls 34. Immediately below the ring 32, the shaft 23 is formed with a reduced portion 35 having mounted thereon a cylindrical, relatively heavy member hereinafter referred to as a driving head 36 which has its end adjacent the collar 25 provided with two lugs 61 and 62 longitudinally extending into the grooves 26 and 27 of the collar 25, each lug being located between two plungers 28 protruding from the side walls of the groove. That same end of the driving head is also formed with a counterbore 37 accommodating the ring 32 mounted on the shaft 23. Exteriorly, the driving head 36 is provided with two diametrically opposed guideways 38 extending longitudinally from one to the other end of the head, each guideway having a key or dog

39 slidably mounted therein flush with the peripheral wall of the driving head and retained within the guideway 38 by a cylindrical sleeve 40 fitted over the driving head 36. The guideways 38 are deep enough to break into the counterbore 37 of the driving head 36. Each dog 39 has its end portion adjacent the collar 25 of the shaft 23 carrying a stub shaft 41 extending into the counterbore 37 where it carries a roller 42 normally located within one of the notches 33 provided in the ring 32. The inner longitudinal wall of each dog is provided with an elongated groove 43 accommodating a compression spring 44 having one end resting against the corresponding end of the groove while the other end rests on a pin 45 carried by the driving head 36 and extending therefrom into the groove 43, thus the spring 44 constantly urges the dog 39 away from the collar 25, which movement is limited by the engagement of the roller 42 with the bottom of the notch 33 of the ring 32.

Rotatable within the front end of the casing 22, there is a driven head comprising a plate 46 resting on the bottom of the casing 22 and having a shaft portion 47 extending therefrom through the casing, which shaft is terminated by a hexagon head 48 fitting within one end of a socket wrench 49 adapted to fit over the work represented by a nut 50 positioned for rotation on a bolt 51. The plate 46 is coaxial with the driving head 36 and has two diametrically opposed lugs or clutch teeth 52 extending from the inner side thereof toward the driving head 36, which lugs are engageable by the dogs 39 to form a releasable clutch. Radially the lugs 52 extend from the outside edge of the plate 46 partly toward the center thereof and have located between them a disk 53 journaled on a small shaft 54 extending from the plate or driven head 46 into the driving head to assist the shaft 35 in rotatably supporting the driving head. The disk 53 is provided with an internal ring gear 55 accommodated within a shallow counterbore 56 in the driving head 36. Meshing with the ring gear 55 there are two small gears 57 each rotatably mounted on a shaft 58 carried by the driving head 36. Between the gears 57 there is a small pinion 59 formed as an integral part of the shaft 54, with which pinion the gears 57 also engage as clearly shown in Fig. 9. The dogs 39 extend radially inward beyond the lugs 52 and consequently inside of the outer marginal edge of the disk to rest on the disk as shown in Fig. 2. In thickness, the disk 53 exceeds somewhat the height of the lugs 52, thereby preventing engagement of the dogs 39 with the lugs 52 when the dogs rest on the disk 53. Externally, the disk 53 is provided with two diametrically opposed longitudinally extending grooves 60 through which the dogs 39 are free to slide for engagement with the lug 52 as will be explained later.

In the operation of the mechanism, rotation in one or the other direction is imparted to the shaft 23 by the motor housed within the housing 20. Assuming now that the rotation of the shaft 23 is in the clockwise direction when viewed from the motor end of the tool, that is in the clockwise direction in Figs. 3 and 4. The rotation of the shaft 23 is transmitted to the driving head 36 by the spring pressed plungers 28 active on the lugs 61 and 62 of the driving head as shown in Fig. 3, the lugs 61 and 62 being normally maintained central within the grooves 26 and 27 by the spring pressed plungers 28.

Normally, the disk 53 is located as shown in Fig. 10, that is with its grooves 60 in position to allow slidable movement of the dogs 39 through the grooves into engagement with the lugs 52 of the driven head 46, thereby transmitting rotation from the driving to the driven head and finally to the nut 50. In this normal driving position of the dogs 39, the rollers 42 carried by the dogs are positioned in the notches 33 as shown in Fig. 5. During this rotation of the driving and driven heads, the gears 57 carried by the driving head will rotate therewith while remaining on their respective shafts 58, and due to their engagement with the ring gear 55 will transmit rotation to the disk 53 at the same rate of speed as that of the heads, thereby preventing rotation of the disk grooves 60 relative to the dogs 39.

