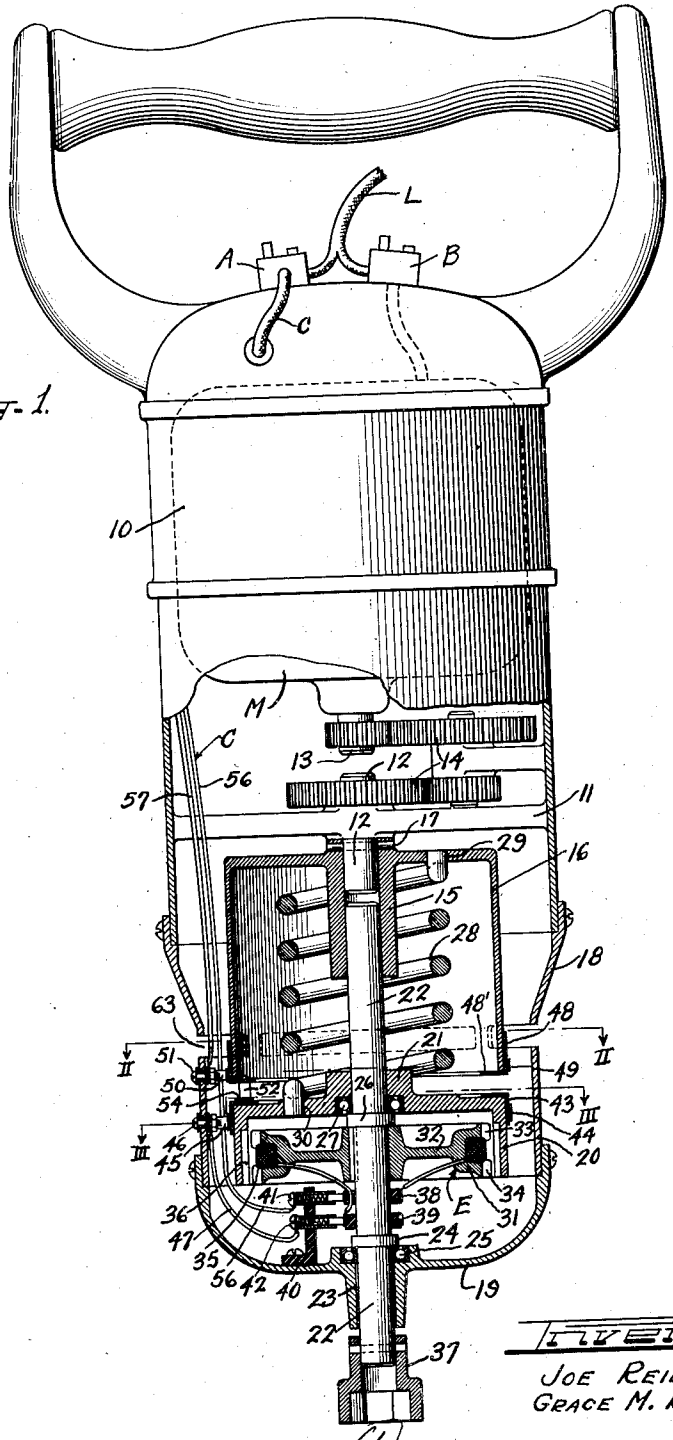
Sept. 10, 1946. J. REILLY ET AL 2,407,450

TORQUE WRENCH

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Fig. 1.



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Fig. 2.

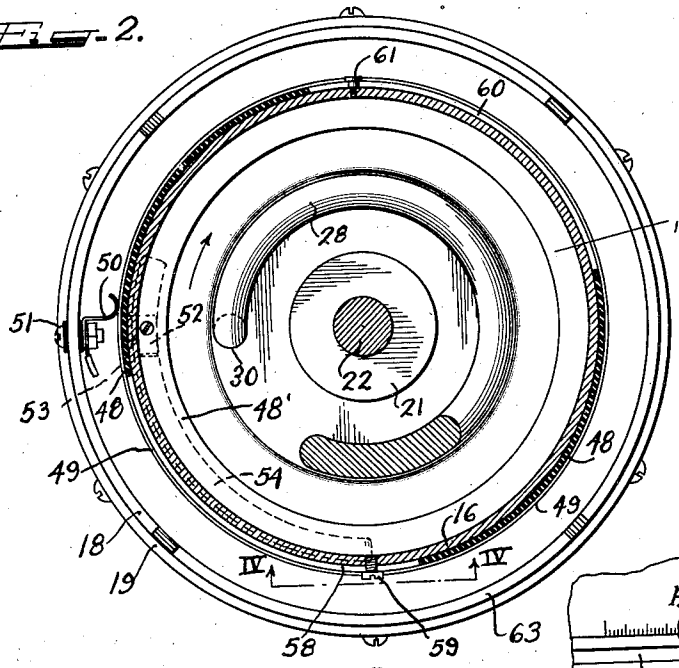


Fig. 4.

