United States Patent

[11] 3,625,297

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[54] **BLEED SYSTEM FOR HYDRAULICALLY ACTUATED DEVICE**
4 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **173/135, 91/5, 92/79**
[51] **Int. Cl.** **B25d 9/00**
[50] **Field of Search** 92/79; 173/134–136; 91/5

[56] **References Cited**
UNITED STATES PATENTS

3,137,213	6/1964	Bryant et al.	92/79
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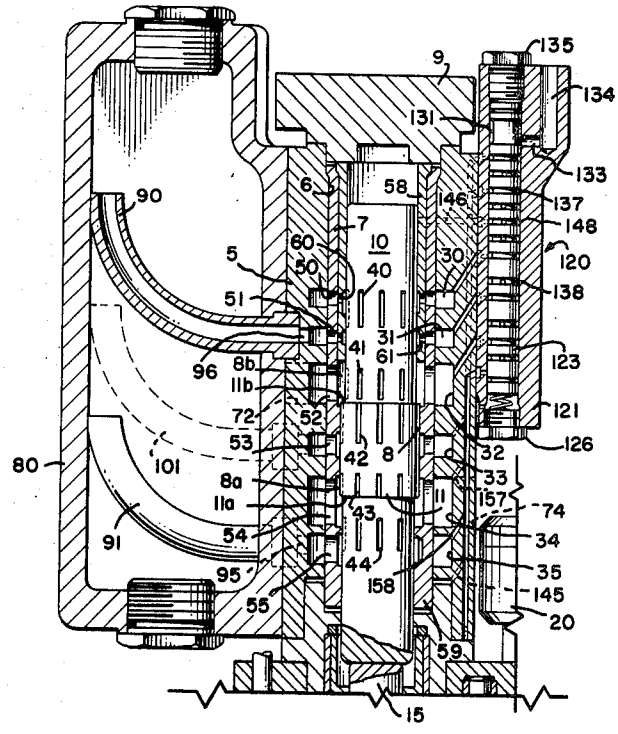
ABSTRACT: A bleed system for devices such as rock drills which are powered by hydraulic fluid. The system includes a valve which when actuated, provides communications between the various chambers in the hydraulically actuated device and a sump which is at atmospheric pressure. After a long period of shutdown the valve is opened to bleed off any air which may be in the hydraulic system.