When the nut 50 is about set, its resistance to rotation will result in a rapid deceleration of the driven head 46 and driving head 36 while the shaft 23 is still rotated at its original rate of speed, thereby causing relative rotation between the driving head 36 and the shaft 23 which is possible by the inward movement of the driving spring pressed plungers 28 within the side walls of the grooves 26 and 27 and limited by the engagement of the lugs 61 and 62 with the side walls of the grooves 26 and 27 as shown in Fig. 4. This limited relative rotation will cause the ring 32 carried by the shaft 23 to rotate relative to the rolls 42 carried by the dogs 39, resulting in a camming action of the side walls 34 of the notches 33 on the rollers 42 for moving the rollers out of the notches and cause them to rest on the end wall of the ring 32 adjacent the collar 25. This outward movement of the rollers is of course transmitted to the dogs 39, causing disengagement or release of the dogs from the lugs 52 of the driven head 46 and enabling free rotation of the driving head 36 relative to the now stationary driven head 46. Immediately after the disengagement of the dogs 39, the gears 57 rotated around the now stationary pinion 59 will transmit rotation to the ring gear 55 and consequently to the disk 53 at a rate of speed calculated to be somewhat faster than that of the driving head. In the present construction, the gears 55, 57 and 59 are calculated to result in three and one-half revolutions of the disk 53 for each three revolutions of the driving head 36. This predetermined differential rate of rotation between the driving head and the disk 53 will result in the grooves 60 of the disk to be moved out of the longitudinal path of the dogs 59, thereby preventing engagement of the dogs 39 with the lugs 52 and consequently enabling the driving head to reach its maximum rotary speed before reengagement of its dogs 39 with the lugs 52.

During the rotation of the driving head relative to the driven head, the lugs 61 and 62 of the driving head will gradually be moved in central position within the grooves 26 and 27 of the shaft collar 25 by the action of the depressed spring pressed plungers 28 on the lugs 61 and 62, thereby positioning the rollers 42 directly above but not in the notches 33.

As the driving head 36 begins its last half revolution relative to the driven head 46, the faster rotative speed of the disk 53 will cause the front end portion of its grooves 60 relative to their direction of rotation to line up with the dogs 39, enabling axial movement of the dogs through the disk 53 into the orbit of the lugs 52 by the action of the compression springs 44.

During this axial movement of the dogs 39, the rollers 42 carried by the dogs will again be moved into the notches 33 of the disk 32 as shown in Fig. 5.

As the dogs 39 finally reach the lugs 52, the inertia of the driving head 36, which head has now reached its maximum rotary speed, is transmitted to the dogs 39 causing them to deliver a powerful rotary impact to the lugs 52 which is communicated to the socket wrench 49 and results in imparting a relatively strong short impulse to turn the nut. When the engagement or impact takes place, resistance to rotation of the driven head will again be transmitted to the driving head which will momentarily stop abruptly, causing the shaft 23 to rotate relative to the driving head from the position in Fig. 3 to that in Fig. 4 and again causing upward movement of the rollers 42 from the position in Fig. 5 to that in Fig. 6 for disengaging the dogs 39 from the lugs 52. These cycles follow each other in rapid succession and are continued until the operator by experience knows that the nut has been driven home as tightly as desired, whereupon the motor housed within the housing 20 is stopped and the tool removed from the nut.

When it is desired to use the tool for removing nuts from bolts, the motor within the housing 20 may be reversed for imparting rotation to the shaft 23 in the other direction. The engagement and disengagement of the clutch comprising the dogs 39 and lugs 52 occurs in the manner above described, since all of the operating parts are double-acting and function exactly the same regardless of the direction of rotation. However, in running the tool in such reverse direction the impacts occur at the start of the operation and after the nut is sufficiently loosened the driven head may turn continuously instead of intermittently.

Although the foregoing description is necessarily of a detailed character, in order to completely set forth the invention, it is to be understood that the specific terminology is not intended to be restrictive or confining and it is to be further understood that various rearrangements of parts and modifications of structural detail may be resorted to without departing from the scope or spirit of the invention as herein claimed.

