Dec. 15, 1953 H. H. BURKHARDT 2,662,434

POWER-OPERATED ROTARY IMPACT WRENCH

Filed Feb. 28, 1952

3 Sheets-Sheet 1

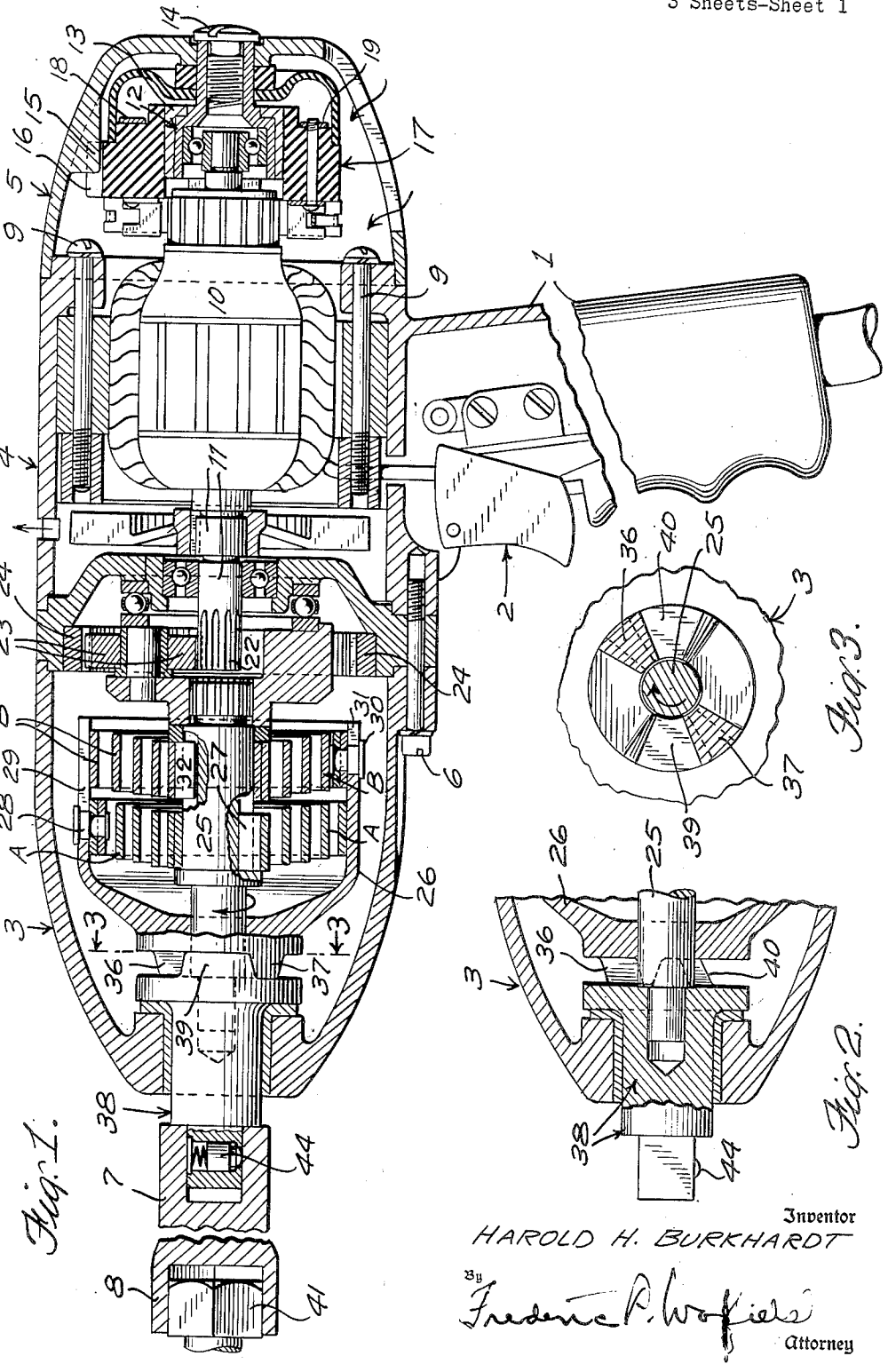


Fig. 1.

Fig. 3.

Fig. 2.

Inventor

HAROLD H. BURKHARDT

By Frederic P. Wolfield

Attorney

Dec. 15, 1953 H. H. BURKHARDT 2,662,434

POWER-OPERATED ROTARY IMPACT WRENCH

Filed Feb. 28, 1952 3 Sheets-Sheet 2

Fig. 4.

