Sept. 11, 1956 G. R. NELSON 2,762,248

RECOIL REDUCING DEVICE FOR MAGNETIC FLUID VARIABLE TORQUE WRENCH

Filed April 2, 1954 2 Sheets-Sheet 1

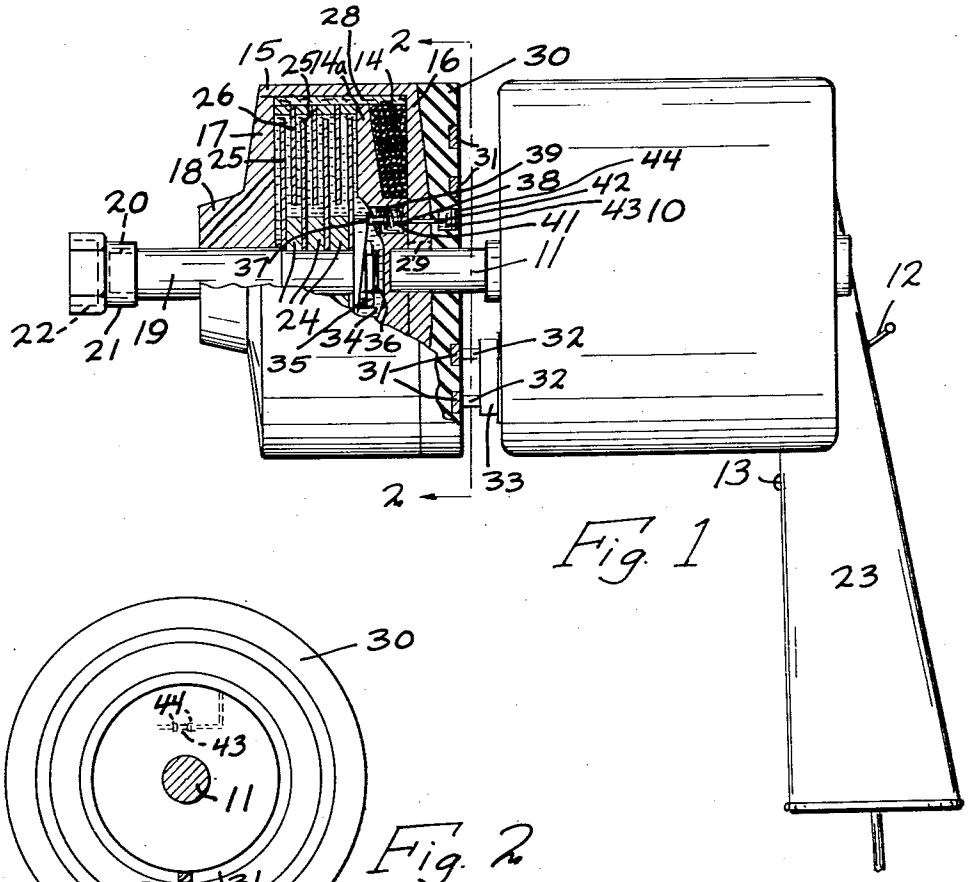


Fig. 1

Fig. 2

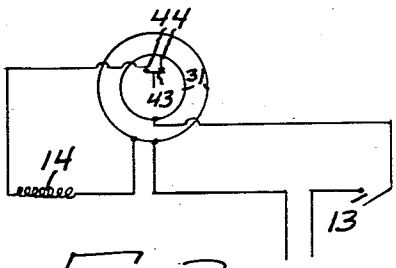


Fig. 3

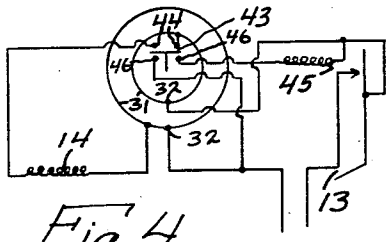


Fig. 4

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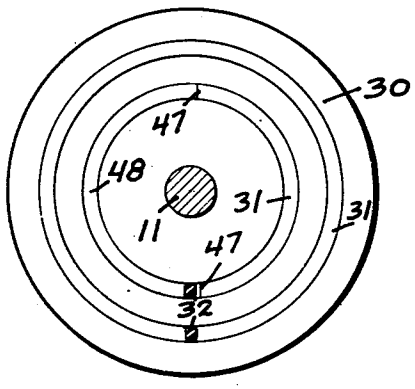


