

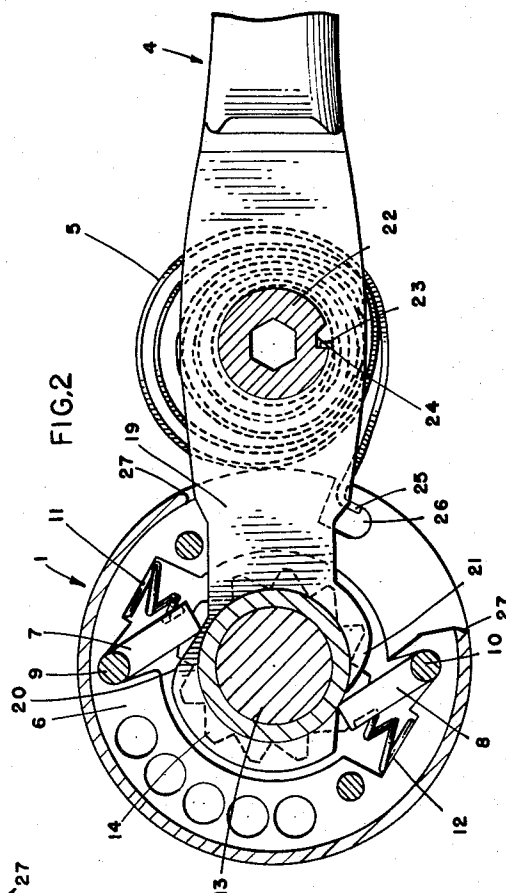
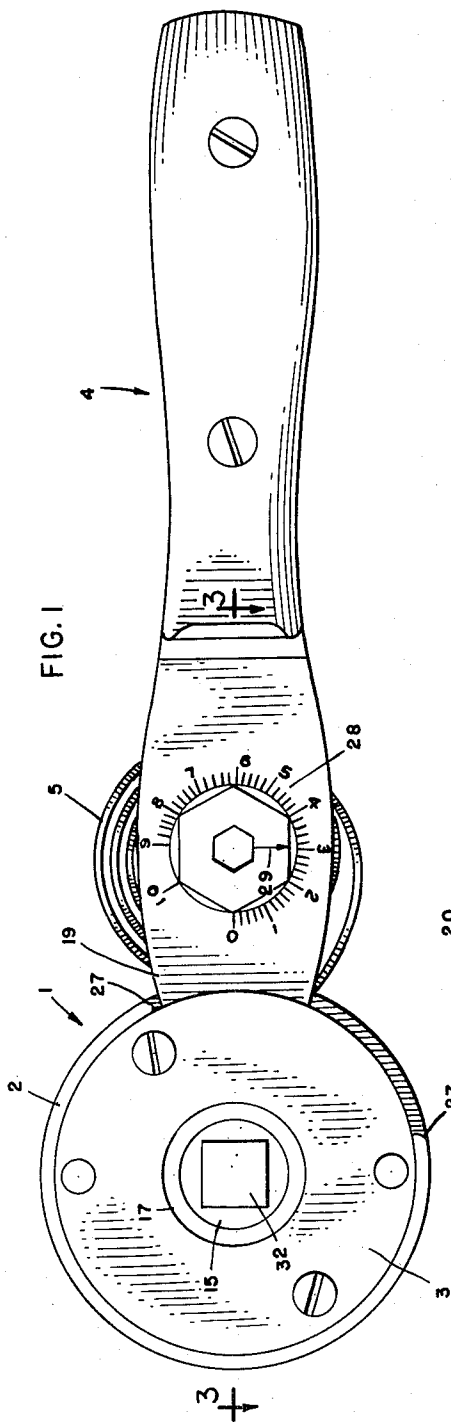
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O. J. SWENSON
RATCHET TYPE IMPACT TOOL

