March 13, 1956 J. E. FEUCHT 2,737,818

INTERMITTENT ROTATION MECHANISM WITH OVERLOAD RELEASE

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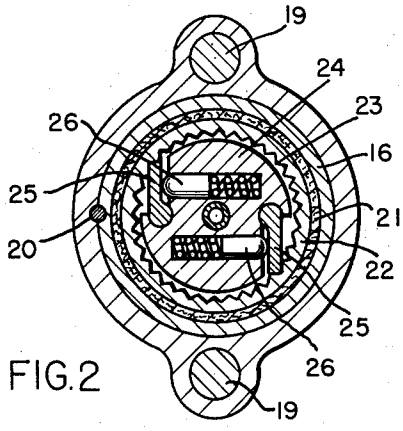


FIG.2

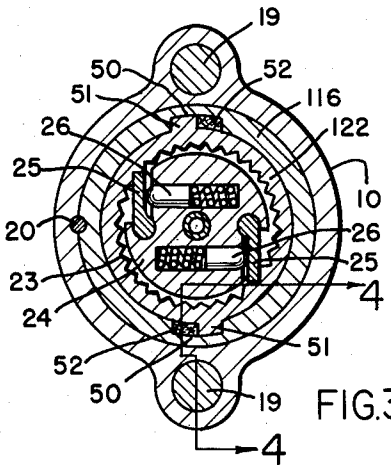


FIG.3

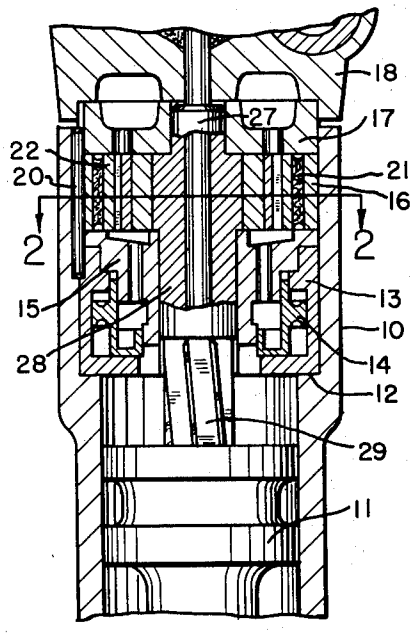


FIG.1

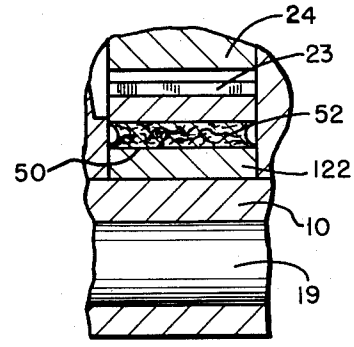


FIG.4

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INTERMITTENT ROTATION MECHANISM WITH OVERLOAD RELEASE

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2 Claims. (Cl. 74—127)

This invention relates broadly to rock drills, but more particularly to an improved rotation mechanism for rock drills of the percussive type.

As is well known in this art, rotation mechanism for rock drills generally includes a rifle bar having a head carrying pawls engageable with the ratchet teeth of a fixed ratchet ring. The rifles of the bar are cooperating with a rifled nut fixed within the head of an impact delivering reciprocatory piston, so that during each stroke of the piston in one direction the piston is made to rotate while the rifle bar pawls are in operative engagement with the teeth of the ratchet ring, and during each stroke in the other direction the rifle bar is made to rotate while its pawls ride over the teeth of the ratchet ring. This step by step rotation of the piston is transmitted to the drill steel by a chuck having the shank of the drill steel fitted therein against relative rotation, the chuck being conneced to the piston by interengaging splines.

Such rotation mechanism has been found to be satisfactory during normal drilling operations, but when drilling in formation of varying density, wherein the drill steel often becomes stuck, that is embedded in the formation and is prevented from rotating, the rifle bar and its cooperating nut were subjected to excessive load which often resulted in pawl and rifle bar breakage. If no breakage occurred, the piston by virtue of the engagement of the rifles of its nut with the rifle bar, was prevented from taking a full stroke and delivering impacts on the drill steel to release it from its stuck condition.

It is therefore an object of this invention to produce an improved rotation mechanism for rock drills capable of automatically becoming inoperative when subjected to a predetermined maximum torque, thereby eliminating excessive wear or breakage of its operating parts.

Another object of this invention is to provide a rock drill with a rotation mechanism assuring complete strokes of its piston even though the drill steel becomes stuck or will not rotate.

Another object of this invention is to provide a rotation mechanism of the ratchet type with resilient or cushion means for the rifle bar to work against during normal operation and to have an overriding effect, should the rifle bar be subjected to a load greater than its designed load.

