July 5, 1955 C. T. SCHODEBERG 2,712,254

POWER DRIVEN IMPACT TOOL

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Fig. 1.

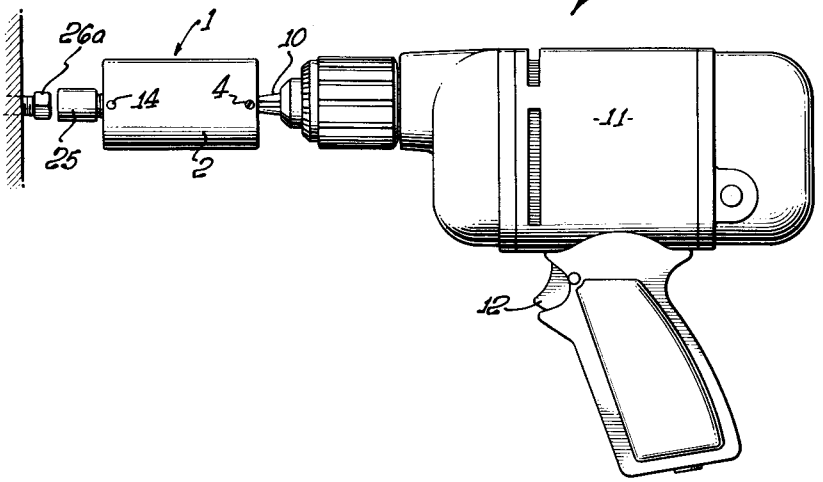


Fig. 2.

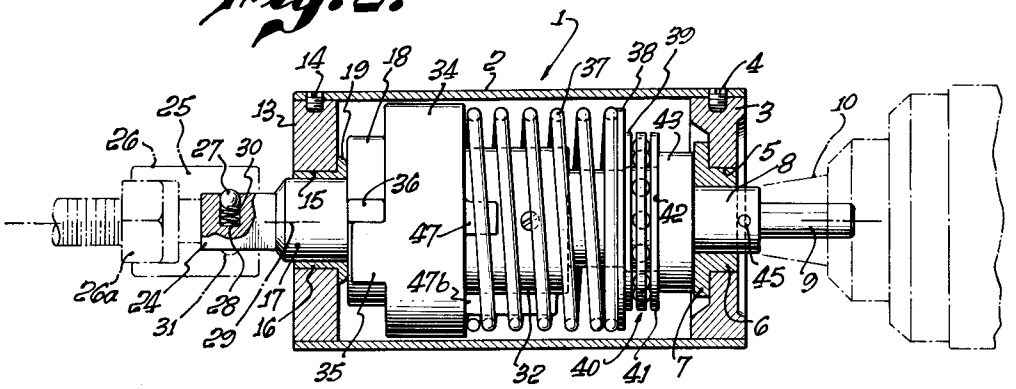
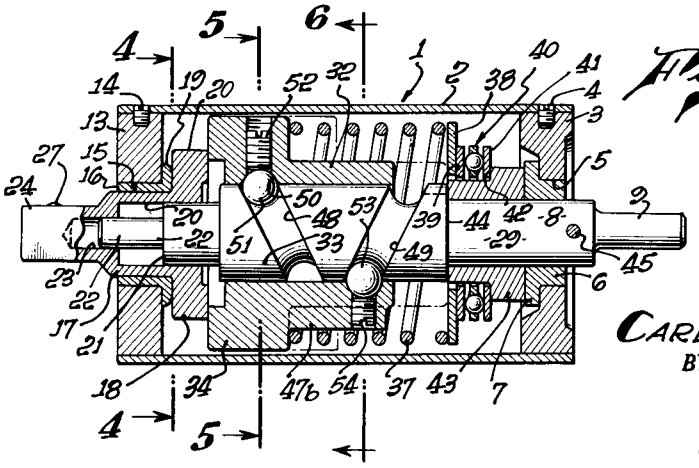


Fig. 3.



INVENTOR.
CARL T. SCHODEBERG,
BY
John F. Lamb
ATTORNEY.