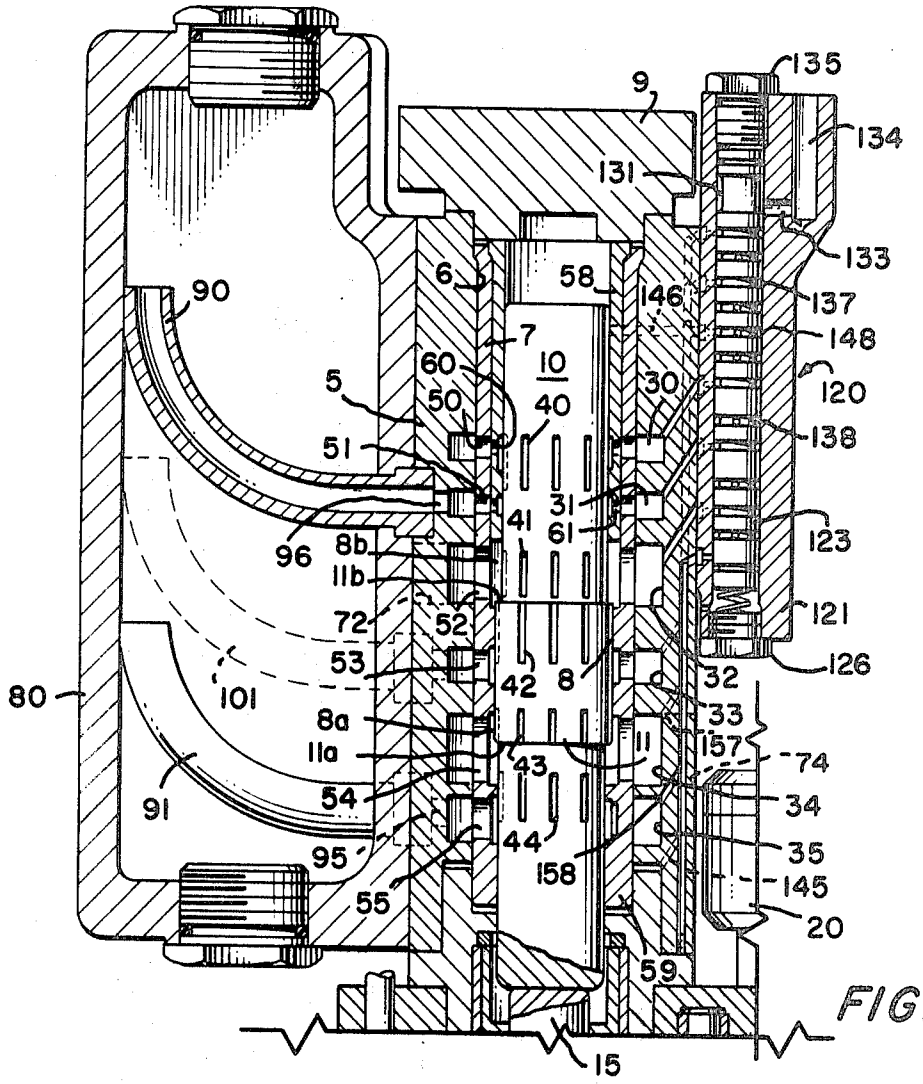


FIG. 2

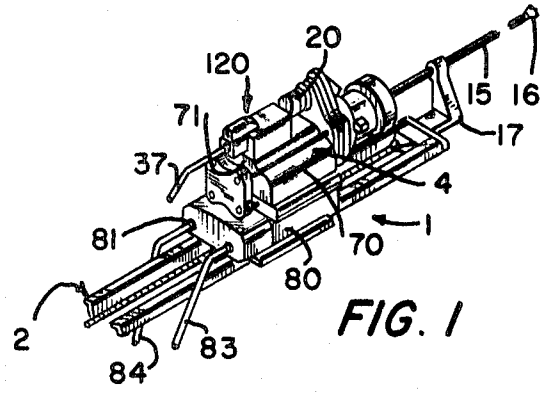


FIG. 1

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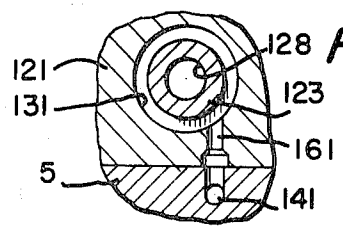

