April 19, 1955 F. G. BOUCHER 2,706,618

SHOCK PULSED ROTARY DRILL BIT

Filed July 28, 1953

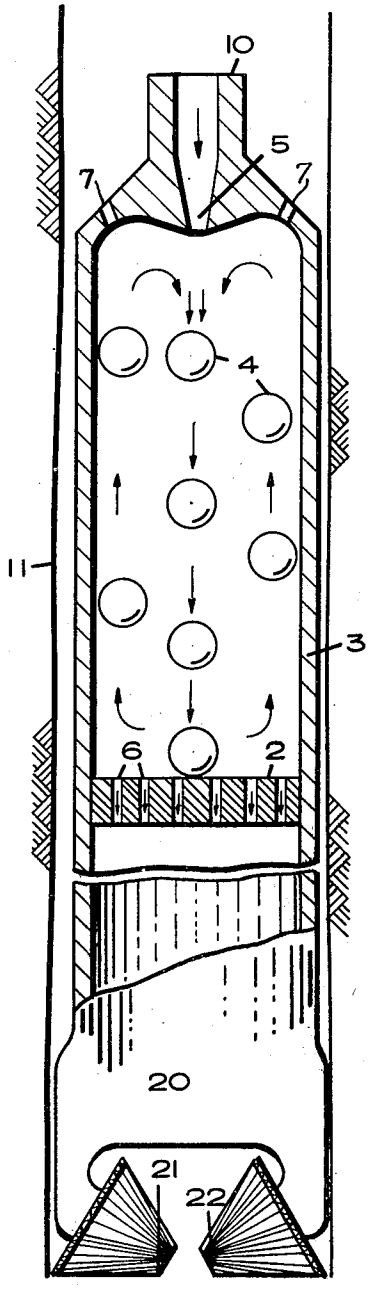


FIG-1

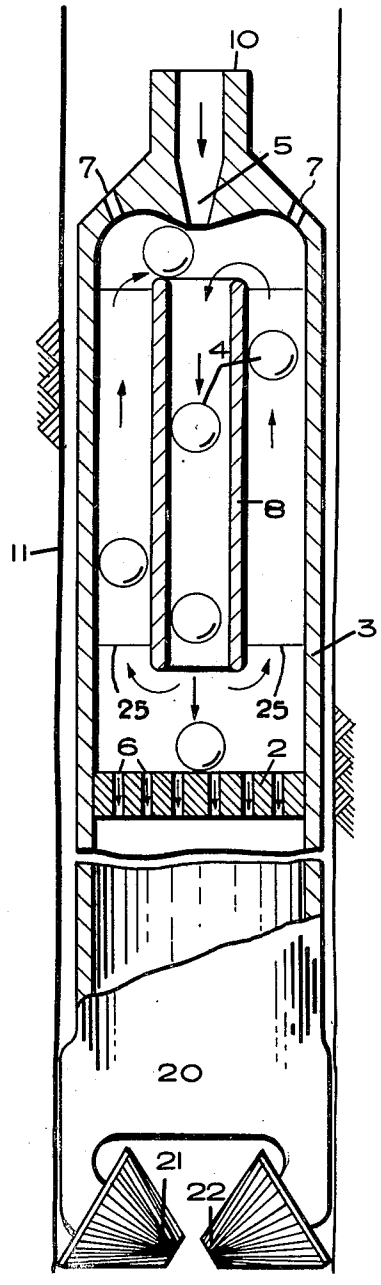


FIG-2

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United States Patent Office 2,706,618 Patented Apr. 19, 195

2,706,618

SHOCK PULSED ROTARY DRILL BIT

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Application July 28, 1953, Serial No. 370,782

5 Claims. (Cl. 255—300)

The present invention is concerned with an improved method and apparatus for drilling well bore holes. The invention more specifically relates to an improved method of rotary drilling particularly when utilizing a rock bit. In accordance with the present invention, rock formations encountered in a drilling operation are subjected to alternating stresses in a manner to cause fatigue and failure of the rock. This is accomplished in accordance with the present invention, by utilizing circulating pellets at the bottom of the drill string in conjunction with the bit. The impact of the pellets serves to provide percussion forces which are transmitted to the bit.