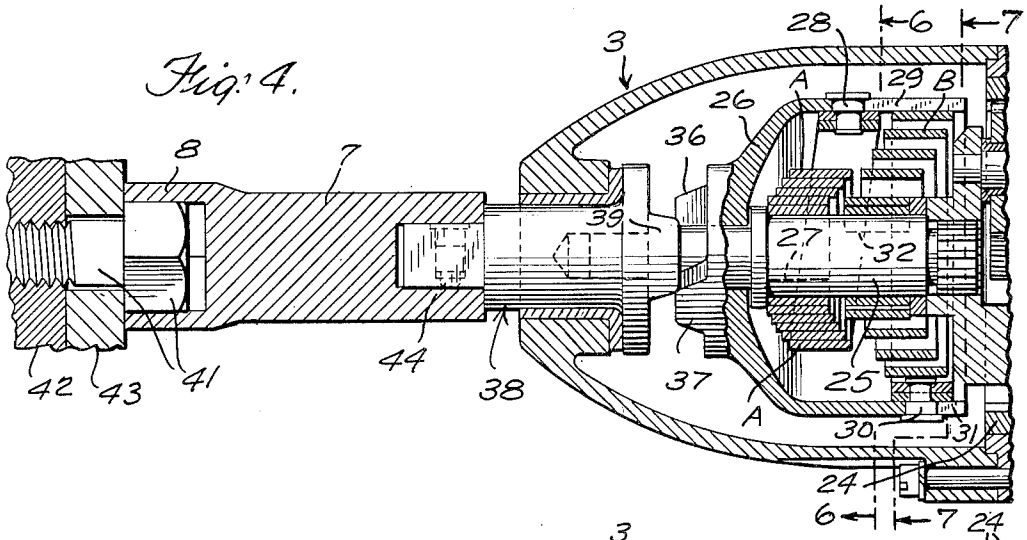
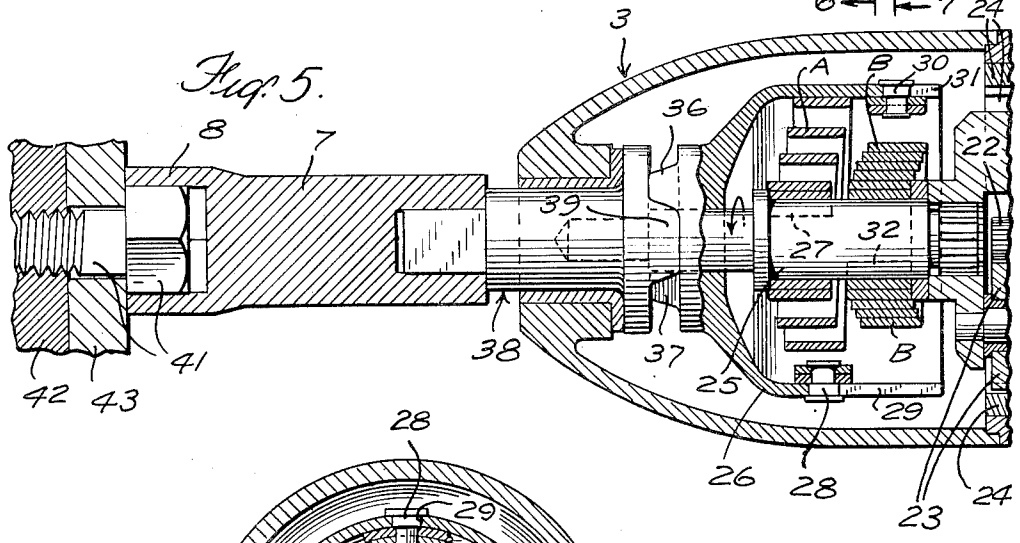


Fig. 5.



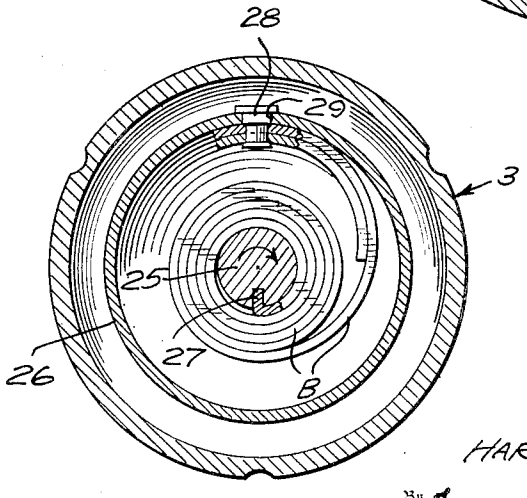


Fig. 6.