FIG. 7

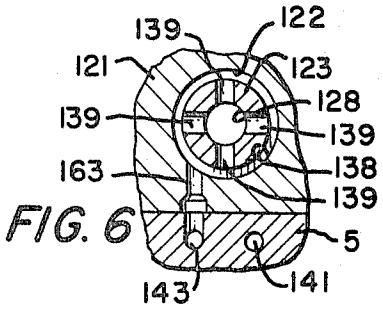

FIG. 6

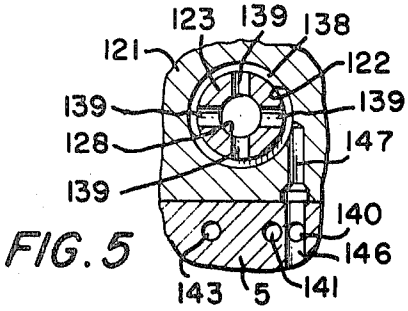

FIG. 5

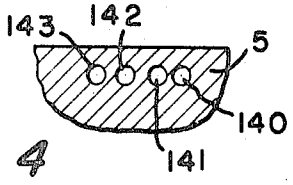

FIG. 4

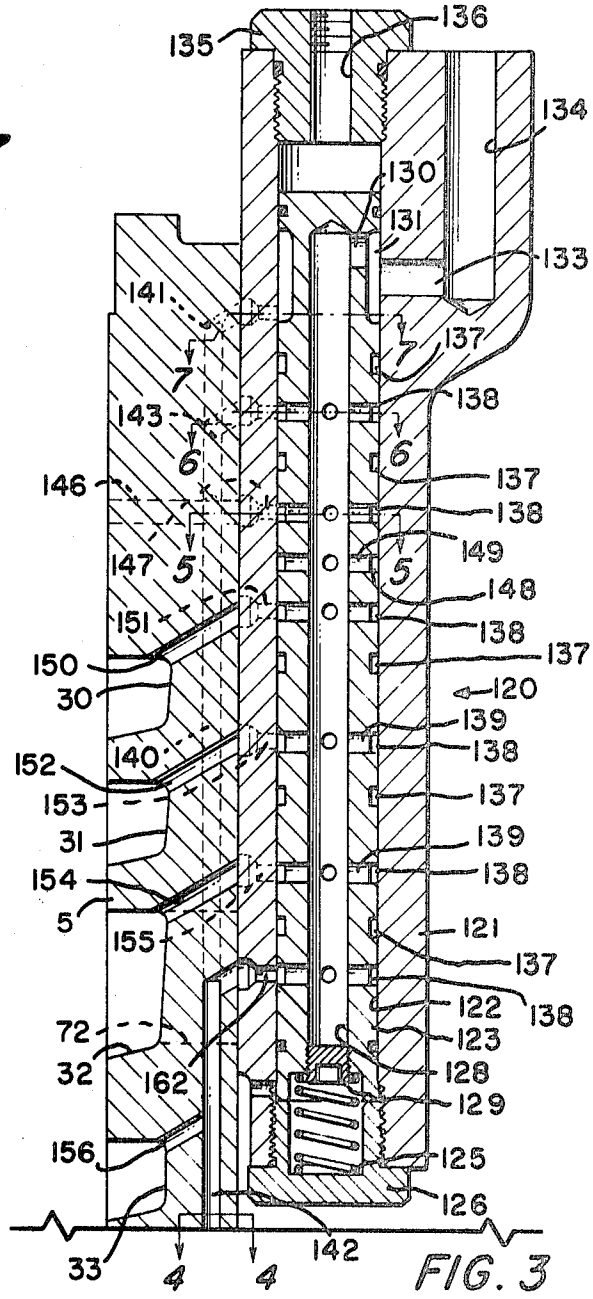

FIG. 3

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BLEED SYSTEM FOR HYDRAULICALLY ACTUATED DEVICE

BACKGROUND OF THE INVENTION

This invention relates to hydraulically actuated devices and in particular to a bleed system for hydraulically actuated devices and in particular to a bleed system for hydraulically actuated devices.

Prior to the present invention, hydraulically actuated device such as rock drills have been known. One such device is shown in U.S. Pat. application Ser. No. 826,923 filed on May 22, 1969 in the name of Eugene L. Krasnoff. In the use of such devices, it has been found that after a long period of shutdown, such as overnight, air will get into the hydraulic system. The air in the system will act as a cushion and interfere with the operation of the device. It has been found that in many instances, the device cannot be started with air in the system. Some means must be provided for exhausting the air in the hydraulic system.

SUMMARY

It is therefore the principle object of this invention to provide a bleed system for a hydraulically actuated mechanism.

It is another object of this invention to provide a bleed system which enables the hydraulic system of a hydraulically actuated device to be purged of air which may be in the system.