In the exploration for oil, the art of drilling well bore holes into subterranean areas of the earth has been widely investigated and extensively developed. The techniques employed are many and a wide variety of drilling bits and associated apparatus have also been developed. One conventional procedure is to attach a suitable bit on the end of a pipe string and to rotate the bit by the rotation of the pipe string.

Thus, at the present time, the majority of drilling operations are conducted by employing "rotary drilling equipment." In conventional rotary drilling, a hollow jointed steel shaft called the drill stem is rotated from the surface of the earth. This shaft, extending downwardly into the earth to any desired depth, rotates a drill bit. For a number of reasons there are attached to the lower end of the drill pipe, heavy sections of pipe termed "drill collars." Also, for a number of purposes, a weighted fluid called drilling mud is circulated in one direction through the drill stem and in the opposite direction through the annulus between the drill stem and the bore hole.

In these drilling operations, it is known that rocks subjected to alternating stresses will fail rapidly in fatigue. This effect is responsible to some extent for the action of conventional rock bits, wherein toothed cutters rolling on the surface of the rock impart alternating stresses to the surface of the rock, resulting in chipping, fracturing, and crumbling of the rock being drilled. The conventional rock bit, however, depends to a very great extent for its cutting action upon compressive stress induced by excessive weight on the bit. This is secured by allowing the weight of the drill string to partially rest on the bit. This process while entirely satisfactory has a number of inherent difficulties. For example, part of the drill pipe may be in compression resulting in buckling of the pipe which in instances causes the hole to deviate from the vertical. Furthermore, the stress induced due to the buckling and unbuckling of the compressed pipe results in corrosion fatigue. To reduce this difficulty, drill collars, which are heavy lengths of pipe, are used. These are expensive, and are subject to frequent failures. Another disadvantage is that the friction against the walls of the hole causes the drill pipe to wind up with the result that a substantial amount of bouncing of the bit occurs on the bottom of the hole. This aggravates the wearing of the cutter bearings in rock bits. Thus, this is not an efficient way to induce alternate stresses of the magnitude and frequency required for efficient use of the mechanism of fatigue failure in the drilling operation. Thus, the present invention is concerned with a device adaptable for use on the conventional rotary drilling rig which provides for subjecting the rock to cyclic stresses. When operating in accordance with the present

invention, induced failure of the rock by fatigue is se cured which promotes more rapid drilling with less wea on the bit and accompanying equipment. The preser invention may be more fully understood by reference t the drawings illustrating embodiments of the same.

Figure 1 illustrates one adaptation of the circulatin pellets used in conjunction with a rock bit, while

Figure 2 illustrates a similar apparatus except that a interior cylindrical guide element for the pellets is prc vided.

Referring specifically to Figure 1, the drill bit assembl is shown attached to the lower end of a drill string 1 disposed at the bottom of a well bore **11**. The drill bi assembly is attached to the lower end of the drill strin **10** by threaded or equivalent means. The drill bit as sembly comprises a cylindrical body element **3** havin at its upper end a restricted nozzle **5** communicating witl the inside of the drill string. The lower end of the dril bit body **3** comprises a heavy percussion or plate ele ment **2**.

The percussion or plate element **2** is attached to bi assembly **20** and the latter has two rollers **21** and 2 at its lower end. Cylindrical body element **3** is als characterized by having outlet ports **7** at the top shoulder thereof. The percussion or head element **2** is also char acterized by containing a plurality of ports or jets **6** whicl permit the fluid to pass downwardly through the bit.

