June 9, 1959 F. A. KAMAN ET AL 2,890,072

RETAINER FOR ROTARY POWER TOOLS

Filed July 10, 1956

Fig. 1.

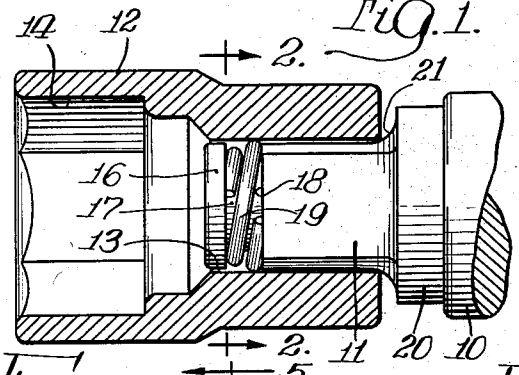


Fig. 3.

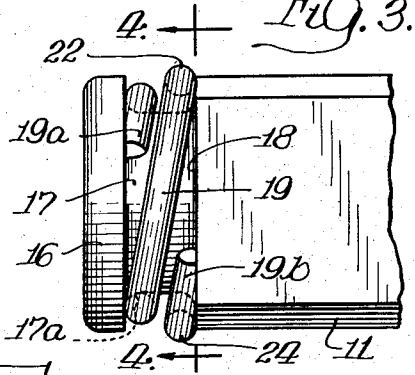


Fig. 2.

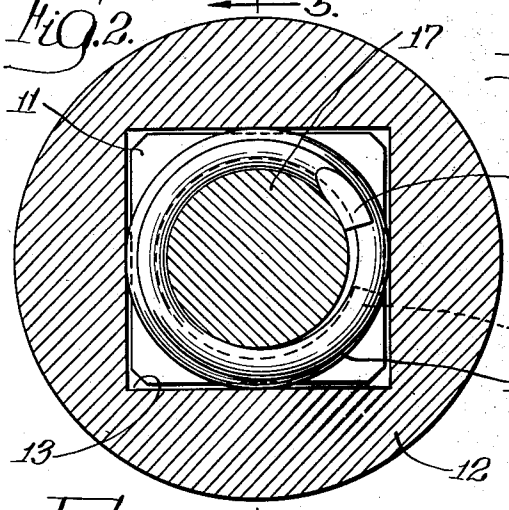


Fig. 5.

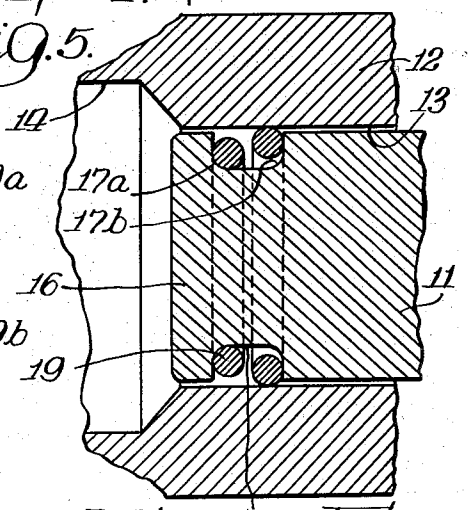


Fig. 4.

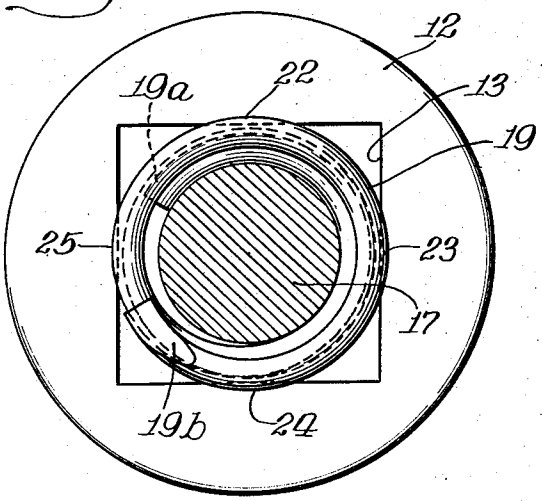


Fig. 6.

