

June 14, 1960

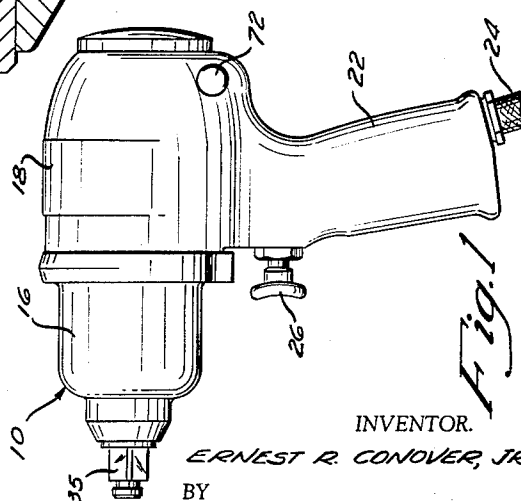
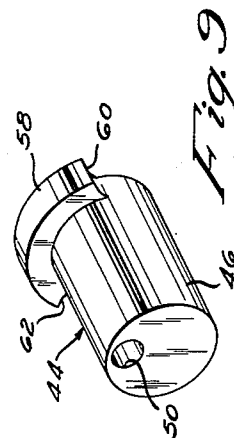
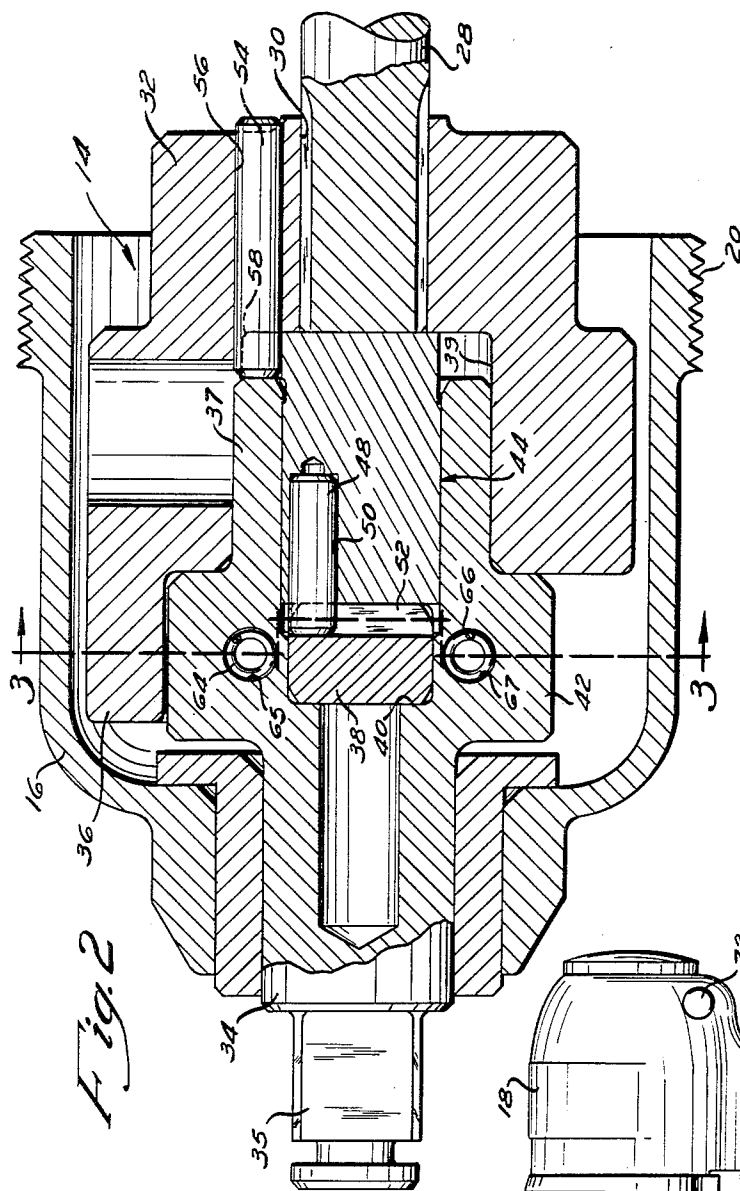
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2,940,566

