Aug. 27, 1935. R. H. POTT 2,012,916

IMPACT TOOL

Original Filed Jan. 30, 1932

Fig. 1.

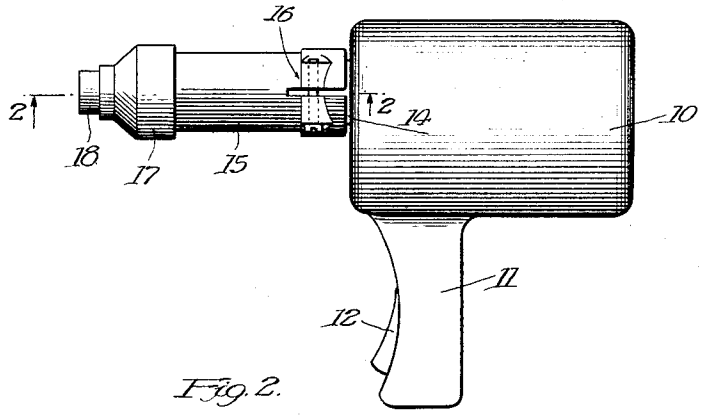


Fig. 2.

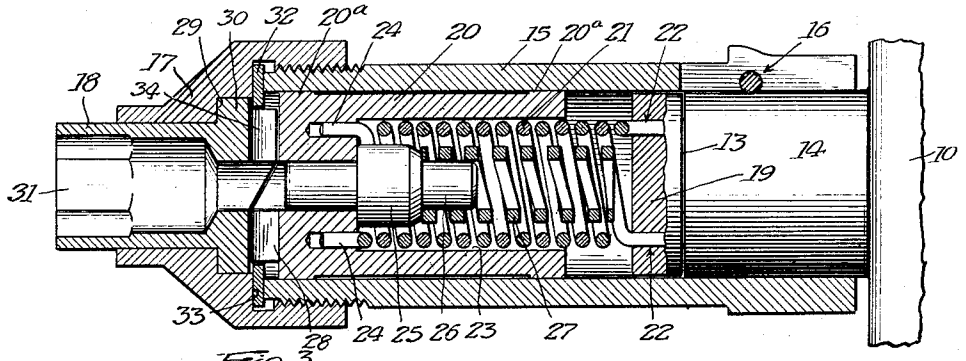


Fig. 3.

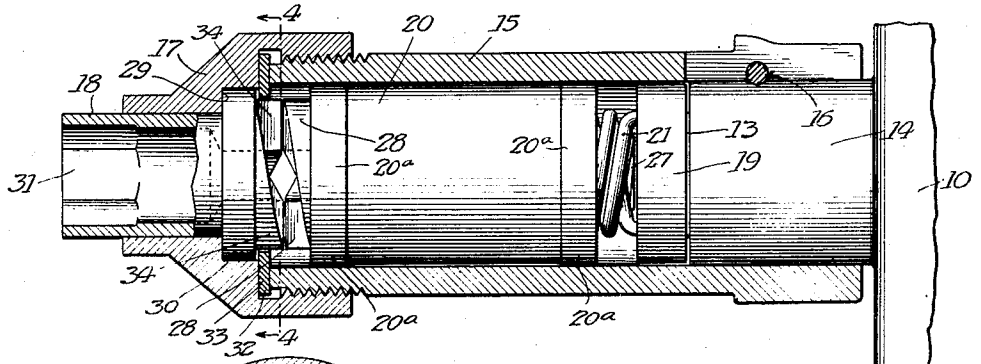
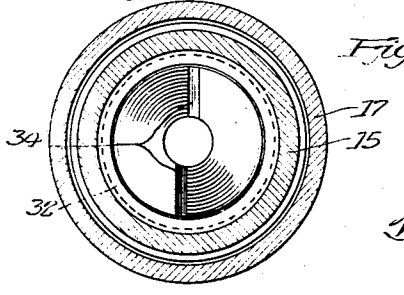


Fig. 4.



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IMPACT TOOL

Robert H. Pott, Evansville, Ind.

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Renewed July 7, 1934

18 Claims. (Cl. 81—54)

The invention relates generally to impact tools and more particularly to tools of this character for applying a torsional force.

An object of the invention is to provide a simple tool embodying a new and improved means for producing a succession of impacts of great force.

A further object of the invention resides in the provision of an impact tool for imparting torsional force to a part engaged by the tool which embodies a novel means for increasing the force of the impact over the force delivered directly by a driving member.