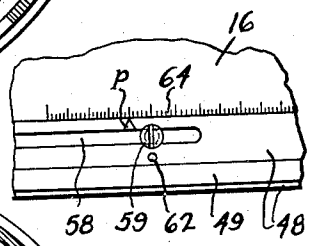
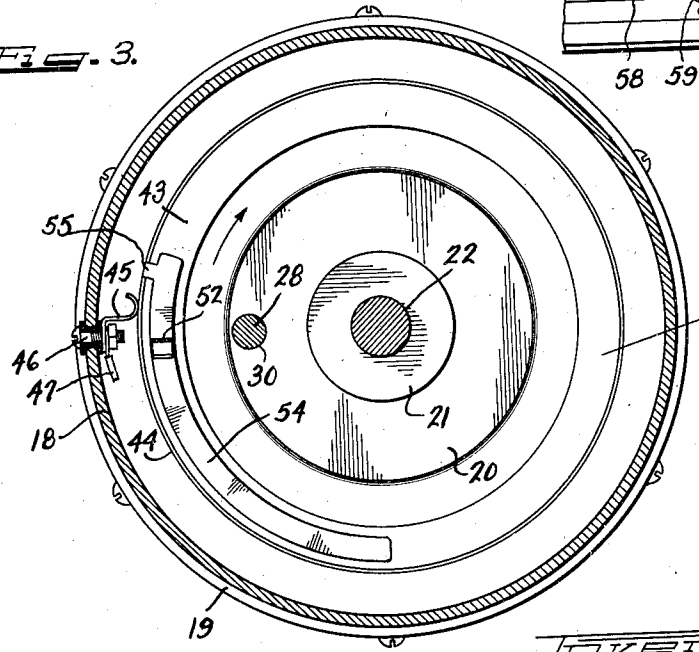


Fig. 3.



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Patented Sept. 10, 1946

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2,407,450

TORQUE WRENCH

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Application December 17, 1943, Serial No. 514,650

6 Claims. (Cl. 192—150)

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Our invention relates to wrenches, particularly power operated torque wrenches for applying fastening devices such as nuts, bolts, screws or the like.

An important object of the invention is to provide a wrench in which an electro-magnetic coupling or clutch is included in the driving connection between the driving motor and the tool which is to be applied to the devices to be fastened.

A further object is to provide an arrangement in which a helical spring and a magnetic coupling are included in the driving connection between the motor and the tool and cooperate to apply torque to the tool.

A further object is to provide a wrench in which an electro-magnetic clutch is included in the driving connection between the motor and the tool, with the circuit for the electro-magnet winding automatically controlled for release of the tool from further drive torque as soon as the drive torque effort has reached a predetermined maximum.

Still a further object is to provide an arrangement in which the electro-magnetic clutch is automatically rendered inoperative to apply further torque to the tool when the torque has reached a predetermined maximum.

On the drawings which disclose our improved wrench,

Figure 1 is a side-elevation partly in diametral section;

Figure 2 is an enlarged section on plane II—II Figure 1;

Figure 3 is an enlarged section on plane III—III Figure 1; and

Figure 4 is a view on plane IV—IV Figure 2.

Referring to Figure 1, 10 designates a cylindrical housing in the upper part of which a driving motor such as an electric motor M is mounted. In the housing 10 below the motor is a cross frame 11 in which is journaled the shaft 12 with which the motor shaft 13 is connected through a suitable reduction gearing train 14. The shaft 12 at its lower end extends into the hub 15 of a cupped or bell-shaped driving member 16, a key 17 securing the shaft to the hub. The driving member 16 extends down into the housing portion 18 which is secured to form a continuation of the motor housing 10 and which at its lower end is closed by a detachable cap 19.