We claim:

1. In a power actuated tool of the class described, a rotary driving head, a driven head, clutch means between said heads capable of release to enable rotation of said driving head relative to said driven head, means responsive to a predetermined resistance to rotation of said driven head for effecting said release, means including a train of gears drivenly associated with said driving head for maintaining said clutch means in released position during more than one revolution of said driving head relative to said driven head, and means effecting subsequent reengagement of said clutch means.

2. In a power actuated tool of the class described, a prime mover, a driving and a driven head, clutch means between said heads capable of release to enable rotation of the driving head relative to the driven head, connecting means between said prime mover and driving head including means enabling limited relative rotation therebetween upon predetermined resistance to rotation of said driving head, means responsive to said limited relative rotation for effecting said release, means responsive to the rotation of the driving head relative to said driven head for maintaining said clutch means in released position during more than one revolution of said driving head, and means effecting subsequent reengagement of said clutch means.

3. In a power actuated tool of the class described, a prime mover, a driving and a driven head, clutch means between said heads capable of release to enable rotation of the driving head relative to the driven head, a resilient connection between said prime mover and driving head enabling limited rotation therebetween upon predetermined resistance to rotation of said driven head, cam means responsive to said limited relative rotation for effecting said release, means deriving motion from the rotation of said driving head relative to said driven head for maintaining said clutch means in released position during more than one revolution of said driving head, and means effecting subsequent reengagement of said clutch means.

4. In a power actuated tool of the class described, a prime mover rotatable in either direction, a driving and a driven head, clutch means between said heads capable of release to enable rotation of the driving head relative to the driven head, a resilient connection between said prime mover and driving head enabling limited rotation therebetween upon predetermined resistance to rotation of said driven head irrespective of the direction of rotation of said prime mover, cam means between said prime mover and driving head responsive to said limited relative rotation for effecting said release, means deriving motion from the rotation of said driving head relative to said driven head for maintaining said clutch means in released position during more than one revolution of said driving head, and means effecting subsequent reengagement of said clutch means.

5. In a power tool of the class described, a rotary driving head, a driven head, teeth on said driven head, longitudinally slidable dogs carried by said driving head engageable with said teeth for transmitting rotation from said driving to said driven head but capable of release to enable relative rotation therebetween, a prime mover for said driving head, a resilient connection between said driving head and prime mover enabling limited relative rotation therebetween upon predetermined resistance to rotation of said driven head, cam means between said dogs and prime mover responsive to said limited relative rotation for effecting said release, means deriving motion from the relative rotation between said heads for maintaining said dogs in released position during more than one revolution of said driving head relative to said driven head, and means effecting subsequent reengagement of said dogs and teeth.

6. In a power tool of the class described, including a drive shaft and means for operating the same, a rotary driving head mounted on said shaft, a driven head operably associated with said driving head, clutch means between said heads capable of release to enable relative rotation therebetween, means responsive to a predetermined resistance to rotation of said driven head for effecting said release, said clutch means including spaced lugs formed on said driven head, longitudinally slidable dogs carried by said driving head engageable with said lugs for transmitting motion from said driving head to said driven head, means carried by said driven head between said spaced lugs and operable by said driving head for maintaining said clutch means in released position during more than one revolution

of said driving head relative to said driven head, and means effecting subsequent reengagement of said clutch means.

7. In a power tool of the class described, including a drive shaft and means for operating the same, a rotary driving head mounted on said shaft, a driven head operably associated with said driving head, clutch means between said heads capable of release to enable relative rotation therebetween, means responsive to a predetermined resistance to rotation of said driven head for effecting said release, said clutch means including spaced lugs formed on said driven head, longitudinally slidable dogs carried by said driving head engageable with said lugs for transmitting motion from said driving head to said driven head, a disc rotatably carried by said driven head and supported between said lugs, said disc having grooves through which said dogs extend for engagement with said lugs, means on said driving head cooperating with said rotatable disc for maintaining said lugs and dogs in released position during more than one revolution of said driving head relative to said driven head, and means effecting subsequent reengagement of said clutch means.