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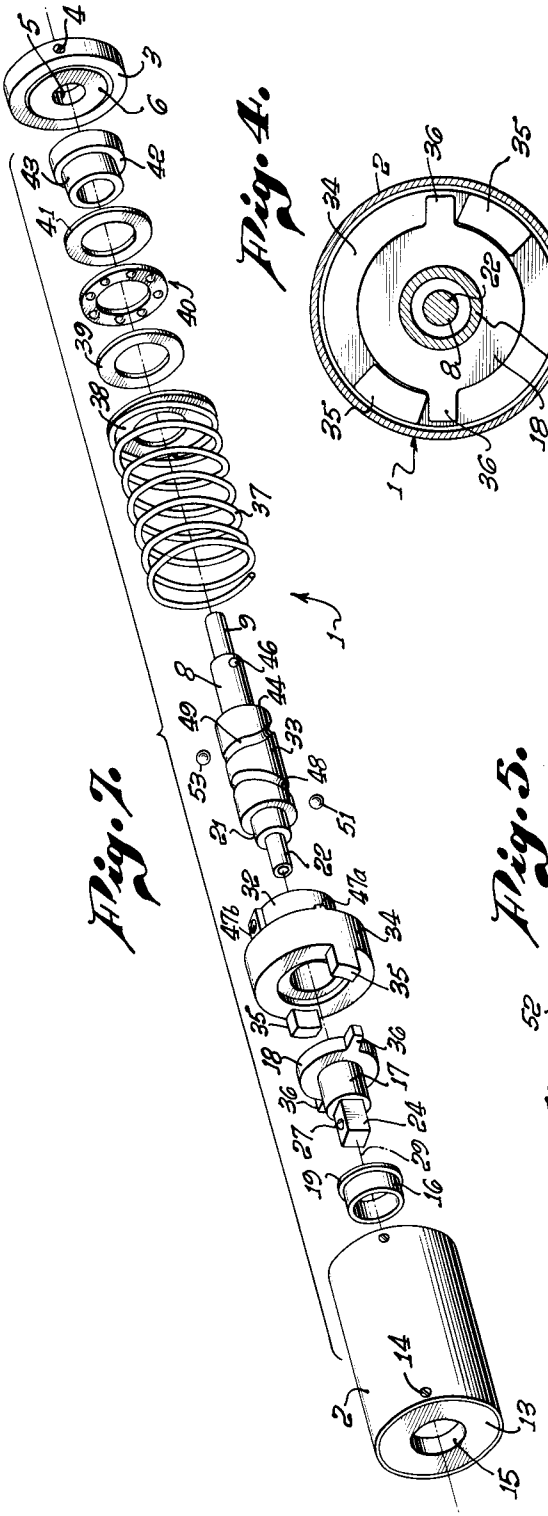


Fig. 7.

Fig. 4.

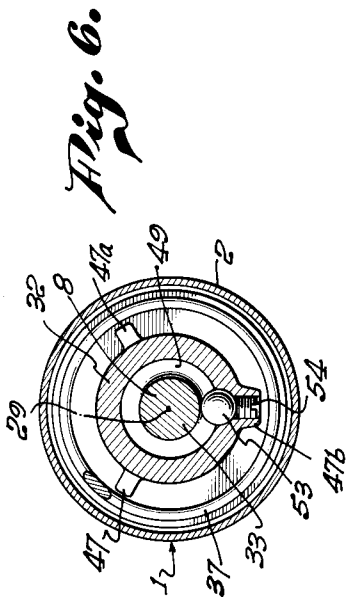


Fig. 6.

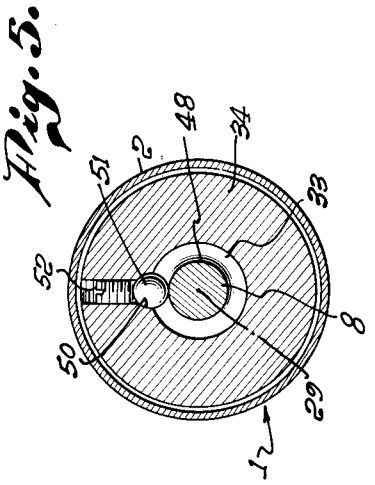


Fig. 5.