Within the housing part 18 is the electro-magnetic coupling or clutch. This coupling or clutch comprises the armature or driving drum 20 whose hub 21 receives the shaft 22 which ex-

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tends downwardly through the bearing hub 23 on the housing cap 19. The shaft 22 has a seating collar 24 secured thereto for seating against the inner side of the bearing hub 23, an anti-friction bearing 25 being preferably interposed. A distance above the seating collar 24, the shaft has another seating collar 26 secured thereto against which the hub 21 of the drum 20 seats, with an anti-friction bearing 27 preferably interposed. At its upper end the shaft 22 extends into the hub 15 of the driving member 16. A helical or torsion drive spring 28 encircles the shaft 22 and extends between the top of the drive member 16 and the top of the armature drum 20, the upper end of the spring being anchored in an opening 29 in the driving member 16 and the lower end of the spring being anchored in the opening 30 in the top of the armature drum, so that when the driving member 16 is rotated by the driving motor in the housing 10, such rotation will be transmitted through the spring 28 to the armature drum 20.

Within the armature drum 20 is an electro-magnet E which comprises the ring 31 of magnetizable material such as iron and which is of U-shape cross-section, this ring being carried by a spider 32 whose hub is keyed to the shaft 22 below the collar 26 thereon. The outer ends of the ring legs are slotted transversely to provide upper and lower circumferential rows of poles 33 and 34, respectively. Within the ring between its pole legs is an energizing winding 35 for receiving direct current so that the poles in one row will all be positive and the poles in the other row will be negative. The cylindrical part of the armature drum 20 which surrounds the electro-magnet ring, is spaced from the ring by a narrow gap and is slotted axially to leave a circumferential row of teeth 36 for functioning as keepers for the poles 33 and 34 on the electro-magnet ring so that when current flows through the winding for energization of the ring, the armature drum will be magnetically coupled to the electro-magnet for transmitting the rotation of the drum to the shaft 22 and to a tool 37 secured to the lower end of the shaft. Eddy currents set up in the armature drum by the magnetic flow will assist in holding the drum and the electro-magnet coupled together.

For connecting the electro-magnet winding 35 for receiving current flow, slip rings 38 and 39 are mounted on the shaft 22 and insulated therefrom, these slip rings being connected with the terminals of the winding. A bracket 40 mount-

ed within the cap 19 carries contact brush structures 41 and 42 engaging the slip rings.

The tool 37 may, as shown, be a socket for receiving nuts or heads of screw bolts, or the tool may be in the form of a screw driver or other device. In order to prevent overturning of a nut or screw, which might result in stripping of threads or breakage of a screw, provision is made to open the energizing circuit for the electro-magnet winding when the torque effort on the tool has reached a predetermined maximum. With the structure shown, the circuit for the electro-magnet winding is automatically opened after a predetermined continuing driving movement of the driving member 16 when a nut or screw has been tightened to the extent that it will offer sufficient resistance to the normal torque effort of the spring 28 to cause the electro-magnet coupling to slow down and lag behind the driving member 16. The driving member will then be rotated by the driving motor a distance independently of the electro-magnet clutch during which independent movement the driving spring 28 will be wound up to increase its torque effort for a final turning movement of the tool through the electro-magnet coupling for final setting of the nut or screw, whereafter the electro-magnet winding circuit will be opened. The means for accomplishing all this is clearly shown on Figures 1, 2 and 3. An annular cap 43 of insulating material receives the upper corner of the drum 20 with its side wall supporting the slip ring 44 which is engaged by a contact brush 45 on a terminal screw 46 extending through but insulated from the housing part 18, the terminal screw being connected by conductor 47 with the brush structure 42 for the slip ring 39 for the electro-magnet winding. An annular cap 48 of insulating material receives the lower end of the driving member 16 and mounts a slip ring 49 engaged by a contact brush 50 on the terminal screw 51 extending through but insulated from the housing part 18. Mounted on the lower wall 48' of the cap 48 is a contact brush 52 which is electrically connected with the slip ring 49 by a connection 53 (Figure 2). The brush 52 extends downwardly for contacting the arcuate contact plate 54 on the upper wall of the insulation cap 43 on the drum 20 (Figure 3), this plate being concentric with the drum and being electrically connected with the slip ring 44 on the drum through the connection 55.

