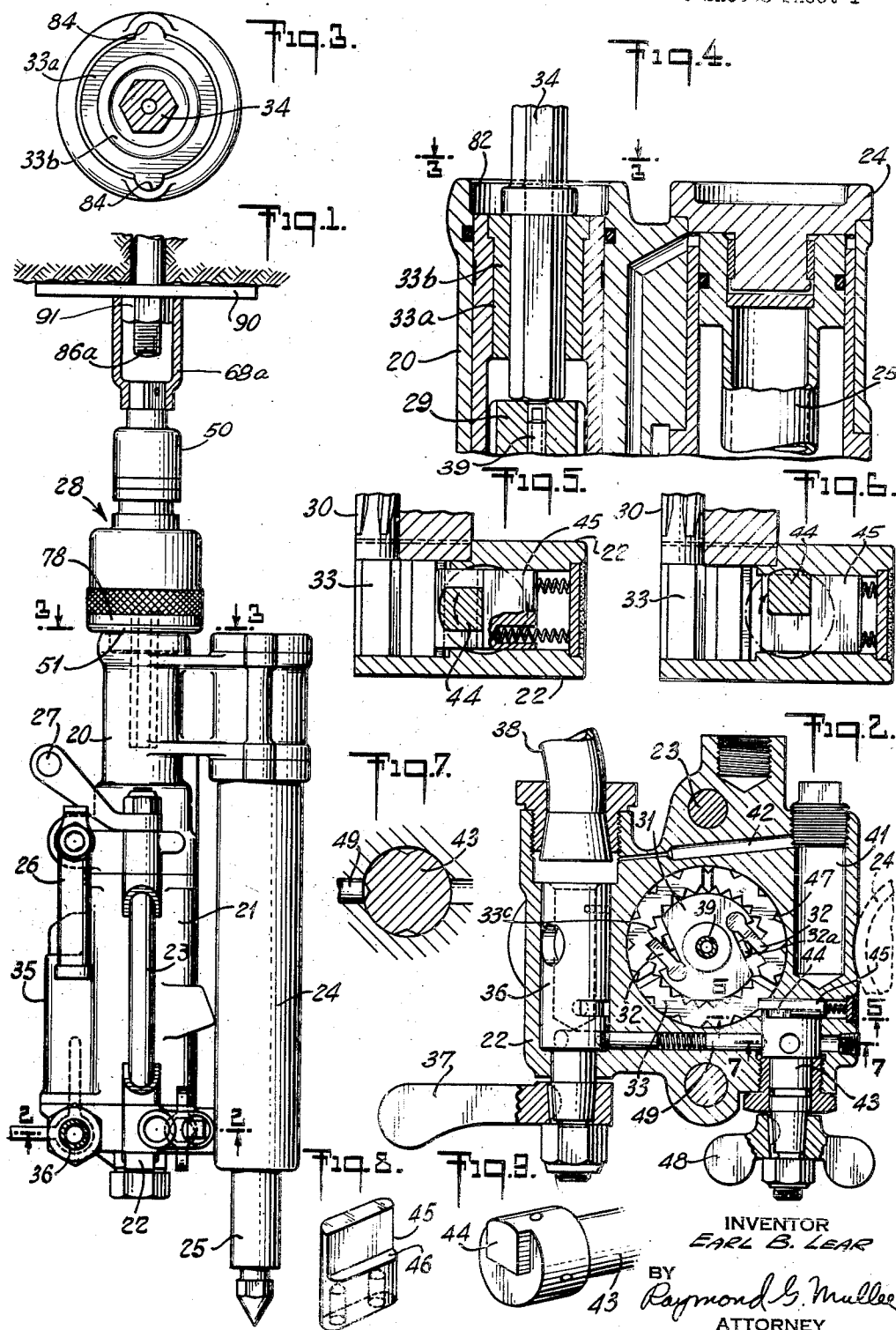


E. B. LEAR

STOPER DRILL WITH ROTARY IMPACT ATTACHMENT

Filed March 31, 1953