IMPACT CLUTCH

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

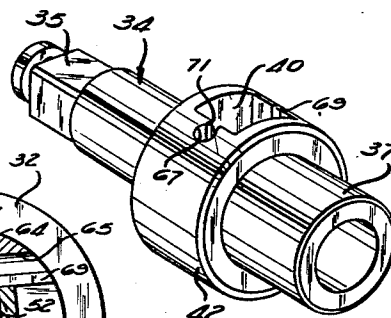
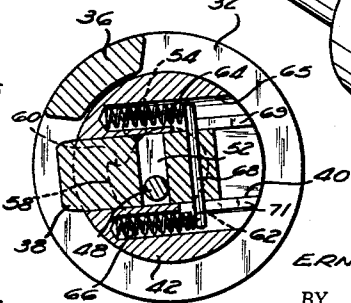
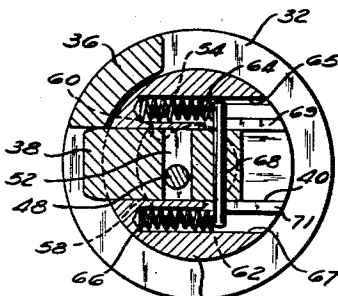
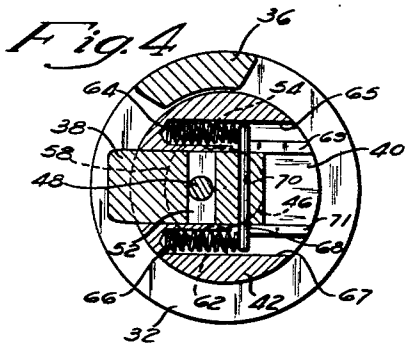
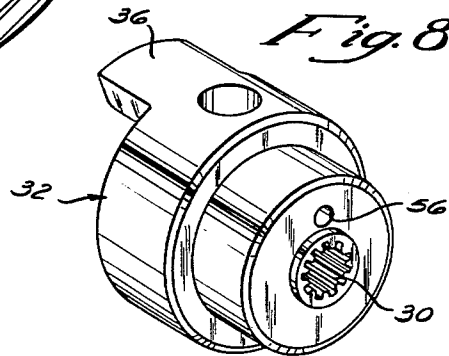
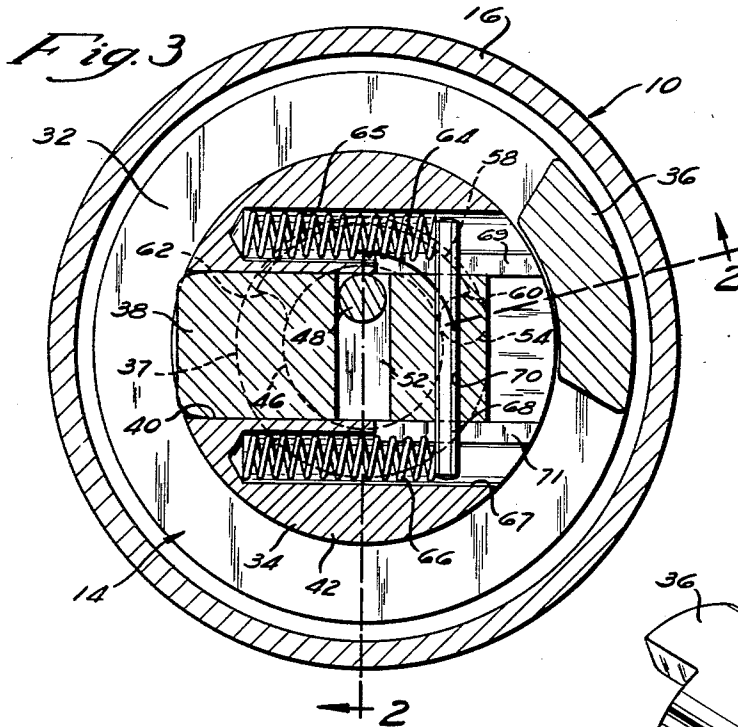


Fig. 7
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IMPACT CLUTCH

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4 Claims. (Cl. 192—30.5)

This invention relates to an impact tool of the type employing a radially extendible anvil mounted in a spindle and interposable in the orbital path of a hammer element for receiving torque imparting blows, and more particularly relates to improved spring means effectively retracting the anvil from its extended position immediately subsequent to an impact between the hammer and anvil and to improved and simplified construction of a tool spindle.