2,661,647

Filed July 11, 1950

2 Sheets-Sheet 1



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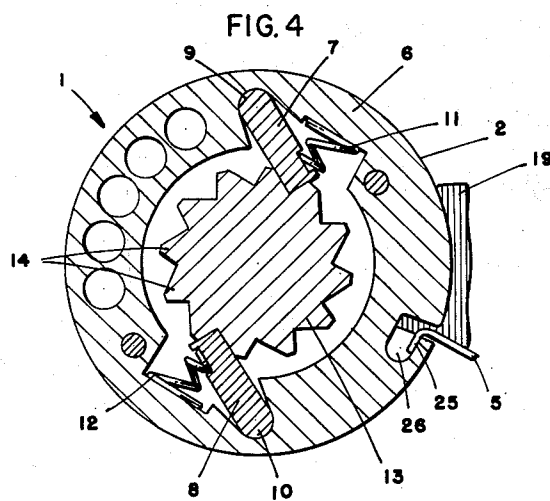
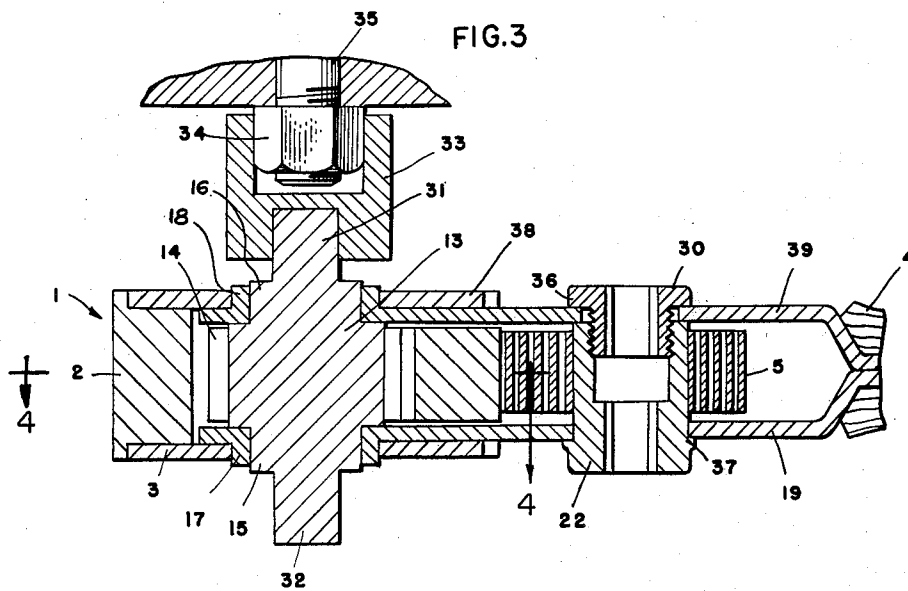
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RATCHET TYPE IMPACT TOOL

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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RATCHET TYPE IMPACT TOOL

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4 Claims. (Cl. 81—52.3)

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This invention relates to hand-operated impact tools and, more particularly, to a hand-operated tool for applying magnified force to threaded type fastenings.

The use of power driven impact tools to provide a magnified torque force for the driving of threaded type fastenings, such as nuts, bolts, screws and the like is already known. The common type of impact tool is one which employs a small electric motor as the driving force and is adapted to use in assembly line shops where one operator performs a single operation on a large number of nuts or bolts. Such a tool has limited use, however, because it must be used proximate to an electrical outlet and it is suitable for employment only on relatively small threaded fastenings. The tool has the further disadvantage of causing operator fatigue due to the vibration and impact which is transmitted to the operator.

It is an object of this invention to provide a hand-operated tool which is capable of imparting a concentrated torsional force of considerably greater magnitude than the force that may be applied directly with a conventional hand-operated tool.

Another object of the invention is to provide a hand-operated tool which is capable of imparting a torsional force of great magnitude in combination with a ratchet element thereby to permit operation of the tool in a limited space.

A further object of the invention is to provide a hand-operated tool which is capable of imparting a concentrated torsional force of adjustable and controlled magnitude.

These and other objects and advantages of the invention will become more apparent from a consideration of the following description taken in conjunction with the accompanying drawings in which:

Figure 1 is a side elevational view of a tool embodying the invention;

Figure 2 is a longitudinal sectional view through the rotor head of the tool;

Figure 3 is a partial sectional view taken along the lines 3—3 of Figure 1; and

Figure 4 is a sectional view of the head of the tool taken along a line corresponding to the lines 4—4 of Figure 3.

The present invention contemplates a hand-operated impact tool embodying a torque magnifying feature. The tool may have a ratchet arrangement for use in limited space and the tool also may have a torque controlling or limiting feature.

Referring to the drawings in detail a rotor 1

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comprising an annular surface 2 and a top plate 3 is associated with a handle element 4 and a spring 5. The rotor 1 is made up of the body 6 (Fig. 4) into which is set the pawls 7 and 8 which are pivoted at 9 and 10 respectively and which are held in extended position by the springs 11 and 12.

A ratchet wheel 13 is adapted to fit within the annular opening in the rotor 1. The teeth 14 of the ratchet 13 are adapted to engage the leading edges of the pawls 7 and 8 in their advanced position. The ratchet 13 is carried on its bearing surfaces 15 and 16 (Figure 3) within the trunnions 17 and 18 which are integral parts of the extensions 19 and 39, respectively, of the handle 4. The ends of the extension 19 and of its companion extension 39 are pivotally associated with the ratchet wheel 13 and with the rotor 1 at the common axis of these two elements. The extension 19 has a pair of cam shaped surfaces 20 and 21 (Fig. 2) which are operatively associated with the leading edges of the pawls 7 and 8 and which serve to disengage the pawls from the teeth 14 of the ratchet wheel when relative rotational movement in the proper direction takes place between the rotor 1 and the handle 4.