Inventor
HAROLD H. BURKHARDT

By Frederick Warfield

Attorney

Dec. 15, 1953 H. H. BURKHARDT 2,662,434

POWER-OPERATED ROTARY IMPACT WRENCH

Filed Feb. 28, 1952 3 Sheets-Sheet 3

Fig. 7.

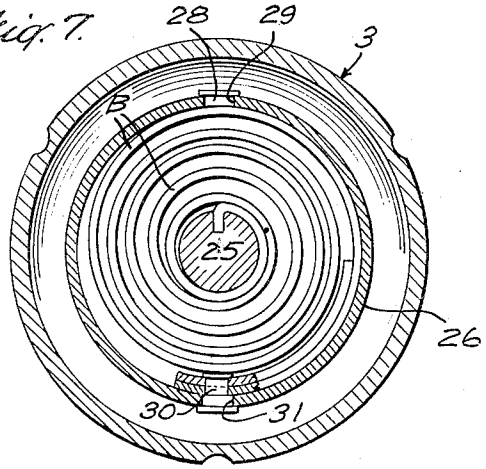


Fig. 8.

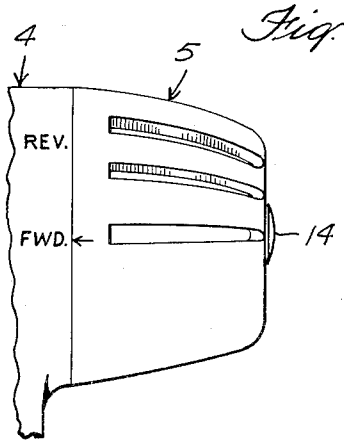


Fig. 9.

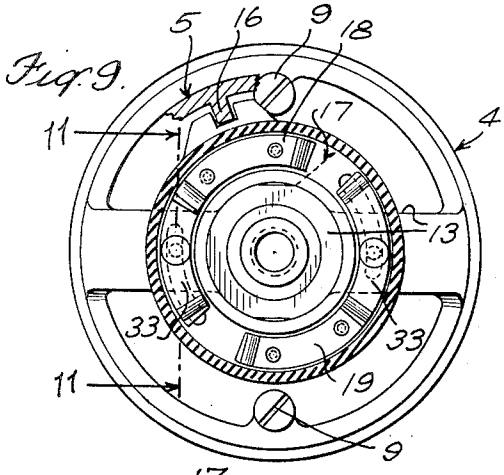


Fig. 10.

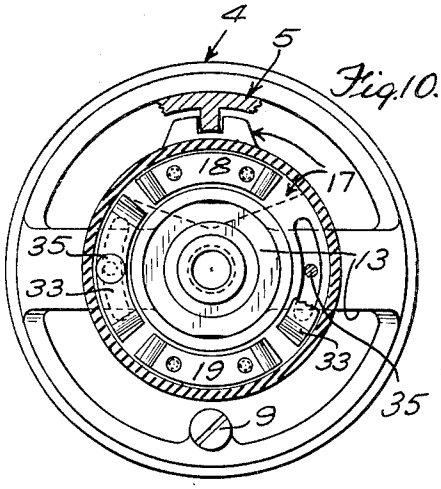


Fig. 11.

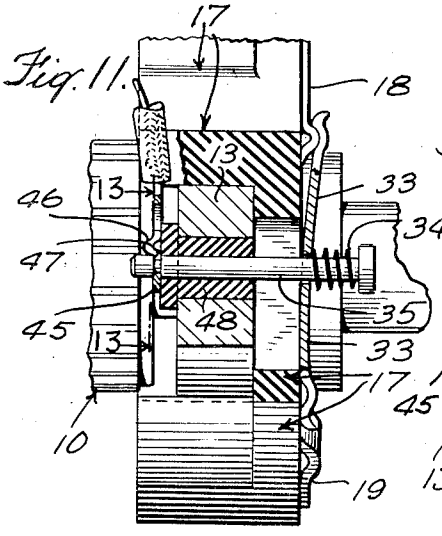


Fig. 13.