In impact wrenches wherein an output torque is produced by a series of rapid blows of a rotary hammer against a rotary anvil which is rotationally coupled to a tool spindle selectively interposable into the path of the rapidly rotating hammer and retractable from the path of the hammer immediately subsequent to impact by spring means, it frequently occurs that sufficient frictional engagement between the hammer and anvil subsequent to such impact is created by the motor torque applied to the hammer to overcome the usual retractive forces applied to the anvil, whereby the anvil becomes locked in extended position and the wrench rendered momentarily inoperative. When the hammer strikes the anvil while it is coupled to a high resistance load, the hammer may rebound and then be driven by the wrench motor to re-engage the anvil, or when the hammer strikes the anvil while it is coupled to a low resistance load the hammer may remain in contact with the anvil. In either event, if the friction at such engagement or re-engagement, after impact, is great, the wrench may become locked. It becomes necessary, therefore, to release the wrench trigger to interrupt the supply of power to the motor to decrease the engagement between the hammer and anvil. Hence, the inability of the anvil retracting means to affirmatively and effectively retract the anvil when necessary is a time consuming and bothersome defect.

Accordingly, it is an object of this invention to provide novel means for positively and affirmatively retracting the anvil subsequent to impact to facilitate further rotation of the wrench hammer for further operation of the wrench, said means being effective for use with high speed wrench motors.

By the provision of a pair of coil springs disposed in a pair of parallel bores, one on each side of the anvil groove in the spindle for providing a balanced retractive force of relatively high intensity to the wrench anvil, the frictional engagement between the hammer and anvil occurring by reason of the wrench motor torque, is simply and effectively overcome to assure proper retraction of the anvil. In accordance with this feature, continuous operation of the wrench, without involuntary interruption, is assured.

It is another object of this invention to provide a simplified and improved spindle structure in an impact tool facilitating mounting and operation of and the spindle anvil actuator elements. In this embodiment of the invention the spindle is provided with a rear, hollow, circumferentially continuous skirt portion to be received in a recess of the driving inertia member of the wrench and

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for receiving in the hollow thereof, the anvil actuator element. The actuator is of such size and dimensions as to fit snugly within the spindle bore with freedom to rotate relative thereto. The skirt portion may be sized and proportioned to be made strong and durable and may be positioned firmly within the mentioned recess to withstand the severe shock and lateral strain imparted to the same each time the wrench hammer strikes the anvil mounted in the spindle. As an advantageous consequence of this feature, any necessity for anti-friction bearings between the spindle and inertia member is eliminated.

Other objects of this invention are to increase the operating efficiency of impact wrenches, by enabling continuous uninterrupted use thereof, by simple, inexpensive, easily installed means.

The foregoing and other objects and advantages of the invention will become apparent in the course of the following description taken in conjunction with the drawings, wherein:

Figure 1 is a side elevation of an impact wrench embodying the features of this invention;

Figure 2 is an enlarged longitudinal sectional elevation through the clutch apparatus of the impact wrench taken on a line 2—2 of Figure 3;

Figure 3 is an enlarged transverse sectional elevation through the clutch apparatus of the impact wrench taken on a line 3—3 of Figure 2;

Figure 4 is a transverse sectional elevation through the clutch apparatus of this invention, with the housing removed showing the relative disposition of hammer, anvil, actuator and spindle at a moment of time prior to impact between the hammer and the anvil;

Figure 5 is a transverse sectional elevation through the clutch apparatus of this invention with the housing removed showing the relative disposition of hammer, anvil, actuator and spindle at a time of impact between the hammer and anvil;

Figure 6 is a transverse sectional elevation through the clutch apparatus of this invention with the housing removed showing the relative disposition of hammer, anvil, actuator and spindle at a moment of time subsequent to impact between the hammer and anvil when the spindle is coupled to a load of high torsional resistance;

Figure 7 is a view in perspective of the spindle of this invention;

Figure 8 is a view in perspective of the inertia member of this invention, and

Figure 9 is a perspective view of the actuator utilized in the wrench of this invention.