Fig. 5

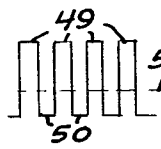


Fig. 6

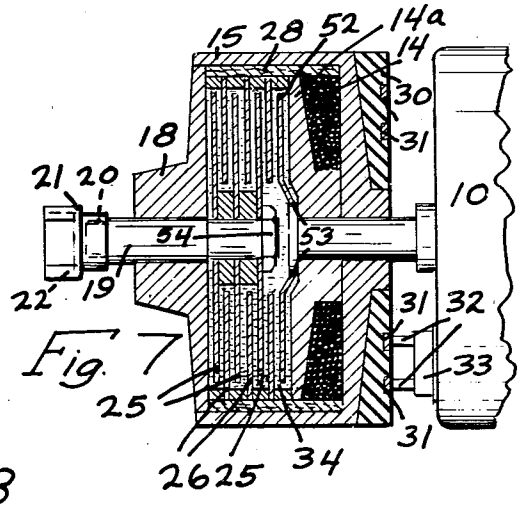


Fig. 7

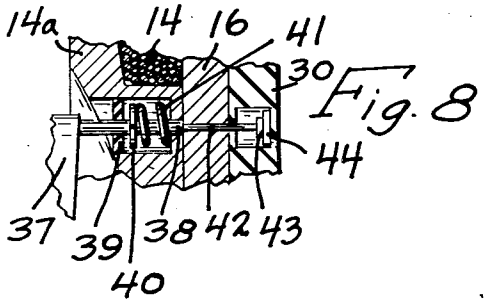


Fig. 8

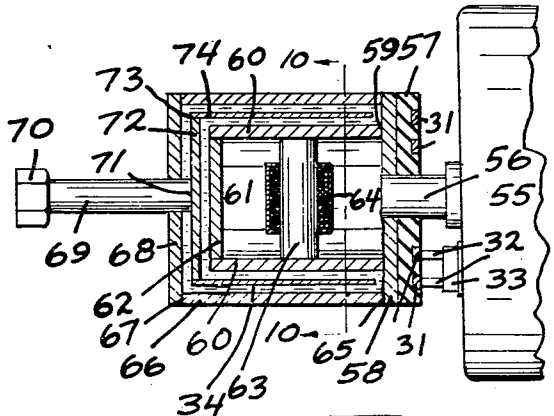


Fig. 9

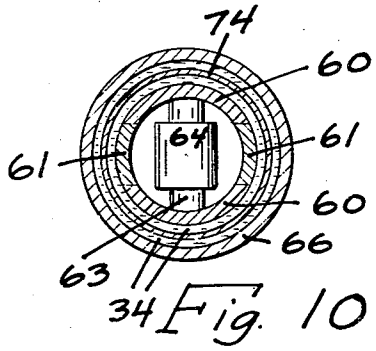


Fig. 10

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2,762,248

RECOIL REDUCING DEVICE FOR MAGNETIC FLUID VARIABLE TORQUE WRENCH

Gorman R. Nelson, Sioux Falls, S. Dak.

Application April 2, 1954, Serial No. 420,654

4 Claims. (Cl. 81—52.4)

My invention relates to a recoil reducing device for magnetic fluid torque wrenches.

An object of my invention is to provide as an improvement in torque wrenches of the electro-magnetic type, means for reducing the recoil in the wrench, so that a nut or other object can be tightened to a predetermined torque, at which torque the inertia imparted by the wrench will be partially released so that the recoil will be reduced to a substantial degree, thereby allowing the operator to tighten nuts and the like with the wrench without the danger of excessive recoil shock.

A further object of my invention is to provide means for accomplishing this result by means of various methods as will be explained.