Referring to Figure 1, the leg 56 of the supply line C for the electro-magnet winding extends to the brush structure 41 for the slip ring 38 of the winding. The other leg 57 of the supply circuit extends to the terminal screw 51 for connection by the contact 50 with the slip ring 49, and normally this slip ring is connected by the brush 52 with the contact plate 54 which is connected with the slip ring 44 engaged by the brush 45 connected by the wire 47 with the brush structure 42 engaging the slip ring 39 for the electro-magnet winding. Thus, when the circuit C is connected with a direct current source the current will normally flow through the electro-magnet winding for energization of the drive coupling. When the driving motor M in the housing 10 operates, the shaft 12 and the driving member 16 will be rotated in clock-wise direction (Figures 2 and 3), and while the coupling follows the driving member, the brush 52 on the driving element 16 will remain in contact with the contact plate 54 on the coupling drum. However, as soon as the nut or screw engaged

by the tool approaches its final setting and resists turning movement by the tool, the driving member 16 will continue its rotation relative to the slowed down coupling for the final torque effort by the spring 28 for final setting of the screw or bolt, the brush 52 then leaving the contact plate 54 to open the electro-magnet winding circuit. The wrench is then withdrawn from the nut or screw and the spring 28 will then return the driving member 16 to its normal position relative to the coupling drum for re-engagement of the brush 52 with the contact plate 54, the wrench being then ready for another driving operation.

Means are provided whereby the operator may set the wrench for the desired final setting of a nut or screw by the tool in order to avoid overturning of the screw or nut which might result in stripping of threads or breakage of the nut or screw. This setting arrangement is best shown on Figures 2 and 4. The annular cap 48 is rotatable on the driving member 16 for setting of the contact brush 52 relative to the contact plate 54. The cap 48 has the slot 58 therein through which extends a guide and locking screw 59 which threads into the driving member 16. The cap may have another slot 60 opposite the slot 58 into which a guide pin 61 extends from the driving member 16, the screw 59 and the pin 61 thus serving to hold the cap to the drive member 16 and to guide its adjustment movement. In order to enable the cap to be readily rotatably adjusted, a hole 62 may be provided therein into which a point or tool may be inserted for rotational adjustment of the cap. This hole is accessible through the circumferentially extending slot 63 in the housing part 18. A scale 64 on the driving member 16 above the cap 48 will cooperate with a pointer P on the cap to indicate the position of the brush 52 relative to the contact plate 54 (Figure 4). After adjustment of the cap for setting of the brush 52, the screw 59 may be drawn up to lock the cap in its set position. Figures 2 and 3 show the brush 52 set for engagement with the plate 54 near the forward end of the plate, this being the normal position. During operation of the wrench to turn a nut or screw, the driving member 16 and the electro-magnetic coupling rotate together with the brush 52 retaining its normal position on the plate 54. When the nut or screw approaches its final setting and its resistance tends to stop the rotation of the coupling, the driving member 16 will continue and through the spring 28 will exert the final setting torque on the tool through the coupling, the brush 52 during such final setting movement being carried with the driving member 16 forwardly along the contact plate 54 to be disengaged therefrom for opening of the electro-magnet winding circuit at the end of the final setting or torque application of the wrench to the nut or screw.

The electro-magnetic clutch should be operated by direct current, and where the driving motor M is a direct current motor, the current supply could be from a direct current line L. The circuit C could be connected through a switch A with the supply line and the motor M could be connected through a switch B with the supply line. Where the driving motor is to be connected with an alternating current power line, a direct current source, such as a battery, would have to be provided for the electro-magnet circuit, with a switch for the electro-magnet circuit and with another switch for the alter-

nating current motor circuit. Where the direct current and alternating current circuits are controlled by separate switches, only the electro-magnet circuit would be automatically opened at the end of final torque application to the tool and screw or nut engaged thereby. Where direct current is used both for the driving motor and the electro-magnet circuit, the motor circuit and electro-magnet circuit could be in series so that both these circuits would be automatically opened at the end of the final torque application by the wrench. After a final setting torque has been applied to a fastening device such as a nut or bolt, and the circuit is automatically opened, the wrench will be withdrawn from the device and the spring **28** will then return the driving member **16** to its normal position relative to the coupling drum for re-engagement of the brush **52** with the contact plate **54**. When the wrench is no longer to be used, the switches A and B are set for opening of the motor and electro-magnet circuits.