Referring now to Figure 1 of the drawings, 10 represents generally the impact wrench of this invention having a barrel for enclosing the wrench clutch 14 in a section 16 of the barrel and enclosing in section 18 of the barrel a wrench motor which is preferably of a pneumatic vane type, but may be of a suitable electric or other pneumatic type. Barrel section 16 is preferably threadedly secured to barrel section 18 as shown at 20. A handle 22 of the wrench is preferably integral with section 18 and provides the attachment to a power source (not shown) through a flexible conduit 24. Application of power to motor 18 from conduit 24 is controlled by suitable apparatus having a control trigger 26 manipulable by a finger of the hand of an operator of the wrench.

The wrench motor provides motive power to clutch 14 through a rotary motor shaft 28 which is exteriorly splined at its end for driving engagement with an interiorly splined bore 30 of a massive inertia driving member 32 located in section 16, shown clearly in Fig. 8 of the drawings. Driving member 32 is rapidly rotated by the wrench motor through a desired angular extent and the

kinetic energy of the same is suddenly imparted to a spindle 34 having a polygonal tool head 35 for receiving a load engaging socket, and having a circumferentially continuous, bored portion 37 positionable within a recess 39 in inertia member 32. The transfer of energy from driving member 32 to spindle 34 is effected by impact between an arcuate hammer 36 formed integral with member 32 at the forward end thereof and an anvil 38 transversely movable in a slot 40 formed in an enlarged portion 42 of spindle 34. The anvil 38 is extendible radially from a retracted position, wherein it lies in slot 40 substantially within the periphery of portion 42, to a position wherein a portion of the anvil projects into the orbital path of the hammer 36. Since the anvil is angularly fixed with respect to the spindle 34 a blow imparted to the anvil is effective to apply a torque to the load coupled to the spindle head 35. Subsequent to impact the anvil is automatically retracted to allow hammer 36 to pass so that the driving member 32 may be rotated by the wrench motor through the desired angular extent to acquire sufficient kinetic energy to impart another blow to anvil 38.

The projection of anvil 38 is effected by cam actuator means including an actuator shown generally at 44 in Figure 9, which actuator has a cylindrical section 46 insertable in the bore of portion 37 of spindle 34. A cam 48 comprising a pin held in a bore 50 of actuator 44 extends forwardly to project into slot 40 and the projecting portion of the cam is accommodated by a groove 52 in anvil 38. Rotation of the actuator 44 relative to spindle 34 is effective to cause the cam 48 to bear against the wall of groove 52 to move the anvil along the slot 40.

Rotary movement of actuator 44 is achieved by a pin 54 disposed in a bore 56 in driving member 32 and projecting forwardly into recess 39 of the driving member and being engageable with an arcuate lobe 58 at one end of actuator 44. The lobe 58 is provided with radial walls 60 and 62 which may contact the pin 54 under certain conditions to be described, so as to effect a rotary motion of the actuator.

In accordance with a feature of this invention, the retraction of anvil 38 after impact with the hammer 36 is accomplished by a pair of coil springs 64 and 66 located in symmetrically disposed bores 65 and 67 in enlarged portion 42 of the spindle, said bores being parallel to the slot 40 on opposite sides thereof. Ends of the springs are bottomed in the bores and the other ends bear against respective ends of a pin 68 which extends transversely through a bore 70 in the anvil and into the bores 65 and 67 through slots 69 and 71 extending along portions of the bores and slot 40 to maintain a strong, continuous, balanced bias to the anvil, urging the same to a retracted position when the same is projected from its slot. The springs 64 and 66 are effective in returning the anvil to retracted position under conditions wherein the hammer engages the anvil under the torque of the motor.