The pawls 7 and 8 are fitted in recesses in the rotor body 6 and are held in their respective seats with freedom to oscillate on the axis of the seats by the plate 3 and its companion plate 38 (Fig. 3). The springs 11 and 12 cause the pawls 7 and 8 to bear against the teeth 14 of the ratchet wheel 13 during clockwise rotation of the rotor 1 but permit free rotation of the rotor 1 in a counterclockwise direction by allowing the pawls to slide resiliently over the ratchet teeth.

The spiral spring 5 is mounted on the arbor part 22 (Fig. 2) which in turn is fixedly mounted between the extension 19 of the handle 4 and its corresponding extension 39. The inner end 23 of the spiral spring 5 is hooked and adapted to engage the edge of the slot 24 in the arbor part 22 to prevent relative rotational movement between the spring and the arbor. The outer end 25 of the spring is also hooked and is adapted to be inserted into the slot 26 in the rotor body 1. By this arrangement the spring 5 can be caused to react with a greater or lesser force between the rotor 1 and the handle 4 by rotation of the arbor part 22 in a direction to cause compression of the spring 5, or decompression thereof.

The arbor part 22 can be locked to the handle 4 in any desired position and at any incidental spring tension by tightening a lock screw 30 (Fig. 3) on the rear face of the handle. The rotor 1

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is restrained from rotation under influence of the spring 5 by contact of the shoulder 27 against the extension 19 of the handle member 4. The graduated dial 28 imprinted on the extension 19 of the handle member 4 (Fig. 1) and the arrow 29 imprinted on the outer end of the arbor part 22 allow the operator to make reproducible settings of the tension on the spring 5 at any desired value within its range. These elements of the device make possible the torque adjusting and controlling feature of the invention.

Other details of the construction of the tool will be brought out by describing the function of the tool when applied to the tightening of a nut on a bolt. A pair of shaft extensions 31 and 32 (Fig. 3) are integrally associated with the ratchet wheel 13 and are adapted to receive a standard socket 33 of a socket wrench set. To operate the tool, the extension 31 is inserted into the matching square opening of the socket 33 and the socket is fitted over a nut 34 on a bolt 35. The handle 4 is then rotated clockwise about the axis of the shaft extension 31. Alternatively the handle 4 may be operated in a reciprocating motion thereby employing the ratchet feature of the tool. In either mode of operation the unique features of the tool commence to function as soon as the nut becomes tight enough to offer resistance to further rotation.

The resistance of the nut 34 is carried through the socket 33 to the shaft extension 31 and to the ratchet wheel 13. The ratchet is held in constant angular relationship with the nut and ceases rotating when the nut ceases. The rotor 1 likewise ceases rotation because the pawls 7 and 8 are bearing against the teeth 14 of the ratchet 13. Continued rotation of the handle 4 now causes the spring 5 to be compressed and to absorb and to store the input energy of the handle stroke. When the handle has advanced sufficiently in axial relationship to the rotor 1 the cam surfaces 20 and 21 encounter the leading edges of the pawls 7 and 8 and move them outwardly against the springs 10 and 11 until they clear the engaged teeth 14 of the ratchet wheel 13.

With the pawls no longer restraining it, the rotor 1 accelerates rapidly in a clockwise direction impelled by the energy previously stored in the spring 5 by the movement of the handle 4. The rate of rotation attained by the rotor 1 is many times greater than could be developed by direct application of manual force to the rotor. As the pawls 7 and 8 pass over the ratchet teeth from which they are disengaged, the springs 11 and 12 cause them to return to their original advanced position relative to the rotor. At this time the cam surfaces 20 and 21 will be in their original disengaged position relative to the rotor. The pawls 7 and 8 thus engage the next opposed pair of teeth 14 on the ratchet wheel 13 and the rotational energy contained in the swiftly moving rotor 1 is released suddenly as impact between the pawls 7 and 8 and the teeth of the ratchet wheel 13. In other words, the ratchet and pawl members also serve as anvil and hammer members, respectively. This impact gives a rotational impetus to the ratchet wheel 13 which is transmitted to the extension 31 and through the engaging socket 33 to the nut 34. A large force has been brought to bear against the nut as a result of the action of the tool which has built up a large torsional force in the spring during the rotation of the handle 4.

If it should be necessary or desirable not to rotate the handle 4 in a complete circle, the han-

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dle may be operated alternatively in a reciprocating motion. The counterclockwise portion of the reciprocated motion cycle will cause the rotor 1 to rotate counterclockwise along with the handle 4 because the extensions 19 and 39 of the handle engage the shoulder 27 of the rotor when counterclockwise motion has begun. Since the ratchet wheel 13 is being held stationary by its connection with the socket and nut, the pawls 7 and 8 drag over the ratchet teeth 14 and offer almost negligible resistance to movement of the rotor and the handle in counterclockwise direction. When the handle is again rotated in a clockwise direction, each of the pawls 7 and 8 will engage the next ratchet teeth 14 in a clockwise direction from them. Further rotation of the handle in a clockwise direction will then produce repeated impacts against the nut in the manner described.