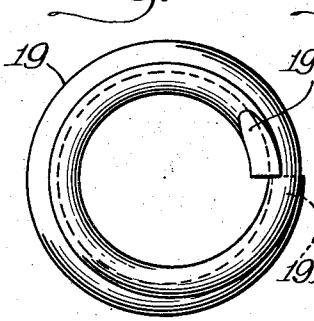
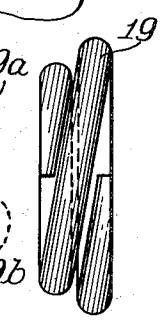


Fig. 7.



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RETAINER FOR ROTARY POWER TOOLS

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1 Claim. (Cl. 287—53)

This invention relates to spindles for power tools and more particularly to retaining means for rotary tool spindles whereby devices such as socket members and the like for engaging work may be detachably secured to the spindle.

Rotary power tools such as nutsetters, impact wrenches, and the like have been commonly provided with spindles projecting therefrom at their forward ends beyond the tool casings. In order to secure to the spindle various attachments such as socket members and the like by which the tool may apply its driving torque to a piece of work, it has been customary to provide various types of retaining means on the spindle square and one of the most common types has been a spring urged detent adapted to be received within a cooperating depression within the square opening of the socket member.

While this detent type of retaining means has been employed for many years, it has been subject to disadvantages which have been tolerated up to the present for want of a complete solution. One disadvantage of such detent types of retaining means has been that the springs which normally urge the detent to projected retaining position have frequently failed, thereby releasing the detent and hence releasing the socket member from the spindle. Also, it has frequently happened that the detent and its spring sometimes became stuck due to dirt or other causes or became cocked which rendered the application or removal of the socket member from the spindle quite difficult, if not impossible. A further disadvantage was the necessity, in order to effect depression of the detent out of locking engagement with the socket member, of using a special tool which quite often was misplaced or unavailable for immedaite use.

Another disadvantage was that frequently the socket member and spindle retaining means were designed and dimensioned especially for each other so that the detent could properly engage within the retaining notch in the socket member at only a certain point, this proper positioning of the socket member on the spindle being accomplished by providing a sharp right angle shoulder against which the rear face of the socket member was seated. The formation of this abrupt shoulder on the spindle resulted in a weakened construction which often caused the spindle to fracture during operation. Furthermore, because precise positioning was required, the spindle and retaining means were not capable of substantially universal application to socket members of various lengths and constructions.

It is, therefore, a principal object of our invention to provide a novel and improved retaining means for detachably securing a socket member or the like on a rotating spindle, which retaining means possesses none of the disadvantages of prior constructions.

Another object of our invention is to provide an improved form of spindle and retaining means for rotary power tools whereby socket members and the like may be readily and quickly applied thereto or removed therefrom without the use of special tools and said socket

members or the like may be securely held thereon during tool operation.

A further object of the invention is to provide an improved retainer structure for a rotary power tool which is of simple, efficient and durable construction and which may be readily assembled with a minimum of effort.

Other objects and advantages of the invention will become apparent from the subsequent detailed description taken in conjunction with the accompanying drawing, wherein:

Figure 1 is a fragmentary side elevational view of the forward spindle end of a rotary power tool with a socket member, partially in longitudinal section, mounted thereon and showing one specific embodiment of the retainer means comprising our invention;

Fig. 2 is an enlarged transverse sectional view taken on the line 2—2 in Fig. 1, looking rearwardly of the tool in the direction of the arrows;

Fig. 3 is an enlarged fragmentary, side elevational view of the forward end of the drive spindle of the rotary tool and the novel retaining means, the socket member being removed therefrom;

Fig. 4 is a transverse sectional view taken on the line 4—4 in Fig. 3, looking forwardly of the tool in the direction of the arrows and showing the relative positions of the parts as the socket member is being moved into position over the spindle and retaining means but before engagement therewith;

Fig. 5 is a fragmentary, longitudinal sectional view of the spindle and the retaining means in retaining position within the square opening of the socket member;

Fig. 6 is a view of the retaining spring disassembled from the spindle and viewed from the lower side thereof; and

Fig. 7 is a side elevational view of the retaining spring.