Another object of this invention is to produce such an improved rotation mechanism of simple and efficient design free of movable parts such as locks, detents or the like subjected to wear and possible breakage.

Other objects of this invention not at this time more particularly enumerated will be clearly understood from the following description.

In the accompanying drawing:

Figure 1 is a partial longitudinal sectional view of a portion of a rock drill embodying the preferred form of the invention.

Figure 2 is a cross-sectional view taken on line 2—2 in Figure 1.

Figure 3 is a view similar to Figure 2 but showing a modified construction, and

Figure 4 is an enlarged partial longitudinal section taken on line 4—4 in Figure 3.

Referring to the drawing, **10** designates the usual cylinder of a rock drill, in which is reciprocably mounted a piston **11**. The upper portion of cylinder **10** is enlarged to form an annular step **12** on which rests a valve cap **13** having slidable therein a valve **14** cooperating with a stationary valve block **15** for automatically controlling supply of pressure fluid alternately to the ends of cylinder **10** for effecting reciprocation of piston **11** in the usual and well known manner.

Valve block **15** rests on a casing in the form of an outer ring **16**, and on it a bearing plate **17** which protrudes from cylinder **10** into a block head **18**. The valve cap **13**, valve block **15**, outer ring **16** and bearing plate **17** are clamped between shoulder **12** and back head **18** by two side bolts **19**, through which the back head is also fixed to the cylinder. Valve cap **13**, valve block **15** and outer ring **16** are locked to cylinder **10** against rotation relative thereto by a locking pin or dowel **20**.

In the usual rotation mechanism of the rifle bar type, the outer metal ring **16** constitutes a one piece ratchet ring with teeth provided on the inner wall thereof. In the present construction, outer ring **16** has vulcanized, cemented or otherwise affixed to its inner wall a resilient ring **21** preferably made of rubber or the like, to the inner wall of which is similarly affixed a metal inner ring **22** formed with ratchet teeth **23** on its inner wall. In other words, in the present construction the usual one piece metal ratchet ring has been replaced by a three piece ring forming a single unit, with both the inner and outer rings made of metal, and the intermediate ring made of resilient material such as rubber. Except for this modified construction of the ratchet ring, the rotation mechanism is of standard design and includes the usual rifle bar head **24** rotatably mounted within the ratchet ring **22**. This head carries the usual pivotally mounted pawls **25** urged outwardly into engagement with the teeth **31** by spring biased plungers **26**. Rifle bar head **24** has a pilot **27** extending upwardly therefrom and journaled within bearing plate **17**. From the head **24** depends a bar **28** journaled within valve block **15**, and having a rifle portion **29** extending into a rifle nut, not shown, fixed within the piston head **11**.

Assuming that pressure fluid controlled by valve **14** is admitted alternately into the ends of the cylinder **10** for effecting reciprocation of piston **11**, the operation of the rotation mechanism is as follows: With the helical splines or rifles of the rifle bar **28** inclined in the direction shown in Figure 1, during each down stroke of the piston, the rifle bar will tend to rotate clockwise in Figure 2, which rotation is prevented by operative engagement of the pawls **25** with the teeth **23** of the ratchet ring **22**, thereby causing piston **11** to rotate in a counterclockwise direction in Figure 2, or clockwise direction in Figure 1, which rotation is in turn transmitted to the drill steel in a well known manner. During the upward or return strokes of the piston, rotation in a counterclockwise direction in Figure 2 is imparted to the rifle bar **28**, while the pawls **25** ride over the teeth **23** of the ratchet ring **22**. In this instance piston **11** moves axially without rotating.

As so far explained, the operation of the improved rotation mechanism is the same as that of standard construction, and during normal operating conditions, it functions substantially in the same manner as the usual rotation mechanism of the rifle bar type.

Assuming now that instead of normal drilling operation, holes are being drilled in a formation of varying density which causes the drill steel to become stuck in relatively soft formation, or more broadly, assuming that

the drill steel becomes stuck in the bottom of the drilled hole and cannot be rotated in the usual manner. In such instance, during the down stroke of the piston which now is prevented from rotating, the rifle bar is subjected to counter forces tending to rotate it in a clockwise direction in Figure 2. In standard construction wherein the ratchet ring is made of a single piece fixed to the cylinder, rotation of the rifle bar in the clockwise direction is not possible by engagement of the pawls with the ratchet teeth, thereby causing breakage of the pawls and sometimes breakage of the rifle bar itself. In the improved construction the ratchet ring **22** being fixed to the cylinder **10** through the medium of the resilient ring **21**, is capable of limited clockwise rotation relative to the cylinder **10** by subjecting the resilient ring **21** to a torsional force causing it to stretch peripherally. This limited rotation of the ratchet ring relative to the cylinder has been found sufficient to release the excessive load to which the pawls **25** and rifle bar **28** would otherwise be subjected to, and thereby prevent their breakage. Furthermore, the piston **11** upon limited rotation of the ratchet ring **22** and consequently of the rifle bar **28** in a clockwise direction in Figure 2 is now capable of completing its down strokes for delivering at least light impacts on the drill steel to dislodge it from its stuck position.