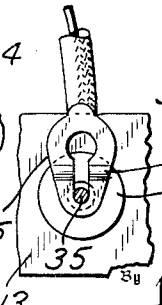
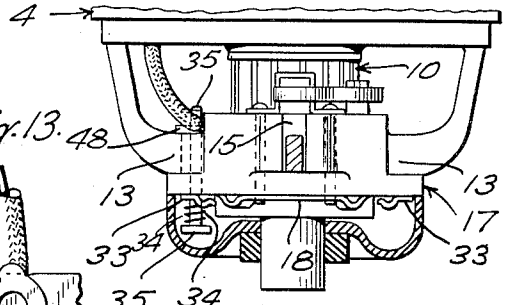


Fig. 12.



Inventor
HAROLD H. BURKHARDT
By
Attorney

Patented Dec. 15, 1953

2,662,434

UNITED STATES PATENT OFFICE

2,662,434

POWER-OPERATED ROTARY IMPACT WRENCH

Harold H. Burkhardt, Greenfield, Mass., assignor to Millers Falls Company, Greenfield, Mass., a corporation of Massachusetts

Application February 28, 1952, Serial No. 273,995

6 Claims. (Cl. 81—52.3)

1

This invention relates to impact tools generally, and more specifically, to impact wrenches.

An object is to provide an impact wrench which shall be comparatively simple in construction, thereby lending itself to ease in manufacture and which shall be efficient in operation, and able to withstand the severe tests met by such tools in use.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention, accordingly, comprises the features of construction, combinations of elements and arrangement of parts, which will be exemplified in the constructions hereinafter set forth, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a longitudinal cross section.

Figure 2 is a fragmentary longitudinal cross section.

Figure 3 is a fragmentary section taken on line 3—3 on Figure 1, looking in the direction of the arrows.

Figure 4 is a longitudinal cross section of the driven end of the impact tool showing a bolt about to be driven home.

Figure 5 is a longitudinal cross section, similar to Figure 4, but with the parts in position due to the driving of the power shaft in the opposite direction from that of Figure 4.

Figure 6 is a cross section on the line 6—6 of Figure 4, looking in the direction of the arrows.

Figure 7 is a cross section on the line 7—7 of Figure 4 looking in the direction of the arrows.

Figure 8 is a fragmentary rear end elevation view.

Figure 9 is a transverse section showing the parts in position for driving the tool in one direction.

Figure 10 is a similar view showing the parts in the off or neutral position.

Figure 11 is an enlarged section on the line 11—11 of Figure 9.

Figure 12 is an end plan view partly sectioned showing the parts in position, corresponding to that of Figure 10.

Figure 13 is a fragmentary section taken on line 13—13 of Figure 11.

Turning now to the drawings, Figure 1 shows the tool as driven by electric power with handle 1, and pivoted switch 2 for turning power on and off, as conventional in such tools.

2

The enclosing body of the tool is made up of three parts, 3, 4 and 5. Parts 3 and 4 are connected after assembly as by lead screw or screws 6, and the other end portion 5 is free to rotate about the central part 4, in order to change the direction of rotation of the driven tool, shown here as a wrench 7, encircling bolt head 41.

Carried by central cover portion 4 as by screw bolts 9 are the field pole pieces of an electric motor of conventional design having armatures 10, and driving a shaft 11.

The outer end of this motor shaft is carried in a ball bearing mounting 12, carried in a part 13, an extension of part 4, upon which is mounted part 5 and held for rotation by cap screw 14.

The rotatable outer end 5 of the cover section carries a projection 15 which engages a slot 16 in the rotatable part 17, which carries contact members 18 and 19, whereby upon rotating the part 5, contacts 18 and 19 may be changed from the position of Figure 9 to the position of Fig. 10 to determine the direction of rotation of the shaft.

This is shown clearly in Figures 9, 10 and 11, wherein contact members 18 and 19 are connected to 17, and upon rotation pass under one end or the other of the part 33, and thereby reverse the direction of rotation of the armature 11. The part 33 is held yieldingly in position by a spring 34 carried around the studs 35, as shown in Figures 11 and 13.