CARL T. SCHODEBERG,
INVENTOR.

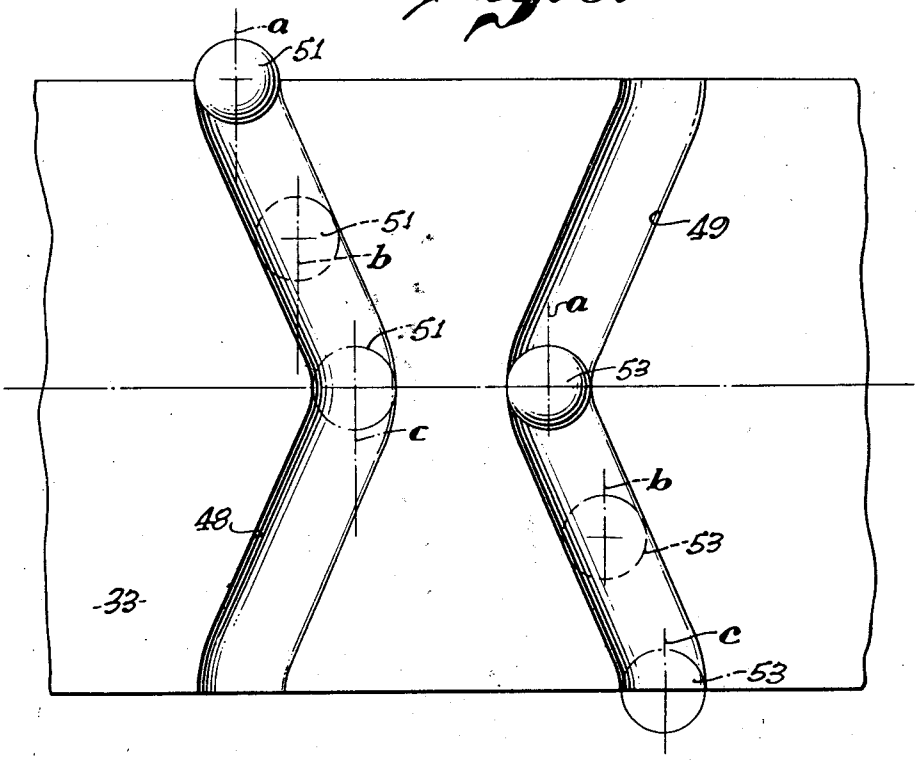
BY John Flam
ATTORNEY.

July 5, 1955 C. T. SCHODEBERG 2,712,254

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Fig. 8.



CARL T. SCHODEBERG,
INVENTOR.

BY John F. Flam
ATTORNEY.

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POWER DRIVEN IMPACT TOOL

Carl Theodore Schodeberg, Los Angeles, Calif.

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3 Claims. (Cl. 81—52.35)

This invention relates to a rotary tool capable of use either as a wrench or screw driver. More particularly, the invention relates to a device of this character, driven by an electric or air motor or the like, and so arranged as to provide periodic impact upon the wrench or screw driver, in the event the resistance to turning is increased.

It is one of the objects of this invention to provide a simple and inexpensive device of this character.

In impact tools, it is necessary periodically to store energy, such as in a spring, and to release the energy, while simultaneously the drive to the tool is interrupted and reestablished. It is another object of this invention to synchronize these steps in a simple manner, especially by the aid of a sloping groove or grooves that serve to connect and disconnect the drive as well as to store and release the impact energy.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming part of the present specification. The form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims

Referring to the drawings:

Figure 1 is a side elevation of an embodiment of the invention, shown as in driving relation to a power device, such as an electric motor;

Fig. 2 is an enlarged view, mainly in elevation of a device incorporating the invention, the casing elements being shown in section;

Fig. 3 is a longitudinal sectional view of the device incorporating the invention;

Figs. 4, 5 and 6 are sectional views taken along planes corresponding to lines 4—4, 5—5 and 6—6 of Fig. 3;

Fig. 7 is a pictorial exploded view of the device; and

Fig. 8 is a diagram illustrating the mode of operating of the device.