3 Sheets-Sheet 1



Sept. 7, 1954

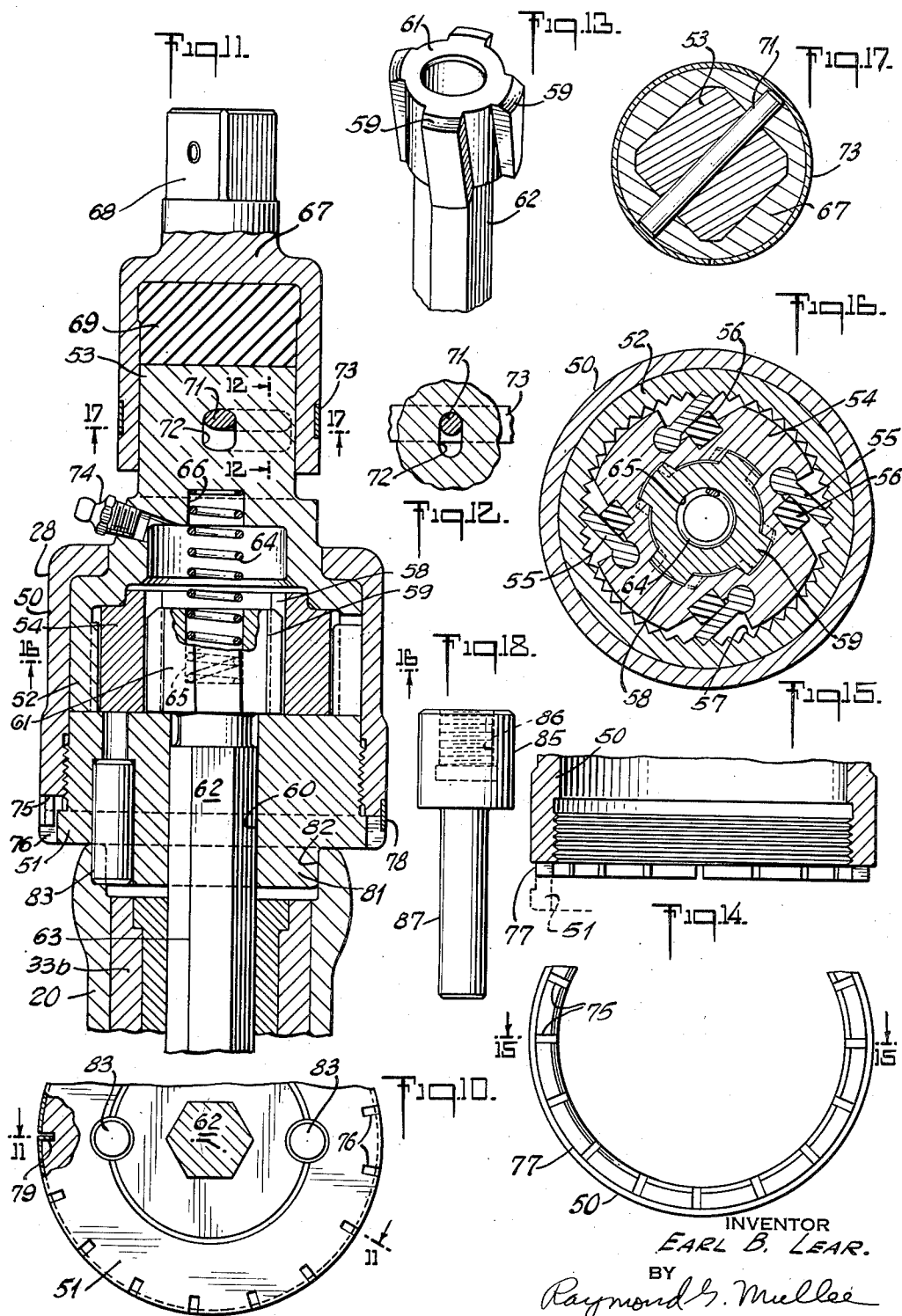
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2,688,268