Part 35 is provided near its other extremity with a bevel or chamfer, and, near the end, with an annular groove 47. Part 45 the brush lead terminal shown in Fig. 11, is provided with a round hole and slot, the round hole to permit insertion of the stud 35, and the slot of a width suitable to accept the small diameter of groove 47 in stud 35. Terminal 45 is further provided with a stamped detent 46 to insure contact of terminal 45 with stud 35 under all conditions except when removal of the terminal is desired. Groove 47 is of a width greater than the height of detent 46. To attach terminal 45 to stud 35 it is only necessary to depress stud 35, compressing spring 34, and causing stud 35 to protrude beyond insulating bushing 48. By placing terminal 45 so that stud 35 enters the large round hole and terminal 45 is in line with groove 47 in stud 35, a slight pull on lead wire will displace terminal 45 until the small diameter of groove 47 comes to rest at the extremity of the slot, detent 46 having passed through the groove and come to rest on the opposite side of stud 35. Releasing pressure on the head of stud 35, thereupon locks all members together securely, ten-

sion on stud 35 by spring 34 causing pressure on contact 33, and, by reaction on terminal 45, with detent 46 preventing any possibility of unintentional breaking of electrical contact or mechanical assembly of the parts.

It is to be noted that the two studs serve to lock the entire reversing switch mechanism, making assembly and disassembly quick and easy without the use of tools.

It is also to be noted that the reversing mechanism not only reverses the brush connections, thereby reversing rotation of the motor, but it physically translates the brushes into the commutating plane most efficient for that rotation of the motor.

The commutator, brushes and other parts shown at the right of Figure 1, are of conventional design and are not further described.

The inner end of the shaft 11 is provided with teeth 22, meshing with a planetary gear 23, which through the fixed gear 24 shown, drives the shaft 25. About this shaft 25 is carried weight 26 free to revolve about the shaft 25 or to be displaced axially therealong. This weight 26 is driven, in the construction shown, by two torsion springs, A and B, each of which has one end locked to the shaft 25 and the other end connected to the weight 26. The weight 26 is provided on its forward extension with two radial lugs 36 and 37, provided with angular cam faces.

As shown, spring A is held to the shaft 25 by the spring end engaged in a slot in the shaft as at 27. The outer end of spring A is held by stud 28 to the weight 26. This stud 28 as shown in Figure 1 is at the lower end of a slot 29 in weight 26. This causes an offsetting of the coils on the spring A as shown, thus preloading the spring A in compression and assuring firm contact of weight 26 to anvil 38 before camming occurs and rapid return of weight 26 after camming.

This is also true of the upper spring B which is connected by a stud 30 resting in a short slot 31 while the connection at 32 to the shaft 25 is below the line of the stud 30, causing this spring also to be offset as shown.

Springs A and B are spirally wound, flat torsion springs of rectangular cross section which, as will be considered later, have a special function in this tool.

The anvil 38 is provided with two radial lugs 39 and 40 with mating cam faces, and the anvil carries at its outer end the wrench 7, shown as driving in this instance the bolt head 41, which may, as shown in Figures 4 and 5, connect the two parts 42 and 43. Figure 1 shows at 44 a spring pressed ball and pin acting as a releasable connection between the anvil 38 and the wrench 7.

The operation of this tool, as shown as a wrench, may now be followed. When the motor shaft 11 is revolving at its predetermined speed, the weight 26, driven through the torsion springs A and B, after a slight lag due to its inertia, revolves at the same speed.

When, however, the anvil is caused to stop or decelerate as by the fact that the bolt is driven substantially home, it causes a similar deceleration or stopping in the weight 26, the cams being engaged. The driving shaft, however, continues to rotate and torsional energy is stored in the springs. When the torque reaches a certain value, it causes the cams to disengage, as shown in Figure 4. At the moment of disengagement, the weight 26 rotates on the shaft 25 at the rotating velocity of the shaft 25 plus the energy imparted to it by the energy stored in the springs. As this spring energy is delivered to the weight 26, the compressive force of the spring is again asserted, and moves the weight 26 forward, so that it causes its cam lugs to strike those on the anvil with considerable impact.

Thus it will be seen that in operation by the switch 2, the wrench as shown, is driven in one direction to run the bolt quickly home and thereafter firmly set by the action of the spring control device shown. When this has been sufficiently accomplished, the power is released and the tool withdrawn.

When it is desired to turn the wrench in the opposite direction, whether for unscrewing a bolt or for screwing, a left-handed bolt, as distinguished from the more usual right-handed bolt, the operator has only to turn the outer end member of the cover 5 as by following the inscriptions "Rev." and "Fwd." for "reverse" and "forward" on Figure 8, and the operation is adjusted accordingly.