More specifically stated, an object is to provide, in a tool of this character, means for momentarily accumulating or storing up energy to be expended when the hammer part of the tool impacts the driven part or tool head.

Other objects and advantages will become apparent in the following description and from the accompanying drawing, in which:

Figure 1 is a side elevation of a tool embodying the features of the invention.

Fig. 2 is a fragmentary axial section on an enlarged scale taken as indicated by the line 2—2 of Fig. 1.

Fig. 3 is a view similar to Fig. 2 but showing the internal parts of the device in elevation and with the parts in another operative position.

Fig. 4 is a transverse section taken along the line 4—4 of Fig. 3.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawing and will herein describe in detail the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed, but intend to cover all modifications and alternative constructions falling within the spirit and scope of the appended claims.

Referring to the drawing, wherein a device embodying the invention is shown merely for illustrative purposes, 10 designates a suitable casing for a driving motor (not shown) of any conventional type, such as an electric or pneumatic motor. The casing has a handle 11 secured thereto for convenience in operating the device, and it is preferred that a finger piece 12 for controlling the motor operation be associated with the handle.

The motor armature 13 (Figs. 2 and 3) extends through a bearing 14 at one end of the casing and the bearing supports a coaxially extending casing or sleeve 15 which is rigidly secured on the bearing in any suitable manner, as by the split collar arrangement designated 16 (Fig. 1). The outer end of the sleeve is externally screw threaded to engage internal screw threads on a centrally apertured member 17 in the nature of a gland which, as will hereinafter become apparent, mounts a head 18 on the device.

Within the sleeve 15 is a disk 19 located adjacent to the end of the bearing 14 and rigidly connected with the motor armature 13. Rotatably disposed in the outer portion of the sleeve is an elongated cylindrical member 20 which serves in part to establish a driving connection between the motor and the head 18. The member also constitutes an impact member and for convenience will be hereinafter referred to as a hammer. At either end of the hammer is a flange 20a finished for snug running engagement with the sleeve.

The hammer is drivingly connected with the disk by flexible means which is capable of accumulating or storing up energy to be expended as a torsional force. In one preferred form, the flexible connection comprises a pair of interwound helical springs 21 rigidly affixed at one end, as at 22, to the disk 19. The springs extend into an axial bore 23, formed in the adjacent end of the hammer, and are firmly secured, as at 24, to the hammer near the outer end thereof. Preferably, two springs are used to produce a balanced driving connection, as well as to divide the necessary resilient force between two members. Within the bore 23 is an axial pin 25, about which the two springs 21 are seated. The pin has an end part 26 of reduced size forming a seat for a spring 27 which extends out of the bore beyond the end of the hammer.

The outer end face of the hammer is fashioned to provide a releasable driving connection with the head. Thus, said face is cut away to form a pair of diametrically opposite, radially extending shoulders 28 facing in the direction in which the hammer is to be rotated by the motor. While two shoulders are herein shown, a different number may be employed, as desired.

The gland 17 is adapted to retain the head 18 for engagement and actuation by the hammer 20. To this end, gland 17 has an annular internal shoulder 29, confronting the screw threaded end thereof, for engagement with an annular flange 30 provided on the head 18. Forwardly of the flange, the head extends through the gland, as a bearing, and the outer end 31 is finished to fit a part to be operated upon. As illustrated, the head is arranged to receive a nut, but it will be

evident that the head could be finished as a screw driver or other similar instrumentality.

The head is held for rotative movement but against axial displacement away from the shoulder 29 by such means as a ring or washer 32 formed to overlap the flange 30 and to be clamped between a shoulder 33 on the gland and the end of the sleeve 15 when the parts are assembled. By this construction the head is supported firmly and rotatably by means which permit of ready removal of the head from the tool.

The inner end face of the head is cut away as the complement of the end face on the hammer, thus providing shoulders 34 thereon which are engageable by the shoulders 28 on the hammer to complete the driving connections between the motor and the head.

As may be seen in Fig. 4, the faces of the shoulders 34 slope slightly from bottom to top in the direction the part is to be driven. The shoulders 28 have a similar construction. This is to effect a separating axial movement of the hammer relative to the head, by the cam action of the engaging faces, when a predetermined amount of resistance to turning is encountered. This will be better understood from a description of the operation.