Referring to the drawings, there is shown the forward portion of a rotary tool spindle **10** having a polygonal or square end **11** which is adapted to project beyond the casing of the tool. The tool may be any one of a number of types of rotary power tools such as nutsetters, impact tools and the like, the work-engaging or socket members for which are adapted to be placed over and secured to the square **11**. The socket member **12** has a polygonal or square opening **13** at its rearward end into which the spindle square **11** is received in a sliding fit and has an enlarged polygonal opening **14** at its forward end adapted to be placed over a bolt head or nut (not shown) for loosening or tightening the same. No notches or depressions are provided in the flat surfaces of the socket square opening **13**. The rotary torque of the power tool is transmitted to the socket member **12** through the driving, non-slip engagement of the spindle square **11** within the complementary square opening **13** of the socket member.

The spindle **10** is provided at its extreme forward or free end with a circular cap or head portion **16**, the diameter of which is substantially the same size as the distance between the flat faces of the square **11**. The spindle **10** also has a short annular neck portion **17** extending between the cap **16** and the square **11** thus forming an annular groove **18**, and in this groove there is positioned a coil spring **19** of novel construction which in combination with the spindle serves to retain the socket member **12** against longitudinal displacement and in driving engagement with the square **11**.

The retaining coil spring **19** is so formed that at its forward end adjacent the spindle cap **16** the forward coil is of reduced diameter and at its rearward end the coil is of enlarged diameter. As shown in Figs. 6 and 7, the forward coil of the spring **19** when disassembled is of a smaller diameter than the diameter of the neck portion **17** of the spindle **10** so that when the spring is

mounted over the neck portion **17** within the groove **18**, the forward coil will be under tension in gripping engagement with the neck. This gripping engagement by the smaller forward coil serves to position or align the retaining spring **19** properly within the groove **18** at all times and under all conditions of operation. To effect this gripping engagement, the inner face of the forward free end **19***a* of the forward coil is in tight frictional engagement with the spindle neck **17** and this tight frictional engagement is maintained for somewhat more than 180°, at which point the coil commences to move progressively outwardly away from the neck **17** until the outer surfaces **22**, **23**, **24** and **25** of the larger upper or rearward coil project beyond the outer limits of the four flat side surfaces of the square **11** as shown more particularly in Figs. 3 and 4. The rearward free end **19***b* of the spring **19** terminates at a point spaced from the neck **17**.

The sides of the forward and rearward ends **19***a* and **19***b* of the spring are flattened as shown particularly in Figs. 2, 3 and 4 so as to engage intimately the side faces of the groove **18**. Also, as illustrated in Figs. 3 and 5, the neck **17** is integrally joined to the cap **16** and to the square **11** by annular fiillets **17***a* and **17***b* which serve to strengthen the construction and resist breakage or fracture of the cap **16** from the neck **17** and the neck **17** from the square **11**.

It is imperative that the large upper or rearward coil of the spring **19** projects beyond the outer limits of the flat side faces of the square **11** and it has been found in actual practice that the projection of the coil portions **22**, **23**, **24** and **25** to an extent of approximately .015 of an inch will afford satisfactory results provided, of course, that the square **11** and the square opening **13** of the socket are of a proper complementary sliding fit. In other words, the rearward coil must project to such an extent beyond the flat sides of the square **11** and be larger than the opening **13** of the socket member **12**, as shown in Fig. 4, as to be placed under compression when the socket member **12** is forced longitudinally thereover. Also the forward or smaller coil must snugly and securely grip the neck **17** under with a sufficient degree of tension so that the axis of the spring **19** will be maintained at all times coincidental with the axis of the neck **17**. This causes the large coil to be held properly and to be evenly spaced from the neck **17** and to project at its four spaced points **22**, **23**, **24** and **25** about its circumference beyond the limits of the four flat faces of the square **11**.

When the socket member **12** has been removed from the spindle **10**, the spring **19** assumes the uncompressed position shown in Fig. 3. In the event the operator of the rotary power tool desires to apply a socket member, such as **12**, to the spindle **10**, the socket member is initially moved rearwardly toward the square **11**, the circular cap end **16** first entering the square opening **13**. The cap **16** and the smaller forward coil of the spring **19** freely enter the square opening **13** until, as illustrated in Fig. 4, the rear vertical face bordering one side of the square opening **13** engages that portion of the spring coil immediately before it has reached its first fully outward projected position at point **25**. This initial contact facilitates entry of the spring and spindle into the square opening. The operator by the application of continued rearward force presses the socket member **12** against the spring **19** which becomes progressively compressed as the spring enters the square opening **13**. The surface of these projecting spring portions **22**, **23**, **24** and **25** being rounded, the operator, upon the application of a rearward force by the socket member **12** against the spring **19**, cams the upper coil into compressed condition so that the large spring coil with the square **11** then enters into the socket square **13** under compression.