We have thus produced a practical and efficient torque wrench in which an electro-magnetic coupling transmits driving power from a driving element to a tool and thereby eliminates mechanically inter-engaging transmission parts with resultant wear and tear. With our improved wrench, the fastening device engaged by the tool can be given a predetermined final setting movement without injury to the device, the release of torque application to the device being automatically accomplished at the end of the final setting movement.

We have shown a practical and efficient embodiment of the features of our invention, but do not desire to be limited to the exact construction, arrangement, and operation shown and described as changes and modifications may be made without departing from the scope of the invention.

We claim as our invention:

1. A torque device comprising a driving motor, a driving member driven by said motor, an electro-magnetic coupling comprising an armature drum and an electro-magnet, a driving connection between said driving element and said drum including a torsion spring, a driven shaft on which said electro-magnet is mounted, and means for controlling the energization of the electro-magnet winding for electro-magnetic transmission by the coupling of the driving power to the driven shaft.

2. A torque device comprising a motor driven driving member, an electro-magnetic clutch comprising a drum and an electro-magnet within the drum having a winding thereon, a resilient driving connection between said driving member and said drum, a driven member mounting said electro-magnet, an electrical circuit for the electro-magnet winding, contacts on said driving member and drum normally in electrical engagement for closing said circuit, said driving member by virtue of said resilient connection being rotatable by said motor relative to said drum for separation of said contacts and opening of the electro-magnet winding circuit when said electro-magnetic clutch is slowed down by the resistance of the driven member.

3. A torque device comprising a motor driven driving member, an electro-magnetic coupling comprising an armature drum and an electro-magnet having an energizing winding, a helical transmission spring connecting said driving member with said drum, a driven member mounting

said electro-magnet, an energizing circuit for said winding, contacts on said driving member and said drum normally in engagement for closing said energizing circuit whereby said coupling will rotate with said driving member to apply torque to the driven member for movement thereof toward a predetermined final position, said driving member by virtue of said helical spring being rotated relative to said coupling when said coupling is slowed down by the resistance of the driven member when approaching its final position to thereby partially wind up said spring for increased torque on said coupling to overcome the resistance of the driven member and for setting thereof into its final position, and means whereby said contacts will be disengaged at the end of the final setting movement for opening of the electro-magnet winding circuit and release of the coupling.

4. A torque device comprising a rotatable driving member, a driven member, an electro-magnetic clutch comprising an armature element and an electro-magnet element, a torsion spring for transmitting the rotational movement of said driving member to one of said coupling elements, the other coupling element being connected with said driven member, a circuit for the winding of said electro-magnet for energization thereof to electro-magnetically hold the coupling elements together, cooperating contacts for said circuit on said driving member and the clutch element connected therewith, said contacts engaging for closure of said circuit when the energized coupling rotates with said driving member whereby said driven member will be rotated, said driving member by virtue of said torsion spring being rotatable relative to the coupling when the resistance of the turned driven member retards the coupling, said contacts being disengaged after a predetermined distance of relative movement of said driving member for opening of said circuit and release of the coupling, said spring during said relative movement increasing its torque effort on the coupling for turning of the driven member to its final position.

5. A torque device comprising a rotatable driving member, a driven member, an electro-magnetic clutch comprising an armature element and an electro-magnet element, a torsion spring for transmitting the rotational movement of said driving member to one of said coupling elements, the other coupling element being connected with the driven member, a circuit for the winding of said electro-magnet for energization thereof to electro-magnetically hold the coupling elements together, cooperating contacts for said circuit on said driving member and the clutch element connected therewith, said contacts engaging for closure of said circuit when the energized coupling rotates with said driving member whereby said driven member will be rotated toward a predetermined final position, said driving member by virtue of said torsion spring being rotatable relative to the coupling when the resistance of the turned driven member retards the coupling, said contacts being disengaged after a predetermined distance of relative movement of said driving member for opening of said circuit and release of the coupling, one of said contacts being adjustable relative to the other contact whereby to predetermine the distance of relative movement of said driving member before said contacts are disengaged, said spring during said relative movement increasing its torque effort on the coupling

for turning of the driven member to its final position.

6. In a torque device, a driving member, a driven member to be turned, an electro-magnetic coupling comprising an armature element and an electro-magnet element having a winding thereon, said driving member having resilient driving connection with one of said coupling elements

and the other coupling element being connected to said driven member, a circuit for said winding, and means automatically controlled to open said circuit for release of the coupling after a predetermined torque has been applied to the driven member.

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