STOPER DRILL WITH ROTARY IMPACT ATTACHMENT

Filed March 31, 1953

3 Sheets-Sheet 2



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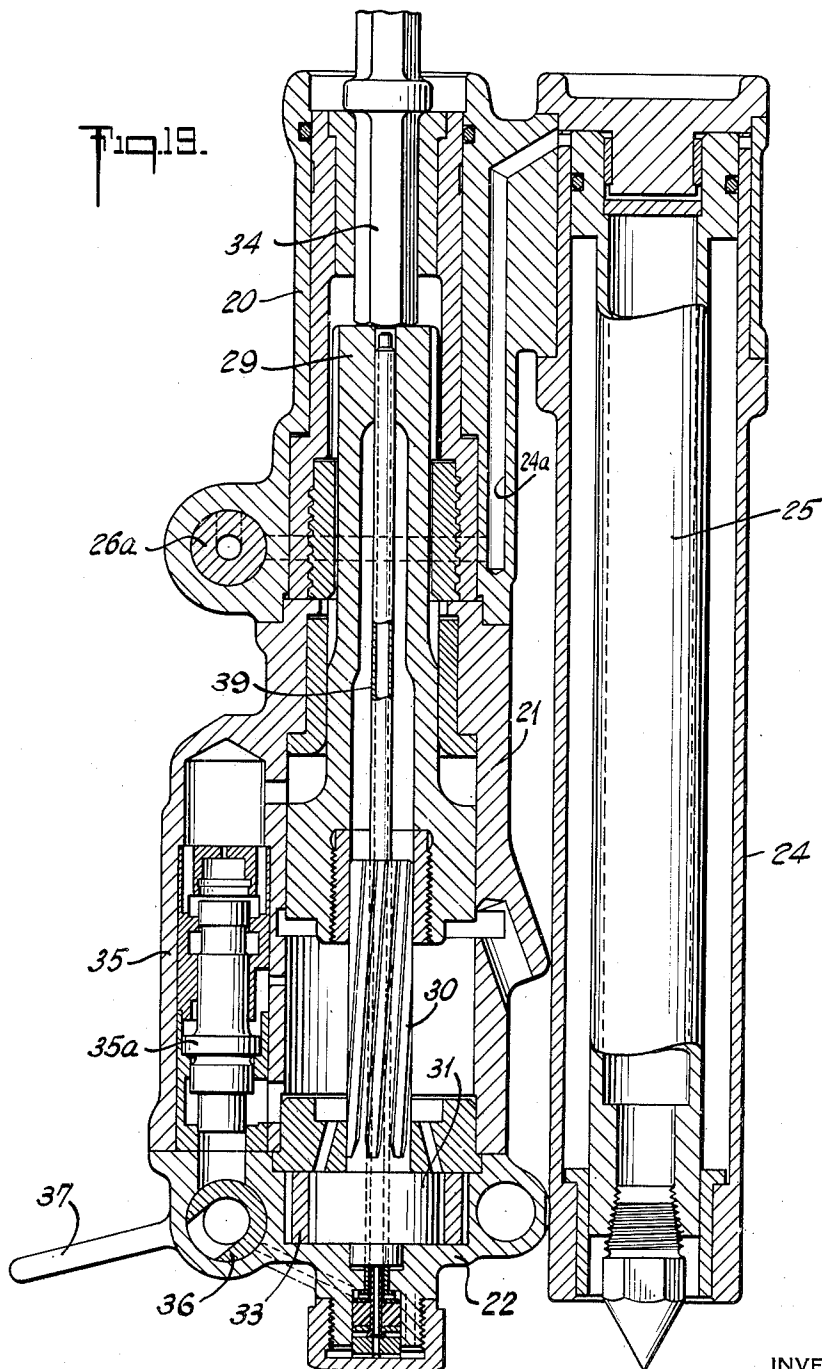
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2,688,268

STOPER DRILL WITH ROTARY IMPACT ATTACHMENT

Filed March 31, 1953

3 Sheets-Sheet 3



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2,688,268

STOPER DRILL WITH ROTARY IMPACT ATTACHMENT

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Application March 31, 1953, Serial No. 345,763

12 Claims. (Cl. 81—52.3)

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This invention relates to drilling and bolting apparatus and more particularly, to a rock drill of the stoper type including an attachment for providing rotary impacts, such as would be useful in the tightening or loosening of threaded members.