In accordance with another feature of the invention, bored portion 37 of the spindle is circumferentially continuous to provide strong continuous support for the rear end of the spindle which fits in recess 39 of member 32 and in turn to provide such a support for actuator 44 entirely about the periphery of its portion 46. Accordingly, the spindle and actuator, so supported, without the necessity of less durable bearing members, can withstand the severe treatment to which the same are normally subjected by the lateral component of force of the blow of the hammer against the anvil.

A suitable reversing control is actuatable by a knob 72 for selecting the direction of rotation of the motor. Since the clutch components are symmetric, the wrench is readily operable in either direction of rotation for tightening or loosening nuts, bolts and the like, of either hand thread.

For an understanding of the operation of the wrench, it is assumed that a work load comprising a bolt or nut

with right hand threads is to be tightened by the wrench. Knob 72 is positioned for forward operation of the wrench and a suitable socket is applied to the bolt or nut and coupled to the polygonal tool head 35 of spindle 34. Motive power is supplied to the wrench motor whereby inertia member 32 is rotatably driven by the motor through the splined engagement between the motor shaft 28 and inertia member 32.

Upon the application of motive power to the motor of the wrench, pin 54 is driven so that it engages the radial wall 60 of actuator 44 and drives the actuator in a rotary manner. Since the actuator 44 is coupled to the spindle 34 through the cam pin 48, the anvil 38 and springs 64 and 66, under certain conditions of light load, the spindle 34 may be driven directly by the motor torque.

As long as the torque resistance imposed by the nut or bolt is less than the force of springs 64 and 66, a free running-down action of the bolt or nut occurs, the hammer 36 and the anvil 38 occupying relative positions some place between that shown in Figure 3 in which the anvil 38 is held in fully retracted position by the springs 64 and 66, and that shown in Figure 4 in which the torque resistance has exceeded the force of springs 64 and 66, and the pin 48 has moved in its orbital path to the point of maximum advance or projection of the anvil 38.

When the torque resistance overcomes the springs 64 and 66, the center of the pin 48 passes through the aforesaid central plane parallel with and midway between the sides of the anvil 38, at which point the anvil 38 has been cammed radially outward to its fully advanced or projected position. The torque resistance has decelerated or stopped the rotation of the driven spindle 34. The driving member at this dead center point is free of the torque load previously transmitted by the spring. At this dead center point the hammer 36 has not yet reached the angular position shown in Figure 4, but is spaced transversely from the adjacent abutment surface of the anvil 38 by an angle equal to the lead of the pin 48 with respect to the hammer 36. As soon as the pin 48 has passed through the aforesaid central plane of the anvil 38, the springs 64 and 66 act in a direction to retract the anvil 38 and exert a small but increasing component of force on the pin 48, tending to accelerate the rotation of the actuator 44 and advance the actuator including its wall 60 ahead of its abutting engagement with the pin 54. However, the motor torque continues to accelerate the hammer 36 in the same direction and maintain the pin 54 in abutting engagement with the wall 60. Thus, the anvil 38 can retract from its fully advanced position only to the position shown in Figure 5, when it is struck by the hammer 36 and the kinetic energy of the hammer is delivered to the spindle 34.

At the instant of impact the inertia member 32 carrying pin 54 is rapidly decelerated, permitting the actuator 44 to continue in its forward rotation, and thereby allowing the wall 60 of actuator 44 to advance ahead of its engagement with the pin 54 and move the pin 48 further along in its orbital path and out of engagement with the bottom wall of groove 52.

This relation and operation are maintained through the full range of operating speeds and conditions. Under all operating conditions the hammer 36 strikes a full solid blow against the side of the anvil 38 which is held in the position shown in Figure 3, in its fully projected position, or in some position intermediate to these two.