With these and other objects in view, my invention consists in the construction, arrangement, and combination of the various parts of my device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which:

Figure 1 is a side elevation of one of the types of the recoil reducing device, with a portion thereof being taken in cross section,

Figure 2 is a sectional view taken along the lines 2—2 of Figure 1,

Figure 3 is one of the circuits employed with the device shown in Figure 1,

Figure 4 is an alternate circuit,

Figure 5 is a view corresponding to Figure 2, however, showing a modification of the device,

Figure 6 is a schematic view of the impulse waves generated by the modification shown in Figure 5,

Figure 7 is a sectional view of a further modification,

Figure 8 is an enlarged detail of a portion of Figure 1,

Figure 9 is a modification, and

Figure 10 is a sectional view of Figure 9 taken along the lines 10—10 thereof.

The present application is a continuation in part of my application on a Recoil Reducing Device for Magnet Fluid Variable Torque Wrench, filed July 16, 1952, Serial No. 299,290, now abandoned.

My invention relates to an improvement on my co-pending application entitled, Magnetic Fluid Variable Torque Wrench, Serial No. 244,956, filed September 4, 1951, now Patent No. 2,687,054, issued Aug. 24, 1954, and relates to methods for reducing the recoil in such wrenches, as will be hereinafter described. The wrench of the aforesaid co-pending application utilizes the principle of a rotating magnetically permeable casing which is attached to a shaft of an electric motor, the casing carrying a plurality of spaced magnetically permeable disks which in turn, through the medium of an oil containing iron particles, will react upon further magnetically permeable disks attached to a further shaft to which shaft is attached the nut-engaging device.

I have used the character 10 to designate an electric motor which drives the driving shaft 11, which shaft 11 can be non-magnetic, and I have used the character 12 to

indicate a switch for starting the electric motor 10, the character 13 indicating a further finger switch adapted to control the circuit to the coil of the wrench, this coil being indicated by the character 14.

The character 14a indicates an iron plate covering one side of the coil. This coil is enclosed within the iron casing member 15 having the wall 16, the character 17 indicating the further end wall, the character 18 indicated extending portion journaling the further shaft 19, it being understood that any type of journaling can be employed, such as roller bearings, ball bearings, etc. The shaft 19 includes a squared end 20 received within the nut-engaging member 21 having the hexagon opening 22 therein for engaging the nut to be turned. The character 23 indicates a handle attached to the motor 10 which can be grasped by the operator, the switch 13 thereby being in convenient position for operation by the forefinger of the hand.

The character 24 indicates a series of annular brass disks between which are firmly secured the further iron disks 25, and spaced from the disks 25 are the further annular disks 26, which are also made of iron, the disks 26 being firmly secured within the fibre cylindrical member 28. The shaft 11 is keyed at 29 to the member 16 so that it will rotate therewith. Also attached to the member 16 is the insulating disk 30 in which is secured a pair of circular conducting rings 31 which contact the brushes 32, which brushes 32 are suitably attached to the holder 33 which is attached to the motor 10, the various circuits of which are shown clearly in Figures 3 and 4 as they relate to the various parts disclosed herein.

The casing comprising the various walls 17, 28 and 16 is filled with a fluid 34, which fluid contains a dispersed mass of fine iron particles, the various disks 25 and 26 thereby being immersed in this fluid.

Attached at the end of the shaft 19 by means of the large nut 35 which engages the threaded portion 36 of the shaft, is a cam member 37 which as shown extends from a thickened portion to a reduced minimum portion, the cam 37 being adapted to bear against an insulated rod 38 which passes through an oil seal ring 39, and attached to the rod 38 is a washer 40 which bears against the spring 41, the rod 38 being attached to a further reduced rod 42 which is attached to a contact member 43 which is adapted to bridge the contacts 44, the contacts 44 breaking the circuit to the coil 14 as shown in the various diagrams when the member 43 is not engaged with the contacts 44.

