May 21, 1929. E. W. STEVENS 1,713,987

ROTATION MECHANISM FOR HAMMER DRILLS

Filed Oct. 15, 1923

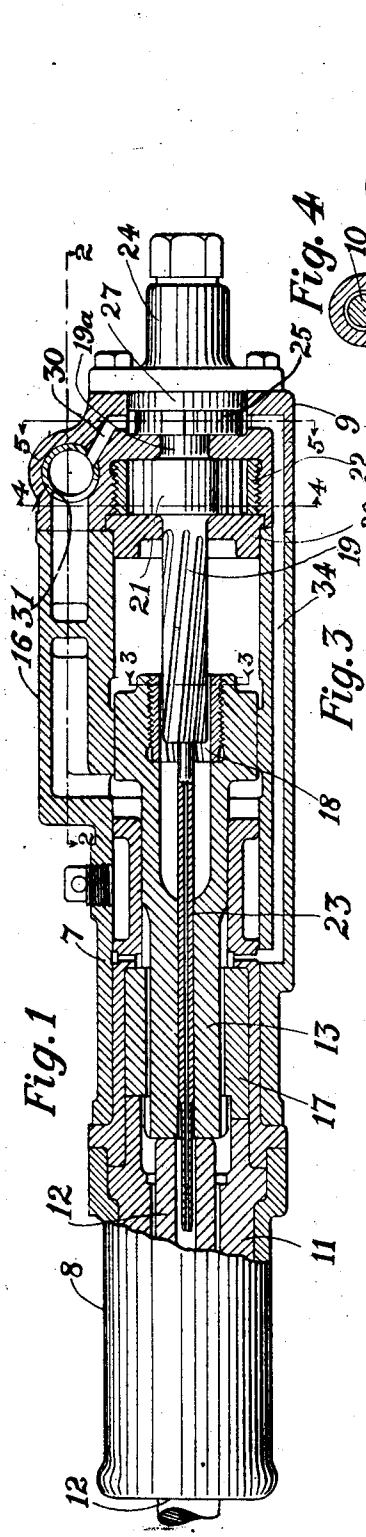


Fig. 1

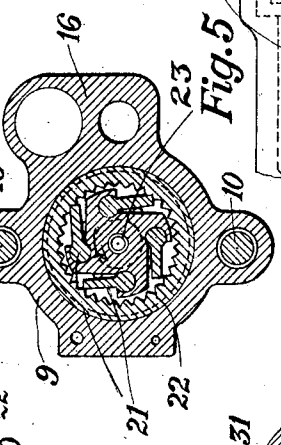


Fig. 4

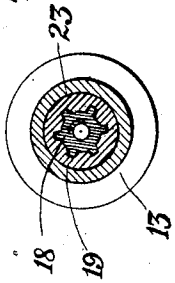


Fig. 3

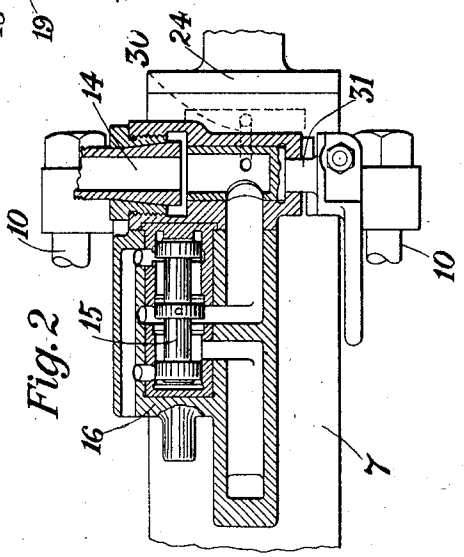


Fig. 2

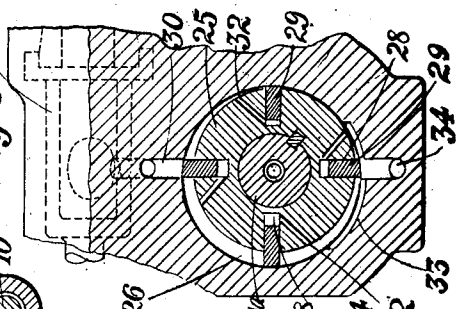


Fig. 5

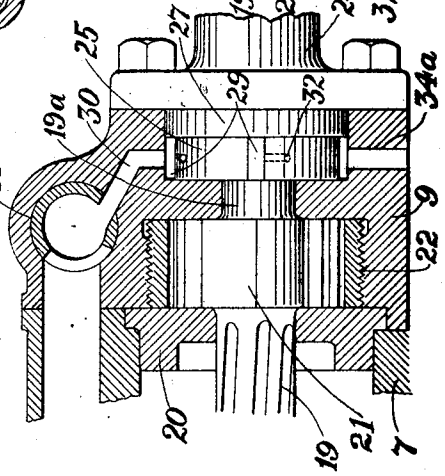


Fig. 6

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UNITED STATES PATENT OFFICE.

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ROTATION MECHANISM FOR HAMMER DRILLS.

Application filed October 15, 1923. Serial No. 668,487.

This invention relates to hammer drills and more particularly to the mechanism for rotating the working tool or drill steel during the drilling operation.

In hammer drills utilizing the well known rifle bar mechanism wherein a rifle bar engages the hammer piston to effect rotation the piston as it reciprocates becomes alternately a driving and a driven member. In one stroke, usually the rearward stroke, the rifle bar is held against rotation by its pawls so that the piston is forced to follow the curved ribs of the rifle bar. On the reverse stroke of the piston the pawls are released and the rifle bar is rotated by the piston which continues to rotate due to inertia. Accordingly at the end of each stroke when the piston changes its function, there is lost motion between the various parts comprising the rotating mechanism including the rifle bar nut, the rifle bar, the pawls and the ratchet ring.

The speed of piston travel which is great in rock drills of the hammer type together with the inertia of the piston tends to produce in effect a continuous rotation of the latter by rifle bar mechanism. This rotation is transmitted by the piston through suitable connections to the drill steel, but the continual shifting of the driving force tends to produce rapid wear. After wear has taken place there is marked loss of rotative power and the hammering effect produced by the backlash at the end of each stroke of the piston causes great strain upon the parts, often resulting in breakage.