In general, the foregoing and other objects of this invention will be carried out by providing in combination, apparatus for delivering an impact to a workpiece including a casing defining a cylinder, a hammer disposed for reciprocal movement in said cylinder and adapted to deliver an impact to a workpiece, said hammer defining with said casing at least one chamber, means for reciprocating said hammer including means for periodically pressurizing hydraulic fluid and communicating with said chamber through a port separate from said means for pressurizing said chamber for alternately receiving energy from said chamber when said chamber is pressurized and releasing energy to said chamber, and means for selectively purging said chamber of gaseous fluid which may be present in said chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in connection with the annexed drawings wherein:

FIG. 1 is a perspective view of a rock-drilling machine employing the present invention;

FIG. 2 is a sectional view of the rock-drilling machine of FIG. 1;

FIG. 3 is a fragmentary sectional view of the bleed system of the present invention with the bleed valve in the open position; and

FIGS 4 to 7 are sectional views taken on the line 4–4, 5–5, 6–6, and 7–7, respectively, of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention will be described as it may be used with the hydraulically actuated rock drill which is the subject of the aforementioned U.S. Pat. application of Eugene L. Krasnoff. Referring to FIG. 1, there is shown a rock-drilling machine generally indicated at 1. The drill is suitably mounted on a supporting apparatus 2 of any desired type.

The drill 1 includes a casing 4 having a central portion 5 having a longitudinal passage 6 therethrough. A sleeve 7 is mounted within the passage 6 and together with the casing 4 defines a cylinder 8. A hammer or piston 10 is mounted for reciprocal movement within the cylinder 8. The hammer 10 includes an enlarged diameter portion 11 which divides the cylinder 8 into a pair of chambers 8*a* and 8*b*. A backhead 9 closes one end of the cylinder 8 and a fronthead is mounted on the forward end of the drill for closing the front of the cylinder 8.

A drill steel 15 having a drill bit 16 secured to one end is mounted in the fronthead and extends into the forward end of the cylinder 8 where it is adapted to be struck by the hammer 10 as the hammer reciprocates. A centralizer 17 is mounted on the supporting structure 2 for guiding the drill steel 15. A rotary motor 20 is mounted on the drill 1 for rotating the drill steel 15 through conventional gearing (not shown).

Suitable air passages (not shown) may be provided in the fronthead of the machine for supplying air under pressure to the bottom of the hole being drilled for blowing cuttings out of the hole.

The central portion 5 of the casing 4 is provided with a plurality of annular passages. These passages have been designated by the numerals 30, 31, 32, 33, 34 and 35 proceeding from the back of the machine toward the front of the machine. The sleeve 7 is provided with radial passages which communicate with the annular passages in the casing 6. These passages have been designated 50, 51, 52, 53, 54 and 55 proceeding from the back of the machine toward the front of the machine. Passages 52, 53, 54 and 55 each terminate in an annulus. A second sleeve 58 is positioned within the sleeve 7 towards the back of the machine and is dimensioned to receive a portion of the hammer 10. The sleeve 7 is provided with an enlarged portion 59 at its forward end dimensioned to receive the forward portion of the hammer 10. The sleeve 58 is provided with radial passages 60 which terminate in an annulus and radial passages 61 which terminate in an annulus. The passages 60 and 61 communicate with the radial passages 50 and 51 in the sleeve 7 and annular passages 30 and 31 in the casing 5.

The casing 4 includes a pair of outboard, closed accumulator chambers 70 and 71 which are filled with "hydraulic fluid." Accumulator 70 communicates with cylinder 8 through a port 74, annular passage 34 and radial passage 54. Accumulator 71 communicates with the cylinder 8 through a port 72, annular passage 32 and radial passage 52.

At various points along its length, the hammer 10 is provided with rows of circumferentially spaced longitudinal slots. These rows of slots have generally been indicated 40, 41, 42, 43 and 44 proceeding from the back of the hammer 10 toward the front. Although slots have been shown, the slots may be replaced by reduced diameter portions extending around the complete circumference of the hammer. The selection of slots as shown or a reduced diameter portion depends upon the particular machine and the fluid flow desired.

The drilling machine is further provided with pressure wave filtering tanks 80 and 81. One of these tanks 80 is clearly shown in FIG. 2. The second tank 81 is a duplicate of the tank 80 in size and shape and is positioned next to the tank 80, as can be seen from FIG. 1. The inlet tank 80 is provided with a conduit 83 for conducting hydraulic fluid under pressure from a suitable source such as a reservoir and pump (not shown) to the interior of the tank 80. A pair of conduits 90 and 91 are positioned in the tank 80 for conducting fluid from the tank 80 to opposite sides of the enlarged portion 11 of the hammer 10. A conduit 101 is positioned in the tank 81 for exhausting fluid from both chambers formed on opposite sides of the enlarged portion 11 of the hammer 10. The outlet tank 81 is provided with a conduit 84 for conducting the hydraulic fluid back to the reservoir.