In the present instance the impact tool device **1** (Fig. 1) is shown as having a generally tubular casing **2** within which substantially all of the operating parts of the device are enclosed. At its right-hand end the tubular casing **2** is provided with a cover **3** telescoping within the casing **2** and held in position by one or more headless screws **4**. This cover has a central aperture **5** accommodating the bearing member **6** having a flange **7** resting against the inner surface of the cover **3**.

Bearing member **6** rotatably supports a shaft **8** having a reduced extension **9**. This reduced extension **9** is adapted to be held in a chuck (Figs. 1 and 2) rotated by a source of power, such as a hand motor **11**. The hand motor **11** may be of a conventional type operated either by electrical power, or by compressed air, and controlled by a trigger mechanism **12**.

The shaft **8** is thus continuously driven by the aid of the motor **11** whenever the motor is energized.

The casing **2** has a left-hand cover member **13** telescoping within the casing **2** and held in place by one or more headless screws **14**. Supported in the central aperture **15** of this cover member **13** is a bearing sleeve **16**. This bearing sleeve **16** serves rotatably to support a tool member **17**. This tool member **17** has a flange **18** adjoining the flange **19** of the bearing member **16**. The tool member **17** has an internal bore **20** within which telescopes the reduced left-hand end **22** of shaft **8**. This extension is piloted within the aperture **23** of the tool member **17**. In this way the shaft **8** is adequately supported for rotation.

The left-hand extremity **24** of the tool member **17** is non-circular in cross section (Fig. 7). In the present instance it is shown as square, capable of being used as a wrench of the type adapted to be received in a socket or recess in the head of a bolt or screw.

Optionally, it may be converted into a socket wrench by the aid of an adapter **25** shown in Figs. 1 and 2. This adapter is arranged to be detachably coupled to the extension **24**. For this purpose, at its right-hand end it has a square aperture into which the extension **24** fits. At its left-hand end the adapter **25** is provided with a socket wrench portion **26** adapted, for example, to engage the head **26***a* of a nut or bolt.

The adapter **25** is detachably coupled to the extension **24** by the aid of a spring pressed ball **27** (Fig. 2) located in a recess **28** of extension **24**, and radial to the axis **29** of rotation. The upper edge of this recess **28** may be upset in order to restrain the ball **27** against removal. A spring **30** is located in the recess **28** for urging the ball **27** into the annular groove **31** formed in the interior of the adapter **25**.

During the period that the resistance to turning of the tool holding member **17** is quite low, there is a direct mechanical drive between the shaft **8** and the tool holder **17**. When the resistance torque increases sufficiently this direct coupling is interrupted. Thereafter, upon continuation of the rotation of the shaft **8**, an impact blow is imparted to the member **17**, urging it angularly.

For this purpose, the shaft **8** carries a driving member **32**. This driving member **32** is in the form of a hollow cylindrical body capable of relative rotation with respect to the enlarged intermediate portion **33** of shaft **8**. The body member **32** has a running fit with respect to this enlarged shaft portion or member **33**. At its left-hand end this driving member **32** is provided with a relatively thick flange **34**. This flange carries on its left-hand face a plurality of driving elements or projections **35**. Two are shown in this instance, arranged diametrically opposite each other. These driving elements **35** project generally in a direction parallel to the axis **29** (see particularly Figs. 4 and 7). They cooperate with radially extending diametrically opposite abutments or elements **36** mounted on the flange **18** of the driven member **17**.

As viewed in Fig. 4, the driving elements **35** cooperate with the elements **36** to rotate the driven member **17** in a counterclockwise direction.

The driving member **32** is continuously urged toward the left, as viewed in Figs. 2 and 3. In this way the elements **35** are urged into cooperative driving relationship with the elements **36**. For this purpose a compression spring **37** is provided. The left-hand end of this compression spring engages the flange **34**. The right-hand end engages a collar or washer **38**. This collar **38** is in contact with the left-hand race **39** of a thrust ball bearing structure **40**. The right-hand race **41** of this thrust bearing structure abuts shoulder **42** of a spacer bushing **43**. The shaft **8** extends through this bushing **43**.