Among the objects of the invention are to produce steady and effective rotation of drill steels in drills of the type described, to overcome lost motion and backlash as the piston reverses its movement, to minimize wear and breakage of parts, and in general to improve prior devices of this character.

In order to illustrate the invention, one concrete embodiment thereof is shown in the accompanying drawings, in which:

Fig. 1 is longitudinal sectional view;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view on the line 3—3 of Fig. 1;

Fig. 4 is a transverse sectional view on the line 4—4 of Fig. 1;

Fig. 5 is an enlarged transverse sectional view on the line 5—5 of Fig. 1; and

Fig. 6 is a fragmentary longitudinal sectional view similar to Fig. 1 but on the scale of Fig. 5 showing a slightly modified form of the invention.

The invention is disclosed as incorporated in an impact type of rock drill of conventional form, except as to specific details to be hereinafter set forth. The drill comprises a cylinder 7 having a front head 8 and a rear head 9 secured in assembled relation by the usual side or through bolts 10 (Figs. 2 and 4). The front head 8 incloses a revolvable chuck 11 adapted to receive the polygonal head of a drill steel 12 and support the same in position to be struck by the hammer piston 13, which is reciprocated in the cylinder 7 by fluid pressure admitted at 14 (Fig. 2) and controlled by spool valve 15 in the offset valve casing 16. The forward end of piston 13 is ribbed to cooperate with a correspondingly grooved sleeve 17 having a driving connection with the chuck 11, so that rotation imparted to the piston is communicated to the drill steel in the usual manner. Rotation of piston 13 is effected by the usual rifle bar mechanism which, as shown, comprises a rifle bar nut 18 secured to the piston and cooperating with the rifle bar 19 which has a bearing in the cylinder or thrust ring 20 and is provided at its rear end with a series of pawls 21 cooperating with a ratchet ring 22 secured in a chamber in the cylinder head 9. If desired, the rifle bar and the piston may have an axial bore to receive a water tube 23 mounted in the back head 24.