The stoper drill and attachment of the invention will be found especially useful in a certain phase of mining operations, namely, the placement of suspension roof supports. Much attention has recently been given to the use of suspension roof supports in tunnelling operations, especially in coal mines. Such a method of supporting a mine roof has many advantages over the conventional timbering method, not only from the standpoint of mining efficiency and resulting economies, but also for the manner in which accident hazard is greatly reduced. Briefly, the suspension roof support method comprises the use of metal rods which are inserted in the tunnel roof and are anchored in areas which are not likely to be stressed or disturbed in the tunnelling operations. Bearing plates, which are next applied to the exposed end of the rods, are drawn tightly against the roof of the tunnel by means, such as nuts. If desired, channel irons, which are held in position by several anchored rods, can be substituted for the bearing plates, so as to give support to a greater roof area. In this type of roof support many different forms of anchor bolts have been devised. One common type of bolt, or stud, is a one inch rod, 4 to 6 feet long which is split on one end while the other end is provided with a thread to fit a standard nut.

The use of the stoper drill and rotary impact attachment of the invention, provides a convenient means for the placing of suspension roof supports, since the rock drill can be used for first drilling the holes for the rods, then after the rods have been anchored in the holes, the rotary impact attachment can be fixed to the drill and the nuts run on the anchored rods so that the bearing plates or channel irons can be drawn tightly against the tunnel roof. Hence, the need for two separate tools, i. e., a drill and an impact wrench, with separate power hoses or lines for each, can be eliminated, since the device of the invention serves a dual purpose.

An object of this invention is to provide a stoper drill and rotary impact attachment for drilling and tightening operations, which will obviate the need for two separate tools, with their respective supply lines, for such drilling and tightening operations.

Another object of this invention is to provide

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a stoper drill and rotary impact attachment whereby the longitudinal impacts of the drill are utilized to produce a rotary impact motion in the attachment, for tightening operations.

A further object is to provide a stoper drill and rotary impact attachment, which will be found especially useful in the placement of suspension roof supports in tunnelling operations.

A still further object is to facilitate release of the rifle bar rotation in the stoper drill either for the purpose of starting a drill hole on the uneven surface of the rock, when interruption of rotation is desirable, or for enabling the stoper drill to be converted readily into an impact wrench. A feature of this invention is a ratchet ring provided with notches on its periphery which are engageable with a locking device under manual control.

Still another object of this invention is to provide a stoper drill and rotary impact attachment, which is simple in design, convenient to operate, economical from the standpoint of first cost and regular use, and of rugged construction and long life.

These and further objects of the invention will appear more apparent from a study of the following specification and related drawings, in which:

Fig. 1 is a side elevation view of the stoper drill and rotary impact attachment of the invention;

Fig. 2 is an enlarged cross-section of the drill as seen from line 2—2 in Fig. 1, illustrating the rotation release mechanism;

Fig. 3 is a view of the top or front end of the drill as seen from line 3—3 in Fig. 1;

Fig. 4 is an enlarged longitudinal section taken through a front portion of the drill, as set for drilling operations;

Fig. 5 is a fragmentary section view illustrating a portion of the rotation release arrangement in locked condition, as seen from line 5—5 of Fig. 2;

Fig. 6 is a view similar to Fig. 5 but showing the unlocked, or released position;

Fig. 7 is a cross-section, as seen from line 7—7 in Fig. 2, showing the rotation release cam shaft and the detent arrangement for yieldingly locking it in adjusted position;

Fig. 8 is a perspective view of a release pawl, as used in the stoper drill of Fig. 1;

Fig. 9 is an isometric view of an end portion of a cam, as used in the stoper drill of Fig. 1;

Fig. 10 is an end view on a still larger scale of a rotary impact attachment of the invention;