The arrangement is such that when the shoulder **44**, formed between shaft **8** and its enlarged portion **33**, approaches closely to the left-hand face of the bushing **43**, the shaft **8** extends for a short distance through the bear-

ing member **6**. A pin **45** passes through a diametrical aperture **46** (Fig. 7) of the shaft **8** to restrain the spring **37** in compressed condition between the collar **38** and flange **34**. The spring **37** exerts a relatively large expansive force even upon a small compression thereof.

The driving member **32** is provided with exterior equiangularly spaced projections **47**, **47***a* and **47***b* (see particularly Fig. 6) serving as a guide for maintaining the spring **37** substantially centralized with respect to the axis of rotation **29**.

In order to rotate the tool member **17**, a coupling is effected between the shaft member **33** and the driving member **32**. This coupling is so arranged that when the resisting torque increases, the driving member **32** is urged toward the right, as viewed in Figs. 2 and 3, until the members 35 and **36** separate. This action also stores energy in the spring **37** since it is compressed by an amount corresponding to the width of the driving abutments or elements **35**.

As soon as the uncoupling is effected the stored energy in spring **37** urges the driving member **32** toward the left and the elements **35** are then urged into cooperative driving position. Continued rotation causes the abutments **35** to engage the abutments **36** whereby an impact blow is imposed upon the abutments **36**.

For securing this type of drive between shaft member **33** and driving member **32**, use is made of one or more oblique grooves **48** and **49** in the periphery of the shaft member **33**. These grooves are of substantially semicircular cross section.

In order that the mechanism operate equally as well for either direction of rotation, both grooves **48** and **49** are formed as complete loops. The loop formed by groove **48** is oblique to axis **29**, and the loop formed by groove **49** is oblique but in an opposite direction to groove **48**, and the obliquities are equal.

These grooves **48** and **49** are shown to best advantage in Figs. 7 and 8. In order not to confuse the drawings, the grooves **48** and **49** in Figs. 5 and 6 are shown in planes normal to the axis **29**. Fig. 8, however, shows the development of the grooves **48** and **49** upon the periphery of member **33**.

The inner periphery of driving member **32** (Figs. 3 and 6) is provided with a ball seat **50** within which is seated a ball **51**. This ball **51** has a spherical surface that cooperates with the groove **48**. It is held in groove contacting position by the aid of the headless screw **52**.

Diametrically opposite to the ball **51** there is located a similar ball **53** cooperating with groove **49** (Figs. 3 and 6). This ball **53** is held in cooperative engagement with the groove **49** by the aid of a headless screw **54** located in the projection **47***b*.

By referring to Figs. 3 and 8 the action of the mechanism may be properly described.

As the shaft **8** is rotated (in a counterclockwise direction, as viewed in Fig. 4) the elements **35** serve to drive the elements **36** and a direct drive is effected between the members **32** and **17**.

When the resistive torque increases upon tool member **17**, the shaft member **33** advances angularly ahead of this tool member. The balls **51**, **53** both move toward the right. At the start of this action, the balls **51** and **53** are in position *a* of Fig. 8. This also corresponds to the position illustrated in Fig. 3. Now as the shaft **8** continues to rotate against the resistive torque, the balls **51** and **53** move by equal increments toward the right along grooves **48** and **49**. An intermediate position *b* of these balls is illustrated in Fig. 8. The balls **51** and **53**, however, remain axially spaced by the same amount as before.

Since the balls **51** and **53** are carried by the driving member **32**, the driving member **32** is urged toward the right during this action, compressing the spring **37**. Energy is therefore stored in this spring.

When the balls **51** and **53** (and driving member **32**) reach a position corresponding to position *c*, the members **35** of driving member **32** are withdrawn to the right, out of driving relation to members **36**. This position *c* corresponds to nearly the extreme rightward extent of grooves **48** and **49**.