The operation of a rock drill having the parts designated above is well known, and in accordance with the usual practice the rifle bar 19 is rotated by the piston 13 on its forward or working stroke while the pawls 21 are released, but when the piston reverses its strokes, the pawls engage the ratchet ring 22 thereby holding the rifle bar against rotation and forcing the piston to rotate as it follows the grooves on the rifle bar. To overcome the play and backlash on the rotating mechanism, which inevitably results with rifle bar mechanism when the piston reverses its movement, suitable means comprising the present invention are provided for maintaining a constant rotative impulse or torque upon one of the elements of the rotation mechanism. In the form of the invention shown, this means is effective upon the rifle bar, which as indicated in Figs. 1

and 6 is provided with an extension 19a journalled in the cylinder head 9 and having keyed to the end thereof a cylindrical member 25 which is eccentrically disposed in a chamber 26 in the cylinder head (Fig 5), which chamber is closed in an air tight manner by a projection 27 on the back head 24. Member 25 has a plurality of radial grooves 28 receiving blades 29, whereby said member forms a fluid pressure motor operated by motive fluid by-passed from the main inlet 14 through a passage 30 controlled, as is the supply to valve 15, by a manually operated throttle valve 31 (Figs. 2 and 5). In the operation of this motor, the blades 29 are forced into substantially air tight contact with the walls of the chamber 26 by pressure fluid admitted to the rear of the blades 29 by restricted passages 32, which pressure is released at the proper time to permit the blades to retract by a relief groove 33 communicating with the exhaust passage 34. The exhaust from the motor may be led by passage 34 to the forward end of the piston chamber as indicated in Fig. 1 to blow through the hollow drill steel. In the alternative form shown in Fig. 6, the exhaust passage 34a leads directly to atmosphere.

As indicated by the drawings the fluid pressure motor is very small and intended to take up the play of the rifle bar produced at the reversal of the stroke of the piston, and also to assist in the rotation of the piston. To accomplish these purposes the motor imparts its rotative impulse to the rifle bar 19 in the direction permitted by the ratchet and pawl structure. This constant rotative impulse on the rifle bar is effective in maintaining one side of each rib of the rifle bar in contact with the corresponding sides of the ribs in the rifle nut 18 and confines the wear to the parts thus maintained in contact. The sides of the ribs of the rifle bar and nut thus maintained in contact are the sides effective to produce rotation of the piston on its back stroke at which time the rifle bar is maintained against rearward movement by the pawls 21 engaging the teeth of the ratchet ring 22. The rotation motor resists and cushions this reverse rotation of the rifle bar and through its constant rotative impulse on the rifle bar, provides means in addition to the pitch of the ribs or splines on the rifle bar for rotating the piston. Thus the tendency of this motor is to increase the effectiveness of the rifle bar as a driving member for the piston on the latter's rearward stroke. It also minimizes the driving effect of the piston on the latter's forward stroke when the rifle bar is normally the driven member since its function is to turn the rifle bar in the direction in which the piston normally rotates the bar on its forward stroke. In this way the motor largely eliminates, or entirely overcomes the lost motion and back lash at each reversal of the movement of the piston and increases the rotation of the piston. By maintaining one side only of the ribs or splines of the bar and nut in contact as described above it is evident that the rotation motor not only reduces the wear ordinarily incurred by the usual rifle bar mechanism but it also automatically takes up all wear thereby insuring a perfect and efficient functioning of the rotating mechanism until completely worn out, a result not heretofore attained. By using a small fluid pressure motor with the usual rifle bar rotation mechanism, the advantage of the latter's positive rotating action is retained and its disadvantages in rapid wear and liability to breakage are greatly minimized if not entirely avoided. In addition the bulkiness, increased weight, and poor balance of drills of the independent rotation type due to the size of the fluid pressure motor needed for effective rotation are avoided.