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Fig. 11 is a longitudinal section view of the rotary impact attachment of the invention, as seen from line 11—11 in Fig. 10;

Fig. 12 is a fragmentary section view illustrating a retaining pin used in the rotary impact attachment of the invention, as seen from line 12—12 in Fig. 11;

Fig. 13 is an isometric view of a portion of a rotation anvil, as used in the rotary impact attachment of the invention;

Fig. 14 is a portion of an end view of a housing used in the device of Fig. 11;

Fig. 15 is a fragmentary sectional view of the same as indicated by the arrows 15 in Fig. 14;

Fig. 16 is a cross-section as seen from line 16—16 in Fig. 11;

Fig. 17 is a cross-section as seen from line 17—17 in Fig. 11;

Fig. 18 is a longitudinal view of a wedge type rod driver for use with the drill of the invention.

Fig. 19 is a longitudinal sectional view taken through the drill of Fig. 1, but with the drill arranged for drilling operations as shown in Fig. 4, and is drawn in an enlarged scale.

Referring now to the drawings, Fig. 1 illustrates a rock drill of the stoper type having a front head portion 20, a cylinder or main body portion 21 and a backhead 22, all of which are secured together by draw bolts 23 arranged on each side of the drill. The front head portion 20 supports a feed leg cylinder 24, which extends parallel to the axis of the drill, and contains a reciprocable piston 25, which is pointed at its lower or rearward extremity. A feed leg control valve 26a arranged within the body of the drill, is operated by handle means 26 to cause flow of compressed air into the forward end of the feed leg cylinder 24, via passageway 24a to force piston 25 rearwardly, or out of the cylinder, which results in forward movement of the drill, assuming that the pointed end of the piston is abutting an immovable body, for example the floor of the mine tunnel. A handle 27, for carrying or supporting the drill, may be affixed thereto in the manner illustrated. A rotary impact attachment 28 of the invention is shown in position at the front head portion of the drill.

Within the cylinder 20 of the rock drill is a reciprocable hammer piston 29, a portion of which is shown in Fig. 4, and a rifle bar 30 having a helical splined portion, which engages the hammer piston. The rear end of the rifle bar has a head 31 containing pawls 32, which are resiliently maintained by spring loaded detents 32a to engage slots 33c formed in a ratchet ring 33 supported in a cavity in the backhead 22. As the piston 29 reciprocates, it is given a step-by-step rotation, due to the helical connection between the piston 29 and rifle bar 30, operating in conjunction with the pawl and ratchet arrangement, all as is well known in the art. The intermittent rotative movements of the piston are transmitted through a chuck 33a which has a splined connection with the piston and which is mounted in the front head 20. The front end of the chuck has a bushing 33b arranged to support a drill steel 34 non-rotatively in the chuck whereby the drill steel is arranged to partake of the step by step rotation of the piston. An automatic distributing valve 35a is arranged within the drill on an exterior portion 35 of the main body portion 21, and a throttle valve 36, positioned in the backhead 22, is operable by handle means 37 to admit compressed air from an air line 38, to the automatic valve, which directs

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the air in a manner to cause the hammer piston 29 to reciprocate within the drill. A water tube 39 centrally arranged within the drill, is adapted to conduct water to the drill steel during drilling operations, as is common practice in a drill of the stopper type. An oil reservoir 41, having a metering passageway arrangement 42, connecting with a cavity containing the throttle valve 36, is provided for the admission of minute particles of oil to the live air for lubricating the drill.