The operation of the rock drill is described in detail in the aforementioned U.S. Pat. application of Eugene L. Krasnoff, but will be briefly described here. Hydraulic fluid is supplied through inlet tank 80 and alternately through inlet passages 95 and 96 to chambers 8*a* and 8*b*, respectively, to reciprocate the hammer 10. When the hammer 10 is in the impacting position, FIG. 2, hydraulic fluid is supplied through tube 91, passages 35 and 55, and slots 44 to chamber 8*a*. Inlet passages 96, 51 and 61 are blocked. Fluid in chamber 8*b* is exhausted through slots 42 and ports 53 and 33 to tube 101. After moving a predetermined amount, the exhaust passages close and continued upward movement of hammer 10 pressurizes accumulator 71 through slots 41 and passages 52 and 72.

When the hammer reaches a certain point, inlet passages 95, 35 and 55 are closed and passages 96, 51 and 61 are opened through slots 41. Hydraulic fluid thus supplied to chamber 8*b* and the hammer 10 is driven forward to deliver an impact to the workpiece. At essentially the same time, the energy previously stored in accumulator 71 is released to chamber 8*b* thereby increasing the impacting force of hammer 10. When hammer 10 moves downward, chamber 8*a* is exhausted through ports 53 and 33 and slots 43 to tube 101 and tank 81. After moving a predetermined distance downward, the exhaust ports are closed and continued downward movement of hammer 10 pressurize, accumulator 70 through passage 54, 34, and 74 and slots 43 where energy is stored until it is released to the chamber 8*b* on the next upward stroke of the hammer 10.

It has been found that after a period of shutdown, air or other gaseous fluid will leak into the hydraulic system. When air is present in the system, operating performance is severely hampered. This is particularly true on startup after a long period of shutdown. It has been found that it is necessary to purge the air from the hydraulic system and by the present invention I have provided means for purging air which may be present in the system.

A valve, generally indicated at 120 is mounted on top of the casing portion 5. The valve includes a valve body 121 having a longitudinal bore 122 therein. A valve member 123 is movably mounted in the bore 122 and is biased outwardly by a spring 125. A cap 126 closes one end of the bore 122 and the other end has a cap 135 having a port 136 therein which is connected to air line 137. The valve member 123 has a longitudinal bore 128 which is closed by a plug 129. The bore 128 communicates with a sump at atmospheric pressure or with atmosphere through a radial bore 130 and annulus 131 in the valve member 123 and bores 133 and 134 in valve body 121. Air under pressure may be supplied as desired to the bore 122 through line 137 to move valve member 123 against the biasing force of spring 125.

The valve member 123 is provided with a plurality annului 137 and 138 around its outer periphery. The annului 137 are blind, but the annului 138 communicate through passages 139 with longitudinal bore 128 and hence with the sump or atmosphere. The casing 5 is provided with a plurality of longitudinal bores 140, 141, 142 and 143. The front of the cylinder 8 communicates with the bore 140 through a passage 145 while the back of the cylinder 8 communicates with bore 140 through a passage 146. The valve body 121 is provided with a bore 147 which provides communication between bore 140 and an annulus 148 in the valve member 123. Passages 149 provide communication between the annulus 148 and bore 128 when the valve 120 is in the closed position. When the valve is open, the front and back of the cylinder 8 communicate with bore 128 through an annulus 138 and bore 139. Thus, the front and back of the cylinder 8 are in continuous communication with the atmosphere. This serves as a drain for any hydraulic fluid which may leak into the front and back of the cylinder.