From the above, it will be apparent that the fluid pressure motor mounted as described tends to supplement by a continuous rotative impulse, the intermittent rotation afforded the piston by the rifle bar and nut and to maintain constantly one side of each rib of the rifle bar against one side of each groove in the nut, thereby avoiding the lost motion heretofore experienced. Thus on the forward or working stroke of the piston and during the inoperative period of the rifle bar mechanism, the motor tends to augment the rotative impulse imparted to the piston during its previous rearward stroke. It will be further apparent that not only are the losses in rotative effect resulting from the backlash and lost motion at each end of the stroke greatly minimized, but that there is also a decrease in wear and an avoidance of destructive strain upon the ratchet and pawl mechanism. The invention provides in effect a continuous torque motor working in tandem with the intermittent torque provided by rifle bar rotation.

I claim:

1. In a hammer drill, rotation mechanism for the drill bit comprising means mounted on the drill casing cooperating with the reciprocating impact member for causing rotation of the latter during a part of its cycle of movement, and means independent of the reciprocative movement of the member tending to augment the rotative movement of the latter.

2. In a hammer drill in which rotation of the piston is imparted to the drill steel, rotation mechanism for the piston comprising means cooperating with the piston to cause rotation thereof during a part of its cycle of movement, said means being mounted on the drill casing for rotation in one direction

only, and means for applying a constant rotative impulse to said piston.

3. In a hammer drill in which rotation of the piston is imparted to the drill steel, rotation mechanism for the piston comprising means cooperating with the piston to cause rotation thereof during a part of its cycle of movement, said means being mounted on the drill casing for rotation in one direction only, and means responsive to fluid pressure for applying a constant rotative impulse to said piston.

4. In a hammer drill in which rotation of the piston is imparted to the drill steel, rotation mechanism for the piston comprising means cooperating with the piston to cause rotation thereof during a part of its cycle of movement, said means being mounted on the drill casing for rotation with the piston during the remainder of its cycle of movement, and means for applying a constant rotative impulse to said piston.

5. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating means on the casing and on the piston for imparting rotation to the latter, and means responsive directly to fluid pressure for augmenting the rotation of the piston.

6. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating means on the casing and on the piston for imparting rotation to the later during its movement in one direction, and means responsive directly to fluid pressure for augmenting the rotation of the piston.

7. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating members on the casing and on the hammer piston for imparting rotation to the latter comprising a rifle bar and a rifle bar nut, and means for taking up lost motion between said bar and nut when the piston reserves its movement.

8. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating members on the casing and on the piston for imparting rotation to the latter comprising a rifle bar and a rifle bar nut, and means for applying a constant torque to one of said last named members.

9. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating members on the casing and on the piston for imparting rotation to the latter comprising a rifle bar and a rifle bar nut, and a fluid pressure rotation motor associated with one of said rotation members for augmenting the rotative impulse applied to the piston.

10. In a hammer drill, a member arranged to rotate the drill bit, a fluid pressure rotation motor for continuously imparting a rotative impulse to said member in one direction, and means restraining said member against rotation in the opposite direction.

11. In a hammer drill, a member arranged to rotate the drill bit, a fluid pressure rotation motor for continuously imparting a rotative impulse to said member in one direction, and ratchet and pawl mechanism for preventing rotation thereof in the opposite direction.

12. In a hammer drill having a percussive motor including a hammer piston, the combination with rifle bar mechanism for imparting rotation to the hammer piston during movement thereof in one direction, of fluid pressure operated means distinct from said percussive motor associated with said mechanism for imparting to said piston a rotative impulse during its movement in the reverse direction.