This energy storing device accordingly consists of a spirally wound flat spring, or springs, of rectangular cross section. This type of spring possesses special useful characteristics which may be enumerated as follows:

1. It is primarily used for storing torsional energy.
2. It occupies considerable space radially but very little in depth.
3. With its ends anchored, it resists axial displacement and thereby acts as a compression spring.
4. When a torsion spring is contained within a cup or ring and is subject to unwinding, it still possesses the ability to store torsional energy.
5. The unit stress becomes higher because, as it is unwound, the spring shortens rapidly, since one coil after another is compressed against the restraining periphery.

The same thing occurs in "winding" but the coils close on the arbor and the diameters being much smaller, the spring shortens at a slower rate.

6. This characteristic is made use of in an impact wrench by using two torsion springs, one "winding," and one "unwinding," so that in either direction of rotation the torsional force is equal.
7. This characteristic may also be made use of in an impact wrench equipped with only one torsion spring, because it stores torsional energy in either direction of rotation, although the torque builds up more rapidly in "unwinding" than in "winding," and the unit stress rapidly increases.

If the angle of deflection is not excessive, a spring can be designed to give satisfactory performance in both directions.

It will thus be seen that I have provided a construction which accomplishes all the objects set forth above, and others, and provides a most efficient, useful, and durable tool.

Since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description, or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention

which as a matter of language might be said to fall therebetween.

I claim:

1. In an impact tool, a driving shaft, a tool driven therefrom, a weight loosely mounted upon said shaft, cam lugs carried by said weight, an anvil carrying the tool, cam lugs on said anvil mating with the cam lugs on the weight, and a spirally wound flat spring, rectangular in cross section, connected at its inner end to the driving shaft and its outer end to the weight at a point spaced axially rearwardly from its connection to the driving shaft, so that the spring is offset toward the anvil.

2. In an impact tool, a driving shaft, a tool driven therefrom, a spirally wound flat spring rectangular in cross section, connected at its inner end to the driving shaft and at its outer end to the weight, and a second spirally wound flat spring rectangular in cross section oppositely wound to that of the first spring, and similarly connected at its inner end to the driving shaft and at its outer end to the weight.

3. In an impact wrench, a driving shaft, a wrench driven therefrom, an anvil carrying the wrench, a weight mounted freely upon the driving shaft, mating cam lugs carried by the anvil and the weight, two spirally wound flat springs rectangular in cross section, wound in opposite directions, each connected at its inner end to the driving shaft and at its outer end to the weight, and a manual means under the control of the operator for reversing the direction of rotation of the driving shaft.

4. In an impact tool, a driving shaft, a tool driven therefrom, a weight loosely mounted upon said shaft, cam lugs carried by said weight, an anvil carrying the tool, cam lugs on said anvil mating with the cam lugs on the weight, and a spirally wound flat spring, rectangular in cross section connected at its inner end to the driving shaft and its outer end to the weight.

5. In an impact tool, a driving shaft, a tool driven therefrom, a weight loosely mounted upon said shaft, cam lugs carried by said weight, an anvil carrying the tool, cam lugs on said anvil mating with the cam lugs on the weight, and a spirally wound flat spring, rectangular in cross section connected at its inner end to the driving shaft and its outer end to the weight substantially as shown and described.

6. In an impact tool, a driving shaft, a tool driven therefrom, a weight loosely mounted upon said shaft, cam lugs carried by said weight, an anvil carrying the tool, cam lugs on said anvil mating with the cam lugs on the weight, and a spirally wound flat spring, rectangular in cross section connected at its inner end to the driving shaft and its outer end to the weight, and a second spirally wound flat spring rectangular in cross section oppositely wound to that of the first spring, and similarly connected at its inner end to the driving shaft and its outer end to the weight, substantially as shown and described.

H. H. BURKHARDT.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,694,270	Lauper	Dec. 4, 1928
1,998,995	Petersen	Apr. 23, 1935
2,028,441	Decker	Jan. 21, 1936
2,100,552	Ripsch et al.	Nov. 30, 1937
2,111,280	Connell	Mar. 15, 1938
2,533,703	Wilhide et al.	Dec. 12, 1950
2,566,661	Hamlin	Sept. 4, 1951
2,583,147	Kaplan	Jan. 22, 1952