It has been found that after a period of shutdown, air in the system will rise to the top of the annului 30 to 35. This is true where the air is in the accumulators 70 and 71, the tanks 80 and 81 or the cylinder 8. In order to purge the air from the hydraulic system, each annului 30 to 35 is provided with a passage capable of establishing communication between the annului 30 to 35 and the valve 120. A passage 150 extends from the annulus 30 to a passage 151 in the valve body 121; a passage 152 extends from the annulus 31 to a passage 153 in body 121; and a passage 154 provides communication between annulus 32 and a passage 155 in valve body 121. Each of the passages 151, 153, and 155 lead to the bore 128. Annulus 33 is provided with a passage 156 which leads to bore 142; annulus 34 has a passage 157 which leads to bore 143; and annulus 35 has a passage 158 which leads to bore 141. The bore 141 communicates with a passage 161 in the valve body 121, the bore 142 with a passage 162 and the bore 143 with a passage 163.

In the closed position shown in FIG. 2, the valve member 123 is in the outward position. Only the front and back of the cylinder 8 communicate with atmosphere and hence a sealed system is provided because each of the annului 30 to 35 in the cylinder 5 communicate only with blind annului 137 in the valve member 123.

When it is desired to purge air from the system, the valve member 123 is moved to its open position shown in FIG. 3. The various annului 30 to 35 are then in communication with atmosphere through bores 140 and 143 and annului 138 and passages 139. Bore 141 communicates through annulus 131. The front and back of the cylinder 8 remain in communication with bore 128 and atmosphere through passage 147, an annulus 138 and passages 139. The valve is held open until a steady flow of hydraulic fluid comes out of port 134. The operator then knows that air in the system is substantially purged. Operation of the drill can then commence.

From the foregoing, it should be apparent that the objects of this invention have been carried out. A relatively simple device for purging air from the system of a hydraulically actuated device such as a rock drill has been provided.

I claim:

1. In combination, apparatus for delivering an impact to a workpiece including a casing defining a cylinder, a hammer disposed for reciprocal movement within said cylinder and adapted to deliver an impact to a workpiece, said hammer defining with said casing at least one chamber, means for reciprocating said hammer including means for periodically pressurizing said chamber and energy storage means containing hydraulic fluid and communicating with said chamber through a port separate from said means for pressurizing said chamber for alternately receiving energy from said chamber when said chamber is pressurized and releasing energy to said chamber, and means for selectively purging said chamber of gaseous fluid which may be present in said chamber comprising a valve body, a valve member movably mounted in said valve body; said casing of said apparatus for delivering an impact having passage means providing communication between said chamber and said valve body, said valve member being adapted to be selectively moved to permit communication between said chamber and atmosphere and the means for reciprocating the hammer including passage means in said casing for admitting hydraulic fluid to said chamber and passage means in said casing for exhausting hydraulic fluid from said chamber and said casing including passages providing communication between said inlet and exhaust passages and said valve body.

2. The combination of claim 1 wherein said casing is provided with a passage providing communication between said energy storage means and said valve body.

3. The combination of claim 2 wherein said valve body includes a plurality of spaced apart passages, each aligned with one of the passages providing communication between said chamber and said valve body and said valve member includes a plurality of passages adapted to selectively communicate with the passages in said valve body and a longitudinal passages providing communication between the passages in said valve member and atmosphere.

4. In combination, an hydraulically actuated rock drill comprising a casing defining a cylinder, a hammer mounted for reciprocal movement within said cylinder and adapted to deliver an impact to a workpiece, said hammer defining with said casing at least one chamber, said casing having at least a pair of passages for conducting hydraulic fluid into and exhausting hydraulic fluid from said chamber for reciprocating said piston, and means for selectively purging said chamber of gaseous fluid which may be present in said chamber comprising valve means providing selective communication between said chamber and atmosphere, said casing including first passages providing communication between said chamber and said valve means and said valve means including a valve body, a valve member longitudinally movable in said valve body having first passages therein providing selective communication between said chamber and atmosphere, and said casing being

provided with second passages providing communication between said cylinder and said valve body, and said valve body and valve member have second passages therein for providing continuous communication between said casing and atmosphere.

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