13. A hammer drill comprising a casing, a drill bit chuck rotatably mounted in the casing, a hammer piston reciprocable in said casing and having a driving connection with said chuck, and means responsive both to movement of said piston in one direction and to motive fluid pressure for rotating said piston.

14. In a hammer drill wherein the hammer piston has a driving connection with the rotatably mounted drill chuck, mechanism for causing rotation of said piston comprising in combination means intermittently imparting a rotative impulse to said piston and means constantly imparting a rotative force thereto.

15. A hammer drill comprising a casing, a drill bit chuck rotatably mounted therein, a hammer piston reciprocable in said casing and having a driving connection with said chuck, a rifle nut on said piston, a rifle bar on said casing cooperating with said nut, ratchet and pawl mechanism restraining said bar against rotation in one direction, and means imparting a constant rotative force to said bar.

16. A hammer drill comprising a casing, a drill bit chuck rotatably mounted therein, a hammer piston reciprocable in said casing and having a driving connection with said chuck, a rifle nut on said piston, a rifle bar on said casing cooperating with said nut, ratchet and pawl mechanism restraining said bar against rotation in one direction, and means responsive to fluid pressure for taking up lost motion between said bar and nut.

17. A hammer drill comprising a casing, a drill bit chuck rotatably mounted therein, a hammer piston reciprocable in said casing and having a driving connection with said chuck, a rifle nut on said piston, a rifle bar on said casing cooperating with said nut, ratchet and pawl mechanism restraining said bar against rotation in one direction, a fluid pressure motor associated with said bar for im-

parting a constant rotative force thereto, and means for directing the exhaust of said motor through a hollow drill bit supported in said chuck.

18. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating means on the casing and on the piston for imparting rotation to the latter in response to its movement including a rifle bar and a rifle nut, and means confining the wear on said bar and nut to one side only of the ribs thereof.

19. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating means on the casing and on the piston for imparting rotation to the latter in response to its movement including a rifle bar and a rifle nut, and means automatically maintaining contact between the same parts of said bar and said nut regardless of wear whereby the efficiency of the rotative means does not diminish with use.

20. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating means on the casing and on the piston for imparting rotation to the latter in response to its movement including a rifle bar and a rifle nut, and fluid pressure responsive means automatically maintaining the same portions of said bar and said nut in contact regardless of wear whereby the efficiency of the rotative means does not diminish with use.

21. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating means on the casing and on the piston for imparting rotation to the latter in response to its movement including a rifle bar and a rifle nut, and means confining the wear on said bar and nut to one side only of the ribs thereof and automatically taking up all wear whereby the efficiency of the rotation mechanism does not diminish with use.

22. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating members on the casing and on the piston for imparting rotation to the latter in response to is movement, said members having engaging surfaces susceptible to wear, and means acting through certain of said members to localize and reduce the wear of said surfaces.

23. In a hammer drill in which rotation of the piston is imparted to the drill steel, cooperating members on the casing and on the piston for imparting rotation to the latter in response to its movement, said members having engaging surfaces susceptible to wear, and fluid pressure means acting through certain of said members to localize and reduce the wear of said surfaces.

24. A fluid pressure percussive drill comprising a casing, a drill bit chuck rotatably mounted on said casing, a hammer piston reciprocable in said casing and having a driving connection with said chuck, a rifle nut on said piston, a rifle bar in said casing cooperating with said nut, ratchet and pawl mechanism restraining said bar against rotation in one direction, and a fluid pressure rotative motor in said casing rearwardly of said rifle bar and in line therewith, said motor being arranged to impart a continuous rotative force to said rifle bar, the rotor of said motor being secured to an extension of said rifle bar and rotating the latter in the direction permitted by said ratchet and pawl mechanism.

Signed by me at Detroit, Michigan, this 6th day of October, 1923.

EDWARD W. STEVENS.

CERTIFICATE OF CORRECTION.

Patent No. 1,713,987. Granted May 21, 1929, to

EDWARD W. STEVENS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 44, claim 7, for the word "reserves" read "reverses"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of July, A. D. 1929.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.