A rotation release arrangement is provided to permit selective operation the rock drill without rotation of the drill steel 34. This rotation release arrangement includes a cam shaft 43 which is rotatably mounted within the backhead 22, the inner end of the shaft having a cam 44, which is adapted to operate a pawl 45, slidably positioned within the backhead. As seen in Fig. 8, the pawl 45 is of slablike proportions and has a recessed section providing a shoulder 46 on one side thereof. Ratchet ring 33 is adapted to rotate within the backhead, and has on its outer periphery a plurality of notches or slots 47. The pawl 45, in locked position, is resiliently maintained so that one end thereof engages one of the slots 47 of the ratchet ring. In such locked condition, the ratchet ring provides a rigid abutment for the pawls 32 to operate against, resulting in the step-by-step rotation of the piston 29 and drill steel 34, as heretofore set forth. When the cam shaft 43 is rotated 90° from the position shown in Figs. 2 and 5, the cam 44 by virtue of engagement with shoulder 46 will maintain the end of pawl 45 out of engagement with slots 47 of the ratchet ring 33. In such unlocked condition the ratchet ring will be free to rotate or oscillate within the backhead and will not provide a rigid abutment for the pawls 32 to operate against; hence, rotation of the drill steel will not occur. It will be seen that in the latter condition, the rifle bar and associated parts including the ratchet ring 33, will oscillate as the hammer piston 29 is caused to reciprocate.

A handle 48 is keyed to the cam shaft 43 to provide for the convenient rotation thereof, and an indexing pin 49 is resiliently arranged to abut detents formed on an exterior portion of the cam shaft, to maintain the latter in either rotation release locked or unlocked condition.

The rotary impact attachment 28, as seen in Fig. 11, includes a housing 50, which is threaded at one end to receive a housing cap 51, and is adapted to surround and support for rotation, a ratchet ring 52 which has a square-sided extension 53. Positioned within the ratchet ring 52 is a rifle bar nut 54 which has four pawl members 55 equally spaced, the outer end of each being resiliently maintained, by rubber inserts 56 or equivalent, in engagement with notches or teeth 57, arranged about the inner surface of the ratchet ring 52. On the inner surface of the rifle bar nut 54 are four spiral equi-spaced grooves 58, which are adapted to receive spline members 59 formed on a head portion 61 of a rotation anvil 62. The rotation anvil has a hexagonal shank portion 63 which extends through a hexagonal hole 60 formed in the housing cap 51, and is of length sufficient to enter into the chuck bushing 33b in front head portion 20 of the drill, to engage with the hammer piston 29, in the manner of the drill steel 34.

A compression spring 64, centered at one end in a cavity 65 formed in the head portion 61 and at the other end in a cavity 66 formed in the extension 53, urges the head portion 61 of the

rotation anvil 62 in the direction of the housing cap 51. Affixed to the extension 53, is a driving head 67 which has a shank portion 68 adapted for coupling with a removable socket 68a for engaging the nut or bolt to be rotated. A rubber cushion 69 is maintained within the driving head 67 for absorbing the axial blows which occur in the use of the impact attachment during a nut tightening operation. The cushion thus serves to prevent shattering of the roof shale or rock surrounding the bolt hole. The driving head 67 is maintained on the extension 53 by means of a pin 71 which extends through an elongated hole 72 formed in the extension 53, the ends of the pin 71 engaging holes in the driving head 67, as shown. A split metal band 73 is positioned within a groove formed on the exterior of the driving head 67, to maintain the pin 71 in position. A lubricant connection 74 is positioned in the ratchet ring 52 for the lubrication of the various movable parts included in the assembly.

At the threaded end of the housing 50 are arranged sixteen radial slots 75, of the same width as seventeen radial slots 76 formed in a flange-like portion of the housing cap 51.

A circumferential groove 77 is formed on the exterior of the housing 50 and the flange-like portion of the housing cap 51, to overlap the slots 75 and 76. A split metal band 78, having a hook 79 at one end, is arranged within the groove 77 so that the hook 79 enters into one of the slots 75 and 76. In this manner, the threaded connection between the housing 50 and housing cap 51 is positively locked.

The housing cap 51 has a cylindrical projection 81 on the lower or rear side, which is of such proportions as to fit into a cavity 82 provided in the front head portion 20 of the drill. A pair of pins 83 are diametrically arranged about the projection 81 of the housing cap 51, in a manner as to engage recesses 84 formed in the front head portion 20, as best seen in Fig. 3. The pins 83 and recess 84 arrangement prevent the rotary impact attachment 28 from turning after it is in position on the drill.