In practice, the pitch of the rifles or helical splines **29**, together with the length of the piston stroke, the thickness of the resilient ring **21** and the resiliency of its material must be taken in consideration and correlated in a manner affording at least contact of the piston with the drill steel at the end of the down strokes of the piston for a maximum stretching or deformation of the resilient ring **21**.

In the modified construction shown in Figures 3 and 4, the outer ring **116** has its inner wall provided with two diametrically opposed longitudinally extending recesses **50** of a given width and depth. The ratchet ring **122** has its outer wall provided with similarly disposed lugs **51** substantially reaching to the bottom of the recesses **50** but of a width about one half that of the recesses. Filling the other half of each recess and located ahead of the lugs with respect to the direction of rotation of the ratchet ring imparted thereto by the pawls **25**, is located a resilient pad **52** also made of rubber or the like and held longitudinally therein by the valve block **15** and bearing plate **17**. To facilitate assembly, the pads **52** may be vulcanized or cemented within the recesses **50**.

In this modified construction, it will be understood that when the drill steel is prevented from rotating, the pawls **25** transmitting torque to the ratchet ring **122** will cause the resilient pads **52** to be compressed by the lugs **51** to allow limited rotation of the ratchet ring and the continued reciprocation of the piston.

An important feature of the two constructions above described resides in the energy stored in the resilient ring **21** and pads **52** during their deflection, which energy in the form of rotary power is transmitted through the pawls and rifle bar to the piston, tending to rotate it and the drill steel during each down stroke of the piston. This takes place even though the drill steel is prevented from rotating, thereby submitting the drill steel to an intermittent torque assisting in dislodging it from the formation in which it is embedded.

It is to be understood that during normal operation, the resilient bond between the ratchet ring and its casing or cylinder, or more particularly between the ratchet ring and the outer ring **16** or **116**, which in turn is locked

to the casing **10**, while not subjected to sufficient torque to cause it to deflect and permit rotation of the ratchet ring in a clockwise direction in Figures 2 and 3, nevertheless acts as a cushion for the ratchet ring capable of absorbing unusual impacts or the load of the pawls against the ring and softening the action of the pawls against the teeth of the ring.

The details of structure and arrangement of the resilient bonds between the ratchet ring and its casing may be variously changed and modified without departing from the spirit and scope of the invention.

I claim:

1. In a rock drill, the combination of a cylinder having a piston reciprocable therein, of a rotation mechanism for said piston including a bar extending into said piston, helical means on said bar coacting with helical means within said piston, a ratchet mechanism including a fixed outer ring, a ratchet ring concentric within said outer ring, ratchet teeth on the inner wall of said ratchet ring, a resilient connecting ring bonded to said outer and ratchet rings and forming therewith a single unit whereby said ratchet ring is resiliently held stationary as long as the resistance to rotation of piston remains below a predetermined maximum, spring biased pawl means operatively carried by said bar engaging said teeth to rotationally lock said bar in one direction to said ratchet ring and thereby translate each stroke of said piston toward one end of said cylinder into a fixed extent of rotation of the piston by virtue of said coacting helical means, the resiliency of said connecting ring enabling said ratchet ring and bar to rotate in said one direction an extent at least equal to the fixed extent aforesaid for each stroke of said piston toward said one end of the cylinder when said resistance to rotation exceeds said maximum, thereby rendering said rotation mechanism inoperative.

2. In a rock drill, the combination of a cylinder having a piston reciprocable therein, of a rotation mechanism for said piston including a bar extending into said piston, helical means on said bar coacting with helical means within said piston, a ratchet mechanism including a fixed outer ring, a ratchet ring within said outer ring, ratchet teeth on the inner wall of said ratchet ring, a resilient bond between said rings resiliently holding said ratchet ring against rotation as long as the resistance to rotation of said piston remains below a predetermined maximum, spring biased pawl means pivotally carried by said bar engaging said teeth to rotationally lock said bar in one direction to said ratchet ring and thereby translate each stroke of said piston toward one end of said cylinder into a fixed extent of rotation of the piston by virtue of said coacting helical means, said pawls riding over said teeth during the rotation of said bar in the other direction by virtue of said helical coacting means during the strokes of said piston toward the other end of said cylinder, the resiliency of said bond enabling said ratchet ring and bar to rotate in said one direction an extent at least equal to the fixed extent aforesaid when said resistance to rotation exceeds said maximum, thereby rendering said rotation mechanism inoperative.

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