8. In a power tool of the class described, including a drive shaft and means for operating the same, a rotary driving head mounted on said shaft, a driven head operably associated with said driving head, clutch means between said heads capable of release to enable relative rotation therebetween, means responsive to a predetermined resistance to rotation of said driven head for effecting said release, said clutch means including spaced lugs formed on said driven head, longitudinally slidable dogs carried by said driving head engageable with said lugs for transmitting motion from said driving head to said driven head, a disc rotatably carried by said driven head and supported between said lugs, said disc having grooves through which said dogs extend for engagement with said lugs, means including a train of gears drivenly associated with said driving head and cooperating with said rotatable disc for maintaining said lugs and dogs in released position during more than one revolution of said driving head relative to said driven head, and means effecting subsequent reengagement of said clutch means.

9. In a power tool of the class described, including a drive shaft and means for operating the same, a driving head mounted on said shaft, a driven head operably associated with said driving head, clutch means between said heads capable of release to enable relative rotation therebetween, means responsive to a predetermined resistance to rotation of said driven head for effecting said release, a collar on said shaft and being formed with diametrically opposed grooves, resilient means in said grooves for connecting said driving head and shaft enabling limited relative rotation therebetween upon predetermined resistance to rotation of said driven head, means deriving motion from the rotation of said driving head relative to said driven head for maintaining said clutch means in released position during more than one revolution of said driving head, and means effecting subsequent reengagement of said clutch means.

10. In a power tool of the class described, including a drive shaft and means for operating the same, a driving head mounted on said shaft, a driven head operably associated with said driving head, clutch means between said heads capable of release to enable relative rotation therebetween, means responsive to a predetermined resistance to rotation of said driven head for effecting said release, a collar on said shaft and being formed with diametrically opposed grooves, a pair of spring pressed plungers slidably mounted in spaced relation within said grooves, said driving head having a pair of lugs extending into said grooves between said pair of plungers for connecting said driving head and shaft and enabling limited relative rotation therebetween upon predetermined resistance to rotation of said driven head, means for maintaining said clutch means in released position during more than one revolution of said driving head, and means effecting subsequent reengagement of said clutch means.

11. In a power tool of the class described, including a drive shaft and means for operating the same, a rotary driving head mounted on said shaft, a driven head operably associated with said driving head, clutch means between said heads capable of release to enable relative rotation therebetween, means responsive to a predetermined resistance of rotation of said driven head for effecting said release, said clutch means including spaced lugs formed on said driven head, longitudinally slidable dogs carried by said driving head engageable with said lugs for transmitting motion from said driving head to said driven head, a resilient connection between said driving head and shaft enabling limited relative rotation therebetween upon predetermined resistance to rotation of said driven head, a ring on said shaft between said driving head and resilient connection, said ring being formed with diametrically opposed notches having outwardly inclined side walls, a roller carried by each of said dogs on the end adjacent said resilient connection and normally positioned within said notches, said roller being responsive to said limited relative rotation for effecting said release, means for maintaining said clutch means in released position during more than one revolution of said driving head, and means effecting subsequent reengagement of said clutch means.

12. In a power tool of the class described, a rotary driving head, a driven head, clutch means between said heads capable of release to enable relative rotation therebetween, means responsive to a predetermined resistance to rotation of said driven head for effecting said release, means drivenly associated with said driving head, control means carried by said driven head and cooperating with said drivenly associated means deriving motion from said relative rotation for maintaining said clutch means in released position during more than one revolution of said driving head relative to said driven head, and means on said control means positionable for enabling subsequent reengagement of said clutch means.

13. In a power tool of the class described, a rotary driving head, a driven head, clutch means between said heads capable of release to enable relative rotation therebetween, means responsive to a predetermined resistance to rotation of said said driven head for effecting said release, means drivenly associated with said driving head, means carried by said driven head and cooperating with said drivenly associated means deriving motion from said relative rotation for maintaining said clutch means in released position during more than one revolution of said driving head relative to said driven head, and means effecting subsequent reengagement of said clutch means.

14. In a power tool of the class described, a

rotary driving head, a driven head, clutch means between said heads capable of release to enable relative rotation therebetween including longitudinal slidable dogs carried by said driving head, a prime mover for said driving head, means between said prime mover and dogs operative upon predetermined resistance to rotation of said driven head for effecting said release, means drivenly associated with said driving head, means carried by said driven head and cooperating with said drivenly associated means deriving motion from said relative rotation for maintaining said clutch means in released position during more than one revolution of said driving head relative to said driven head, and means effecting subsequent reengagement of said clutch means.

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