To turn a nut in a counterclockwise direction, as to remove it from a bolt, the tool is turned over and the shaft extension 32 is inserted into the socket 33 instead of the shaft extension 31. Thereafter, the operation of the tool is exactly the opposite as described above for tightening the nut.

After operating the tool in the manner described for a time sufficient to cause it to impart several impacts to the nut, an equilibrium is reached between the resistance offered by the nut to further rotation and the torsional force imparted to it by each additional impact. Under continued subjection to impacts of the same intensity, the nut will not be further rotated or tightened. Hence, the tool functions as a torque controlling or torque limiting wrench in the manner hereafter described.

The initial tension of the spring 5 determines the amount of energy which can be stored in it and released at each impact. It is a feature of the tool that the tension on the spring, and thereby the force of the impacts, can be adjusted by a simple adjustment of the arbor parts in the tool. The arbor parts are manually rotated by means of suitable common wrenches in a suitable direction. The arbor parts may then be locked in the desired position by tightening the lock screw 30 which seats the shoulders 36 and 37 frictionally against the handle extensions 39 and 19. The degree of spring tension may be reproduced at each setting by simply aligning the arrow 29 with a predetermined number on the graduated dial 28. Hence, once the operator has determined a setting of the arrow and dial which will result in a certain torsional force upon operation of the tool, he need only reset the device to the same number in order to achieve the same torsional force at any future time.

During normal operation of the device while imparting impacts of a very large torsional force to a piece of work, the operator feels no shock in the handle from the impacts. This, together with the torque magnifying properties of the device and with the reciprocating ratchet feature of the tool, greatly reduces operator fatigue incidental to tightening and loosening threaded type fastenings. Bolts and nuts which would ordinarily require a four foot wrench plus an extension on the handle of the wrench may now be tightened or loosened by the simple operation of the present tool by a single operator.

The various features of the tool make it particularly useful in the operation of tightening and loosening bolts and nuts of large size, e. g., the size used in high pressure chemical equip-

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ment. The device is small and light in weight and can easily be operated in a limited space by an operator of normal strength.

The invention is hereby claimed as follows:

1. In a manually operable impact tool the combination of a rotatable tool head for engaging a threaded type fastening, manually actuated driving means, driving connections therebetween including ratchet and pawl members adapted to prevent relative movement of said driving means and said head in one direction and to allow relative movement thereof in another direction, a handle, cam means associated therewith for effecting separation of said ratchet and pawl members in response to movement of said handle when movement of said head is resisted by a predetermined force and spring means adapted to store up energy from the movement of said handle and to release said energy as impact energy upon the re-establishment of contact between said ratchet and pawl members.

2. In a manually operable impact tool the combination of a rotatable tool head for engaging a threaded type fastening, manually actuated driving means, driving connections therebetween including ratchet and pawl members adapted to prevent relative movement of said driving means and said head in one direction and to allow relative movement thereof in another direction, a handle, cam means associated therewith for effecting separation of said ratchet and pawl members in response to movement of said handle when movement of said head is resisted by a predetermined force, spring means adapted to store up energy from the movement of said handle and to release said energy as impact energy upon the re-establishment of contact between said ratchet and pawl members, and means for adjusting the original tension on said spring means.

3. In a manually operable impact tool the combination of a rotatable tool head for engaging a threaded type fastening, manually actuated driving means, driving connection therebetween including ratchet and pawl members adapted to prevent relative movement of said driving means and said head in one direction and to allow rela-

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tive movement thereof in another direction, a handle, cam means associated therewith for effecting separation of said ratchet and pawl members in response to movement of said handle when movement of said head is resisted by a predetermined force, spring means adapted to store up energy from the movement of said handle and to release said energy as impact energy upon the re-establishment of contact between said ratchet and pawl members, and means for adjusting and controlling the amount of torsional energy stored up in said driving means including arbor parts adjustable on said handle and operatively associated with one end of said spring means, said parts being adjustable to place said spring means under a predetermined tension.

4. A manually operable impact torsion tool comprising the combination of a tool head, driving means including ratchet and pawl means operatively associated to drive said head, energy storage means operative in response to manual operation to store up and release torsion energy in said driving means, cam means to cause disengagement of said ratchet and pawl means in response to manual operation when movement of said head is resisted by a predetermined force, and second energy storage means to cause said pawl means to reengage said ratchet means with impact in response to dissipation of energy stored in said first storage means, said ratchet and pawl means serving as anvil and hammer members, respectively, upon said reengagement.

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