As soon as this occurs, the resistive torque imposed upon member **32** is greatly reduced. Angular rotation of shaft member **33** and driving member **32** continues and is ahead of the driven member **17**. The left-hand surfaces of the driving projections or abutments **35** (as viewed in Fig. 2) slide over the righthand surfaces of members **36**. After a small relative angular movement, the members **35** will have been moved out of angular overlap with the respective members **36**. Then the force of the spring **37**, operating through balls **51** and **53**, and grooves **48** and **49**, effects a quick advance of shaft **8**, and an impact blow is effected upon the members **36** by members **35**. By the time member **32** moves into a driving position, the shaft **8** will have brought the members **35** into contact with members **36**. The cycle can then be repeated.

Since the grooves **48** and **49** form symmetrical loops, the same action occurs for a reverse direction of rotation.

The inventor claims:

1. In a rotary impact tool mechanism: a driven tool holding member, a rotary driving member; said members being rotary on a common axis, and having interengaging elements by the aid of which a drive may be effected, said driving member being axially movable to couple and uncouple the members; a resilient means urging said members to coupling position; a shaft mounted on said common axis and adapted to be power rotated; said shaft having a pair of axially spaced peripheral grooves each in the form of a closed loop and symmetrically oblique to the axis; and projections on diametrically opposite parts of the driving member and respectively entering said grooves.

2. In a rotary impact tool mechanism: a casing; a rotary shaft having an end extending beyond one end of the casing for connection to a source of rotary power; bearing means carried by the casing supporting the shaft for rotation about an axis; a driven tool holding member having an end extending beyond the opposite end of the casing for connection to the load; bearing means carried by the casing supporting said driven member for rotation about said axis; a rotary driving member in the casing supported upon the shaft for relative rotation with respect thereto; means for axially moving the driving member with respect to the shaft in accordance with the relative angular movement therebetween, comprising means forming a pair of axially spaced peripheral grooves on said shaft, each groove being in the form of a closed loop, the grooves being equally oblique to the said axis and symmetrically oriented with respect to a plane normal to said axis, and ball detents carried by the driving member extending respectively into the grooves, the ball detents being axially spaced from each other in an amount corresponding to the axial spacing of the grooves, the ball detents being located on diametrically opposite sides of said axis, the detents being capable of simultaneously engaging respectively those portions of the grooves located nearest the driven member to determine a limited axially advanced position of said driving member; means forming a coupling between the members separable upon a predetermined axial retraction of said driving member from said axially advanced position, comprising abutments carried respectively by the members; and a helical compression spring extending about the driving member and engaging at opposite ends, said bearing means and said driving member for urging the driving member toward said axially advanced position.

3. In a rotary impact tool mechanism: a casing; a rotary shaft having an end extending beyond one end of the casing for connection to a source of rotary power; bearing means carried by the casing supporting the shaft for rotation about an axis; a driven tool holding member

having an end extending beyond the opposite end of the casing for connection to the load; bearing means carried by the casing supporting said driven member for rotation about said axis; a rotary driving member in the casing supported upon the shaft for relative rotation with respect thereto; means for axially moving the driving member with respect to the shaft in accordance with the relative angular movement therebetween, comprising means forming a pair of axially spaced peripheral grooves on said shaft, each groove being in the form of a closed loop, the grooves being equally oblique to the said axis and symmetrically oriented with respect to a plane normal to said axis, and ball detents carried by the driving member extending respectively into the grooves, the ball detents being axially spaced from each other in an amount corresponding to the axial spacing of the grooves, the ball detents being located on diametrically opposite sides of said axis, the detents being capable of simultaneously engaging respectively those portions of the grooves located nearest the driven member to determine a limited axially advanced position of said driving member; means

forming a coupling between the members separable upon a predetermined axial retraction of said driving member from said axially advanced position, comprising abutments carried respectively by the members; a helical compression spring extending about the driving member and engaging at opposite ends, said bearing means and said driving member for urging the driving member toward said axially advanced position; and a pin detachably carried by the said end of said shaft limiting axial movement of said shaft under the influence of said compression spring.

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