It will now be noted that when the motor is started, the rotation of the outer casing 17, 28, etc., will carry the disks 26 in a rotary manner, and through the magnetic binding action through the fluid will also rotate the further disks 25, thereby rotating the shaft 19 and the nut which is tightened by means of the member 22. During this action the finger button 13 is pressed inwardly, which energizes the coil 14 and causes the electrical current to flow through the coil 14, which causes the electro-magnetism to flow through the disks, all of which is described in my co-pending application, a positive magnetic and viscosity increased binding attraction being supplied by the disks.

It will be noted that normally, the outer casing and the shaft 19 are rotating at the same speed, however, as soon as the nut-engaging member 22 tightens beyond a predetermined torque, slippage will automatically occur between the cam member 37 and the outer casing, and as soon as such slippage occurs, the spring 41 will force the rod 42 inwardly, carrying the contact member 43 away from the contact members 44, at which point the circuit will be broken, with the coil 14 thereby being de-energized. In other words, as soon as this slippage occurs, the contact will be established only momentarily during each high point of the cam member

37, with the electrical energy thereby being absent in the coil during the greatest part of the cycle. As a result, the torque of recoil will be automatically reduced to a substantial degree.

Figure 4 illustrates a further modification wherein a lock-in relay indicated by the character 45 is employed, which is added to the same circuit shown in Figure 3, the character 46 indicating further contacts which are added, and in this type of circuit the lock-in relay is operated by the finger switch 13 which will operate the relay only if the push rod is not at the upper end of the cycle. If this condition exists, the finger switch will operate directly upon the switch contacts 44. With this type of circuit, the switch at contacts 46 opens after the contacts at 44 are closed, and when the contacts at 46 are opened deenergizing the relay 45, the coil voltage is disconnected.

Figure 5 illustrates a further modification of the same general principle wherein the conducting inner ring 31 is provided in the form of a semi-circle, terminating at the point 47, and merges with the semi-circular insulated band 48 upon which the brush 32 will ride during the rotary motion of the wrench.

In this use of the device, the contact member 43 will not be required nor the spring etc., as shown in Figure 1, the connections from the rings 31 passing directly to the coil 14. It will be noted by the use of this device that the electrical impulses passing to the coil 14 will occur somewhat as shown by the diagram in Figure 6 wherein the character 49 indicates the peak or highest portions of the current, these peaks dropping to the lower portions 50 due to the intermittent electro-magnetic energizing of the coils occasioned by the use of the inner split ring 31 and 48, so that an intermittent impulse arrangement will be provided producing an effective recoil torque as indicated approximately by the dotted line 51, or in other words, due to the fact that the constant torque is not applied during the rotation of the tool, but is applied only intermittently, when the nut is tightened to a pre-determined torque, the recoil will be considerably reduced.

Figure 7 illustrates a further modification wherein identical characters as used hereinabove will describe identical parts. In this form of the device it will be noted that there are provided three disks 25 immersed in the magnetic fluid medium, these disks being attached to the output shaft 19. In this arrangement, however, I attach a further single disk 52 which is attached at 53 to the termination of the input shaft 11, the circuit passing directly to the brushes 32 and the rings 31, the rings 31 being connected to the coil 14. In this type of device the casing will rotate freely upon the shaft 11 and will not be keyed thereto. The disks 25 are locked to the shaft 19 by means of the nut 54. It will now be noted from this construction that the single disk 52 which rotates with the shaft 11 is the only disk which will cause rotation to the various other disks and casing portions, so that when the electrical energy is applied with the switch 13 closed, the rotation of the single disk will gradually cause the various other disks to rotate with the casing, until the momentum of the entire housing will be the required energy which sets the nut at the predetermined torque. The torque applied to the disks 25 is furnished by the momentum of the casing, which momentum in turn is established by application of torque through the disk 52. Thereby, when torque is applied to the nut, the recoil torque is never greater than the torque applied through the disk 52. It would be obvious that this condition would not be present if several disks 52 were used, since the only function of the single disk 52 is to initiate the action in creating a momentum to the balance of the casing and disk structure.