It will be seen from a study of the arrangement of the rotary impact attachment 28 as described above, that with the assembly in position on the drill, each blow of the hammer piston 29 of the drill, against the end of the shank 63 of anvil 62, will drive the anvil forward and the rifle nut 54 will be given a rotary motion, due to the splined connection between the latter two elements. This rotary motion will be transmitted to the ratchet ring 52, by virtue of the pawls 55 in engagement with the notches 57 of the ratchet ring, thus the driving head 67, connected to the ratchet extension 53, will be rotated, as well as the socket which is affixed thereto and which engages a driven nut. The reactive force of the anvil 62 acting upon the rifle nut 54 to cause rotation of the ratchet ring 52, is transferred to the housing cap 51, by the hexagonal shank 63 of the anvil 62 working in the hexagonal hole 60, and then to the drill, by way of the pin 83 and recess 84 arrangement between the rotary impact attachment and the front head portion 20, and is resisted by the operator of the drill, either manually or by fixing the drill in operative position. Upon completion of its forward thrust the anvil 62 is restored to its normal or rearward position by the compression spring 64. During such rearward movement the splined portion 59 on the anvil rotates the rifle nut 54 in a direction opposite

to that which occurred during the power stroke. Such backward or restorative turning movement of the rifle nut is not transmitted to the ratchet ring 52 or to the tool head 67 because of the disposition of the pawls 55 as will be apparent from Fig. 16. Thus, the rifle nut is caused to oscillate in response to the reciprocations of the anvil, and during each power stroke turns the ratchet ring through a distance equal to 1, 2 or 3 ratchet teeth, depending on whether the nut fits tightly or turns freely on the bolt.

The rotary impact attachment 28 is shown for right-hand rotation; if left-hand rotation is desired, it would be necessary to provide parts having a reverse slope of the anvil splines 59 and the mating grooves 58 of the nut 54, as well as a change in the operative direction of the pawls 55.

When the drill is used for drilling operations, it is arranged as shown in Figs. 2 and 4, namely, the rotation release arrangement is locked, and the drill steel 34 is in position in the front head portion 20.

After the holes have been drilled in the roof and the bolts driven and anchored therein, the drill is used for nut tightening operations. For this purpose it is then arranged as shown in Fig. 1, namely, the rotary impact attachment 28 is in position on the front head portion 20, with the anvil 62 in the stopper chuck and the rotation release cam shaft 43, is turned so that the cam 44 is in position shown in Fig. 6. A washer plate 90 of suitable dimension, for example 8 inches square and $\frac{3}{8}$ inch thick, is placed on the rod 86a together with a nut 91. The rotary impact attachment drives the nut extremely tight, thereby actually bending the plate to conform to the uneven contour of the rough face of the roof rock.

While the impact wrench of the present invention is designed especially for tightening or loosening nuts on roof support bolts in mines, it has other applications, for example in the erection or dismantling of heavy equipment.

In Fig. 13 is shown a wedge type rod driver 85, which may serve as an auxiliary part in suspension roof support placement operations. The driver 85 has a threaded portion 86 for engagement with the end threaded rod 86a to be anchored in the drilled hole, and a shank portion 87, which is of cylindrical shape, and which is placed in the chuck bushing 33b of the drill, in the manner of the drill steel 34. The impacts of the hammer piston 29 upon the end of the shank 87, quickly drives the rod to anchored position within the roof tunnel hole.

What is claimed is:

1. In a device of the character described, an assembly including a reciprocable hammer piston arranged to deliver impact blows to an element supported by the assembly, a rotation arrangement for rotating the supported element, means to disengage said rotation arrangement to prevent rotation of the supported element, and a rotary impact attachment connectable to the assembly for utilizing the impact blows of the hammer piston to deliver rotary impact blows.

2. In a device of the character described, an assembly including a reciprocable hammer piston arranged to deliver impact blows to an element supported by the assembly, a rotation arrangement for rotating the supported element, disengaging means operable to disengage said rotation arrangement to prevent rotation of the supported element, and a rotary impact attachment posi-

tionable in part within said assembly and adapted upon operation of said disengaging means to utilize the impact blows of the hammer piston to deliver rotary impact blows.