For illustration, it will be considered that a nut is to be applied to a bolt. The socket in the head 18 is fitted about the nut and the motor started. While the nut is turning smoothly and easily on the bolt, the parts are in the position shown in Fig. 2. In this position the head is driven directly by the motor through the disk 19, springs 21, hammer 20, shoulders 28 on the hammer, and shoulders 34 on the head. The springs 21, of course, have ample tension to maintain engagement between the shoulders under normal conditions. As the nut becomes seated, resistance to turning increases until the cam-shaped engaging faces on the shoulders 28, 34 effect an axial movement of the hammer away from the head against the tension of the springs 21. In order to exert a driving force of ample strength to effect this cam actuated movement, the motor places the springs under torsional tension, which is maintained and probably increases as long as the hammer cannot move with comparative freedom. When the axial movement of the hammer releases the engagement between the shoulders 28, 34, as shown in Fig. 3, the energy which has thus been accumulated or stored up in the springs is released to drive the hammer ahead at a speed which is greater than the motor speed. At the same time, the springs expand and move the hammer toward the head to effect engagement of the succeeding shoulders. Since the motor is running constantly, the driving force of the springs is coupled with or added to the momentum of the motor, and the shoulders on the hammer will, therefore, strike the shoulders on the head with an impact, the force of which is materially increased over that which would be obtained solely from the momentum of the motor. In fact, when the hammer is forwardly driven by the springs, the primary force delivered to the head results from the inertia of the moving hammer as produced by the accumulated force in the springs. Moreover, the flexibility of the drive allows the motor to operate without substantial retardation, the force thereof being stored up in the springs when movement of the hammer is momentarily arrested. The operation thus described is, of course, recurrent to produce a succession of blows for firmly seating the nut. In the absence of a rigid driving connection between the power input and the hammer, the shocks of the impacts cannot be reversely transmitted.

It should be noted that the hammer is of much greater mass than the head and that both hammer and head are compact. The head itself, therefore, offers little resistance to movement by the impact force of the hammer and a minimum amount of the impact force is dissipated in overcoming the inertia of the head. Moreover, the compact nature of the parts minimizes the dissipation of force due to the inherent elasticity of the metal. The inner spring 27 projects beyond the end of the hammer and engages the face of the disk 19 as a bumper or shock absorbing means to prevent engagement of the hammer with the disk.

It will be apparent from the foregoing that a device has been provided which creates and utilizes an impact force much greater than can be obtained solely and directly from the motive power. Moreover, since this force is transmitted with a minimum of loss to the part being operated on, the device is highly efficient.

I claim as my invention:

1. In a tool of the character described, the combination of a tool head, a driving member having a driving connection with said head releasable by relative movement of the member axially away from said head and automatically re-engageable after such release, means for effecting such movement when said head encounters a predetermined resistance to movement, a prime mover, and means for drivingly connecting said prime mover with said member including means for accumulating energy as the resistance to the rotation of the head increases as long as said head and driving member are engaged.

2. In a tool of the character described, the combination of two relatively movable members, means drivingly connecting said members and releasable to disconnect said relationship upon relative movement therebetween, said members being automatically re-engageable after release, and means for driving one of said members including means for accumulating energy as the resistance to the rotation of the head increases prior to disengagement of said members and for storing all of such energy until said members have disengaged.

3. In a tool of the character described, the combination of two relatively movable members having complementary juxtaposed faces provided with releasable interengaging means constituting driving connections between said members under certain conditions of operation, said means being successively releasable and reengageable under other operative conditions, driving means connected with one of said members, and means for increasing the momentum of the driven member over that imparted thereto by said driving means as said members move relatively into reengagement.

4. In a tool of the character described, the combination of a driving member, a driven member, driving connections therebetween including cam means for effecting relative separation of said members when movement of said driven member is resisted by a predetermined force and automatically re-engageable after release, a prime mover for said driving member, and driving connections between said prime mover and said driving member including means for accumulating energy as the result of resistance to ro-

tation prior to relative separation of said members.

5. In a tool of the character described, the combination of a driving member, a driven member, driving connections therebetween including cam means for effecting relative separation of said members when movement of said driven member is resisted by a predetermined force, a prime mover, driving connections between said prime mover and said driving member including a yielding element for supplementing the driving action of said driving member upon said driven member in the reestablishment of the connection therebetween, said means acting yieldingly to resist separation of said members and being operable to reestablish such connection.

6. An impact tool comprising, in combination, rotatable driving and driven members, driving connections between said members including cams for effecting relative axial movement to interrupt said connections, a prime mover, and resilient means drivingly connecting said prime mover and said driving member and arranged yieldingly to oppose said axial movement, said resilient means being adapted to accumulate force for rotating said driving member into reengagement with said driven member.