Figures 9 and 10 illustrate a further modification wherein the motor is indicated by the character 55 and the motor shaft by the character 56, and attached to the shaft

56 is an insulating disk 57 including a pair of conducting rings 31 somewhat similar to the arrangement shown in Figure 5, and wherein the similar brushes 32 etc. are used, and with one of the rings including the portion 48 as shown in Figure 5, it being specifically understood however that any of the other types of current interrupting devices could be employed as shown herein, or even other types as well. The disk 57 is secured to a non-magnetic plate 58 to which is attached at 59 a magnetic cylindrical piece comprising the arcuate end portions 60 which are attached to the non-magnetic portions 61, and attached to the end of the members 60 is the non-magnetic disk 62. Joining the member 60 is a magnetic cylindrical bar 63 upon which is wound the electromagnetic coil 64, the coil including suitable leads passing to the rings 31 either through the shaft 56 or otherwise to thereby provide an intermittent or interrupted circuit.

Attached to the disk 58 at 65 is a further outer magnetic cylindrical member 66 to which is attached at 67 the non-magnetic end plate 68 in which is journalled the further shaft 69 to which is attached the nut-engaging socket 70, and attached to the shaft 69 at 71 is the non-magnetic disk 72 to which is attached at 73 the magnetic cylindrical member 74 which is thus spaced from the members 64 and 66, the space between the members 66 and 60 being filled with a similar magnetic fluid 34. The arrangement shown in Figures 9 and 10 provides means wherein the device can be made in a much smaller and more compact casing for the purpose intended and it will be seen that by virtue of this construction the magnetic flux passes from one of the end pieces 60 through the cylindrical members 74 and 66 and thence back through the other end piece 60, with the binding attraction and viscosity effects being provided in a manner above described to thereby drive the shaft 69 and socket 70. The cylindrical member 74 can be made of a non-magnetic material if such is desired and still function properly, however, a magnetic material is preferred to thereby decrease the reluctance in the magnetic circuit.

It will be quite obvious that other slight modifications could be made in my invention without departing from the essential spirit and purpose of my invention.

It will now be seen that I have provided the various advantages set forth in the objects of my invention with various other advantages being readily apparent.

Some changes may be made in the construction and arrangement of the parts of my invention without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope.

I claim as my invention:

1. A torque wrench comprising a driving shaft, a casing attached to said driving shaft, a magnetically permeable disc-like member attached to said driving shaft, a driven shaft including nut-engaging means attached thereto, a plurality of magnetically permeable discs attached to said driven shaft, a plurality of further magnetically permeable discs attached within said casing, said casing containing a magnetic fluid therein enclosing all of said discs, an electro-magnetic coil for producing magnetic flux, means for applying a system momentum to the driven shaft in iterative pulses of variable width and amplitude.

2. A torque wrench comprising a driving shaft, a casing attached to said driving shaft, a driven shaft including nut-engaging means attached thereto, said casing containing a magnetically actuated material therein, an electro-magnetic coil for producing magnetism in said casing, a further member attached to said driven shaft including magnetic elements actuated by said coil, means attached to said driven shaft responsive to the magnetic attraction between said casing and said member and said magnetically actuated material to rotate said driven shaft,

means for applying a pulsed electrical current to said coil.

3. A torque wrench comprising a driving shaft, a casing attached to said driving shaft, a driven shaft including nut-engaging means attached thereto, said casing containing a magnetically actuated material therein, an electro-magnetic coil for producing magnetism in said casing, a further member attached to said driven shaft including magnetic elements actuated by said coil, means attached to said driven shaft responsive to the magnetic attraction between said casing and said member and said magnetically actuated material to rotate said driven shaft, means for applying an interrupted current to said coil.

4. A torque wrench comprising a driving shaft, a casing attached to said driving shaft, a driven shaft including nut-engaging means attached thereto, said casing containing a magnetically actuated material therein, an electro-magnetic coil for producing magnetism in said casing, a further member attached to said driven shaft

including magnetic elements actuated by said coil, means attached to said driven shaft responsive to the magnetic attraction between said casing and said member and said magnetically actuated material to rotate said driven shaft, means for applying an interrupted current to said coil, said means including a pair of spaced annular conducting rings attached to said casing, one of said rings having an insulated section for providing said interrupted current.

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2,687,054 Nelson ---------- Aug. 24, 1954

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