While the energy of the hammer is being delivered to the spindle 34 during the impact blow, the high pressure of the hammer 36 against the anvil 38 prevents the springs 64 and 66 from retracting the anvil 38 further, even if the actuator 44 continues to rotate and runs ahead of the inertia member 32. As soon as the energy of the hammer has been delivered to the driven spindle which is advanced somewhat, as shown in Figure 6 of the

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drawings, the high pressure and consequent friction between the hammer 36 and the anvil 38 diminish. At this point the inertia member 32 may rebound, or turn a short distance in the opposite direction to that in which it is being urged by the motor torque. In any event, when the high pressure of the impact blow has ceased, the springs 64 and 66 move the anvil 38 into its fully retracted position, moving the lobe 58 on the actuator 44 further ahead of the driving pin 54 on the actuator. As soon as the anvil 38 is fully retracted, the hammer 36 is free to rotate past the end of the anvil 38 and motor torque again accelerates the inertia member 32, again advancing the hammer 36 around to the position illustrated in Figure 3. During this acceleration of the hammer, pin 54 catches up with wall 60 of lobe 58 on actuator 44, so that the actuator again drives pin 48 to cam anvil 38 outwardly against the position of springs 64 and 66. The impact action then continues, the inertia member 32 being accelerated by the motor and striking a blow against the adjacent side of anvil 38 each revolution until the successive blows have tightened the work load to the desired extent. The operator then releases the wrench trigger 26 to stop the motor.

According to this invention, springs 64 and 66 may be sized and proportioned over a rather wide range to provide the desired retraction bias to anvil 38 according to the demands of the particular torque requirements of the wrench.

Having thus described this invention in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains to make and use the same, and having set forth the best mode contemplated of carrying out this invention, I state that the subject matter which I regard as being my invention is particularly pointed out and distinctly claimed in what is claimed, it being understood that equivalents of modifications of, or substitutions for, parts of the above specifically described embodiment of the invention may be made without departing from the scope of the invention as set forth in what is claimed.

What is claimed is:

1. An impact wrench comprising a rotatable inertia member having a hammer movable in an orbital path, said inertia member being formed with an axial bore, a spindle having a hollow, circumferentially continuous end portion fitting within said bore of said inertia member, an actuator having a portion fitting in said hollow, an anvil mounted in said spindle, means mounting and guiding said anvil for sliding motion transversely to the axis of said spindle, cam means coupled to said actuator and to said anvil for intermittently extending said anvil into said orbital path and means urging said anvil to retracted position within said spindle.

2. An impact wrench comprising a rotatable inertia member having a hammer movable in an orbital path, said inertia member being formed with an axial bore,

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a spindle having a hollow, circumferentially continuous end portion fitting within said bore of said inertia member, an actuator having a portion fitting in said hollow, an anvil mounted in said spindle, means mounting and guiding said anvil for sliding motion transversely to the axis of said spindle, cam means coupled to each of said actuator and said anvil for intermittently extending said anvil into said orbital path, and spring means disposed in said spindle on opposite sides of said anvil for urging said anvil to retracted position within said spindle.

3. An impact wrench comprising a hammer having an orbital path, a rotatable tool spindle having a transverse opening therein, an anvil slidably fitting in said opening and movable therein transversely of said spindle between a retracted position and an advanced position, said spindle being formed with a pair of transverse bores parallel to and spaced on opposite sides of said transverse opening, and with slots connecting said transverse opening with said bores through at least a part of the length thereof, abutment means on said anvil projecting laterally therefrom through said slots and into said bores, a pair of coiled springs disposed in said bores and engaging said abutment means, reaction means on said spindle also engaging said spring, said spring being tensioned between said abutment means and said reaction means to bias said anvil toward retracted position, means for intermittently projecting a portion of said anvil into advanced position in the orbital path of said hammer against the force of said springs and means for moving said hammer in an orbital path.

4. An impact wrench comprising a hammer having an orbital path, a rotatable tool spindle having a substantially rectangular transverse opening therein, an anvil slidably fitting in said opening and movable therein transversely of said spindle between retracted and advanced positions, said spindle being formed with a pair of transverse blind bores parallel to and spaced on opposite sides of said transverse opening, and with slots connecting said transverse opening with said bores through at least a part of the length thereof, abutment means on said anvil projecting laterally therefrom through said slots and into said bores, a pair of coiled springs disposed in said bores engaging the closed ends thereof and engaging said abutment means for biasing said anvil toward retracted position within the periphery of said spindle, means for intermittently projecting a portion of said anvil into advanced position in the orbital path of said hammer against the force of said springs and means for moving said hammer in an orbital path.

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