As shown in Figs. 1, 2 and 5, the larger coil of the spring **19** bears against the inner flat surfaces of the

socket square **13** at four spaced points and because the forward or lower coil is in tight gripping engagement with the spindle neck **17**, the larger coil is positioned acurately within the socket square **13** even under compression. Hence, the expansive pressure of the spring **19** is applied substantially in equal amounts at equally spaced points within the socket square **13** and this results in a tight frictional engagement between the spring **19** and the socket member **12** which serves to retain the socket member **12** in proper longitudinal position on the square **11**. It has been found that although the frictional engagement between the spring **19** and the socket square **13** is of sufficient magnitude and character to prevent inadvertent removal of the socket member **12** during all normal operating conditions, nevertheless, the operator may readily remove the socket **12** by simply pulling it off the square with a minimum of effort.

As shown more particularly in Fig. 1 of the drawings, the square **11** is connected to the enlarged portion **20** of the spindle **10** by an integral annular fillet **21** which serves to greatly strengthen the spindle and square. Heretofore, with the detent type of retaining means, it has been necessary to form a sharp shoulder by joining the square directly at right angles to the enlarged spindle portion, this sharp shoulder being required to seat and engage the rearward end face of a socket member in order to locate properly and align the detent of the square with respect to the cooperating notch or groove in the retaining square opening of the socket member. Thus, because such accurate positioning was required, such socket members were usable only with the spindles and retaining means for which they were especially designed, and the spindle was not generally usable with socket members having square openings of varying lengths. However, with the present spindle and retaining means, no preciseness of positioning is required of the spindle and retaining means within the socket member, and the socket member need not be pushed up against the spindle shoulder **20**, thus permitting the use of the strengthening fillet. It is only necessary that the square **11** be inserted into the socket square opening **13** a sufficient extent to provide a firm driving engagement therewith and when this occurs the retaining spring **19** is also in proper retaining position.

From the foregoing it will be readily evident that the present invention possesses benefits and advantages not found in the retaining devices of the prior art. The socket member or annular work piece may be quickly forced over and affixed to the driving square by a forceful longitudinal movement in which position it is retained positively without any likelihood of removal or displacement therefrom during normal tool operation. No special tools are required to secure the socket member on the square nor are any required to disengage the member from the square and retaining means to effect its removal. Moreover, the improved spindle and retaining means comprising the present invention may be utilized in conjunction with socket members having polygonal openings of different longitudinal lengths since the retaining means is substantially universal in its application and requires no preciseness of fit or cooperation with any complementary retaining element in the socket square opening. All that is required is that the relationship between the socket opening and the retaining spring be such that there is a relatively tight frictional engagement therebetween as above explained. The use of spring urged detents as retaining means and their disadvantages has been eliminated by the above-described spring means which is not subject to misoperation or malfunctioning but which may be readily cleaned and inspected and which is capable of a long reliable life without the likelihood of failure.

Although the invention has been described in connection with one specific embodiment, it will be understood that various equivalent structures and modifications may

be resorted to without departing from the scope of the invention as defined in the appended claim.

We claim:

In combination, a rotary spindle adapted to project into and drive a work-engaging member and having an annular groove therein forming a spindle neck portion of reduced size, and means for detachably securing a work-engaging member on said spindle comprising a coil spring in said groove carried by and encircling said spindle neck portion and having a forward coil secured in tight gripping engagement with said spindle neck against lateral displacement relative thereto and a rearward coil spaced from said neck and having circumferential portions thereof extending beyond the peripheral limits of said spindle, said forward and rearward coils having their

outer sides flattened for intimate engagement with the adjacent radial side faces of the annular groove in the spindle, said rearward coil being adapted to be engaged and radially inwardly compressed by the interior of the work-engaging member to retain the same in operable position on the spindle.

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