7. An impact tool comprising, in combination, rotatable driving and driven members mounted for relatively axial movement, shoulders on each member interengageable to provide driving connections therebetween, said shoulders being cam-shaped to effect relative axial separating and disengaging movement therebetween, a driving motor, means connecting said motor and said driving member for driving said members when the shoulders are engaged and for rotating said driving member to reestablish interengagement of said shoulders after a cam effected disengagement thereof, said connecting means comprising a spring arranged to be placed under torsional tension by the operation of the motor.

8. In an impact tool, the combination of a rotatable tool head, a rotatable impact hammer arranged to deliver a series of blows to said head to rotate the same, means for rotating said hammer, and means for causing said rotating means to impart additional rotative impact force to said hammer.

9. In an impact tool, the combination of a rotatable tool head, a rotatable impact hammer arranged to deliver a series of blows to said head to rotate the same, a prime mover, spring means interposed between said prime mover and said hammer, said spring means being rigidly connected with said hammer and said prime mover whereby opposition to movement of said hammer is effective to place said spring under torsional tension, and means to restrain and release the action of said spring.

10. An impact tool comprising, in combination, a tubular casing, a tool head rotatably supported at one end of said casing, a hammer rotatably disposed within said casing adjacent said head, said hammer having means thereon for delivering a succession of blows to said head to rotate the head during relative rotation therebetween, a motor, and helically coiled spring means interposed between said motor and said hammer and rigidly connected with each for driving said hammer, the action of said spring being restrained while said head and hammer are engaged and released when said head and hammer are relatively rotatable.

11. An impact tool for rotating nuts, bolts or the like, said tool comprising a rotatable head adapted for connection with the work, a rotatable impact hammer having a normally engaged rotation-transmitting connection with said head, said connection being releasable automatically when said head encounters a predetermined resistance to movement to permit limited rotation of the hammer independently of said head into reengagement with the head, a resilient member having at one end a rotation-transmitting connection with said hammer, and a constantly rotated drive shaft having a rotation-transmitting connection with the other end of said resilient member whereby to rotate said hammer and said head synchronously with said shaft when the resistance of the work is relatively small and to place said resilient member under gradually increasing torsional stress as said resistance approaches said predetermined maximum.

12. In a tool of the character described, the combination of two relatively movable members, means for drivingly connecting said members and releasable to disconnect the driving relationship upon relative movement therebetween, said members being automatically reengageable after release, driving means, and resilient means connecting said driving means and one of said members, and constituting the sole driving connection therebetween.

13. In an impact tool, the combination of a rotatable tool head, a rotatable impact hammer arranged to deliver a series of blows to said head to rotate the same, and means for rotatably driving said hammer including resilient means for intermittently impressing an increased rotative impact force to said hammer, the mass of said hammer being relatively greater than that of said head.

14. In a device of the character described, the combination of a driving member, a driven member, a driving connection therebetween releasable upon relative movement to interrupt the driving connection and automatically reengageable after release, a prime mover, and a resilient driving connection between said driving member and said prime mover and constituting the sole driving connection therebetween, said resilient driving connection being adapted to be placed under torsional stress when movement of the driving member is opposed and concurrently therewith to be shortened to permit release of the driving connection between said driving and driven members followed by an acceleration of the driving member by release of the torsional stress to reengage said first mentioned driving connection.

15. In a tool of the character described, a pair of rotatable members having axes extending generally in the same direction, means releasably engaging the two members intermittently, and means for storing energy in one of said members while said members are in engagement to be expended upon the other member upon a subsequent reengagement therewith to drive said last mentioned member through a working stroke.

16. In a tool of the character described, a pair of coaxial rotatable members, means to impart energy to one of said members at substantially a constant rate, and means to cause the last said member to transfer accumulations of such energy intermittently to the other member.

17. A tool of the character described comprising a cylindrical hammer supported for rotative and longitudinal movement, a tool head rotatably mounted at one end of said hammer, a re-

leasable impact clutch between said hammer and said tool head, a driving member at the other end of said hammer, and a resilient power accumulator housed within said hammer and having rotation-transmitting connections at its opposite ends with said driving member and said hammer.

18. A tool of the character described comprising, in combination, a cylindrical hammer supported for rotative and longitudinal movement and having one substantially closed end, a tool head rotatably supported externally of and adjacent to said end, complementary releasable impact clutch members on said end and head, a resilient power accumulator mounted in said hammer and having its inner end connected with said hammer, and driving means connected with the outer end of said accumulator.

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