3. A device according to claim 2, wherein said rotary impact attachment comprises a housing arrangement adapted to be maintained in fixed position relative said assembly, a first rotatable member supported by said housing arrangement and having an extension adapted to receive socket means, a second rotatable member enclosed by the first rotatable member and having a plurality of pawl members engageable with the first rotatable member for rotary driving connection in a given direction, a reciprocally arranged driving element positioned in part within the housing and having a portion adapted to receive impact blows and a portion having helical splines for engaging with grooves on the second rotatable member whereby movement of the driving element in a forward direction as a result of an impact blow will cause rotation of the second rotatable member, and resilient means compressively arranged between the extension of the first rotatable member and the helical splined portion of the driving element.

4. A rotary impact attachment comprising a housing arrangement adapted to be maintained in relatively fixed position, a ratchet ring rotatably supported by said housing arrangement and having a plurality of notches on an inner periphery and an extension adapted to receive a socket means, a rifle bar nut arranged within the ratchet ring and having a plurality of pawl members pivotally connected thereto a free end of each of the pawl members engaging the notches of the ratchet ring so that the ratchet ring may be rotated in a given direction, an anvil member positioned in part within the housing for reciprocal movement and having a shank portion adapted to receive impact blows and a portion having helical splines for engaging with grooves formed on an inner periphery of the rifle bar nut whereby movement of the anvil member in a forward direction as a result of an impact blow will cause rotation of the rifle bar nut, and a compression spring arranged between the ratchet ring extension and the helical splined portion of the anvil member.

5. A rotary impact attachment according to claim 4 wherein a cushioning means is positioned between the ratchet extension and the socket means to absorb compressive shock resulting from an impact blow on the anvil member.

6. A rotary impact attachment according to claim 5 wherein the housing arrangement includes a housing element and a housing cap element threadably connected therewith, and a locking arrangement for maintaining said elements in connected condition comprising a split ring which is positioned in a peripheral groove formed in part on each of said elements, said ring having

a hook at one end which engages slot means formed in each of said elements.

7. A rotary impact attachment according to claim 6 wherein the shank portion of the anvil is fixed against rotary movement with respect to the housing cap.

8. A device according to claim 2, wherein the rotation arrangement includes a rotatable rifle bar having a head portion carrying a plurality of pivoted pawl members, a rotatable member surrounding the head portion and having a groove means on an inner and outer periphery thereof, said pawl members being resiliently arranged to engage grooves of the inner groove means.

9. A device according to claim 8, wherein the disengaging means comprises a disengaging pawl reciprocally arranged so that one end thereof can be moved into a groove on the outer periphery of the rotatable member and prevent the latter from rotating, and a manually operable cam arrangement for moving the disengaging pawl out of engagement with a groove on said outer groove means.

10. In a stoper drill, a reciprocating hammer piston, a rotation mechanism for turning the piston and including a rifle bar having a head portion carrying a plurality of pivoted pawls, a ratchet ring surrounding the head portion and pawls, and having notches on its inner and outer periphery, said pawls being resiliently arranged to engage the notches on the inner periphery of the ratchet ring to permit relative rotation in one direction only between the rifle bar and ratchet ring, and means for disabling the rotation means to permit the hammer piston to reciprocate without rotation, said disabling means including a disengaging pawl arranged for reciprocable movement into and out of locking engagement with the notched outer periphery of the ratchet ring, yieldable means for moving the disengaging pawl toward the ratchet ring, and a manually operable cam for moving the disengaging pawl in the opposite direction in opposition to said yieldable means.

11. A stoper according to claim 10, in which the disengaging pawl has a flat shape and is mounted for rectilinear movement in a direction approximately tangent to the periphery of the ratchet ring.

12. A stoper according to claim 11, in which the disengaging pawl is recessed to receive the operating portion of the manipulative cam.

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