In operation, drilling fluid is pumped down within th drill string **10**. This fluid passes from the drill strin through the restricted nozzle **5** and picks up in the fluic stream pellet elements **4**. These pellets are hard, metal lic alloys, as for example, various ferrous alloys. Th size of the pellets may vary from about ¼ inch to 1 incl and larger in diameter. These pellets impinge upon th percussion element **2** at a relatively high velocity anc then rebound outwardly and flow upwardly along th inner side of the cylindrical body element. Approxi mately 50–75% and more of the drilling fluid pumpec down the drill stem passes through the port elements **6** This drilling mud passes downwardly through the bi and upwardly in the area between the outer surface o cylindrical body element **3** and the wall of the well bore The remaining drilling fluid passes upwardly through ports **7**. The upflowing pellets are repicked up by the downflowing stream at nozzle **5** and again flow down wardly and impinge on the percussion element.

Referring specifically to Figure 2, the construction is identical with that described with respect to Figure 1 except that an inner open-ended cylindrical conduit element **8** is concentrically disposed within the body element **3** and supported by means of web members 2 that in turn are secured to body element **3**. In operation the pellets **4** flow downwardly through conduit element **8**, impinge on the head element **2**, rebound and flow upwardly in the area between the inner wall of the body element and the outer surface of the cylindrical element.

The present invention is broadly concerned with a mechanism and apparatus for producing a resonant action of the drill bit in a rotary drilling operation, particularly when utilizing a rock bit. In accordance with the present invention, this is secured by the utilization of circulating pellets which impinge on a head plate which is attached directly above the bit.

The rolling of the toothed cutters of the bit on the rock imparts to the resonant drill collar axial impact loads.

What is claimed is:

1. Improved drill bit assembly designed to be attached to the lower end of a drill string which comprises a roller type bit, a perforated percussion element positioned above said bit, a pellet chamber positioned above said percussion element, conduit means for jetting a stream of fluid from said drill stem into said chamber and pellets within said chamber adapted to be circulated by said jetted fluid so as to impart shocks to said percussion element, whereby a pulsing motion is imparted to said bit.

2. Apparatus as defined by claim 1 wherein a hollow open-ended cylindrical element is concentrically disposed within said chamber, said cylindrical element being

spaced from the interior surfaces of said chamber and supported therefrom by means of web members.

3. An improved rotary drill bit assembly designed to be attached to the lower end of a drill string which comprises in combination a hollow, cylindrical body member; a roller-type rotary bit mounted on the lower end of said body member; a perforated percussion plate within said body member; said percussion plate being attached to the body member and forming a pellet chamber with the interior surfaces of said body member; a plurality of hard metallic pellets within said chamber; and conduit means arranged to jet fluid within said pellet chamber from said drill string and to circulate said pellets within said chamber whereby the pellets impinge upon said perforated plate and transmit pulsing shocks to said rotary bit.

4. An improved rotary drill bit assembly for drilling bore holes and designed to be attached to the lower end of a drill string which comprises in combination a hollow, cylindrical body member attached to the lower end of said drill string, said cylindrical body element being characterized by having a restricted fluid passageway at its upper end communicating with the inside of said drill string, said body member also being characterized by containing a plurality of fluid ports at its upper end communicating with the area between said drill string and the surrounding bore hole, said body member further

being characterized by having a lower percussion impact surface, a plurality of hard metallic pellets within said body member, said percussion surface containing a plurality of ports communicating with the interior of said body member and the area below said body member, and a roller-type rotary bit attached to the lower end of said body member.

5. An apparatus for drilling bore holes which comprises in combination a string of drill pipe; a hollow, cylindrical body member attached to the lower end of said drill string; a jet passageway interconnecting the interior of said body member with the interior of said drill string; a plurality of hard metallic pellets within said body member; means for transporting a fluid through said drill string and thence through said jet passageway into said body member; a percussion plate forming the bottom of said body member; and a roller type rotary drill bit attached to the lower end of said body member, the percussion plate being perforated to provide fluid passageways from the interior of said body member to said rotary bit.

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