

July 29, 1952

P. M. REA
MUD PUMP VALVE AND SEAT

2,605,080

Filed Feb. 24, 1948

2 SHEETS—SHEET 1

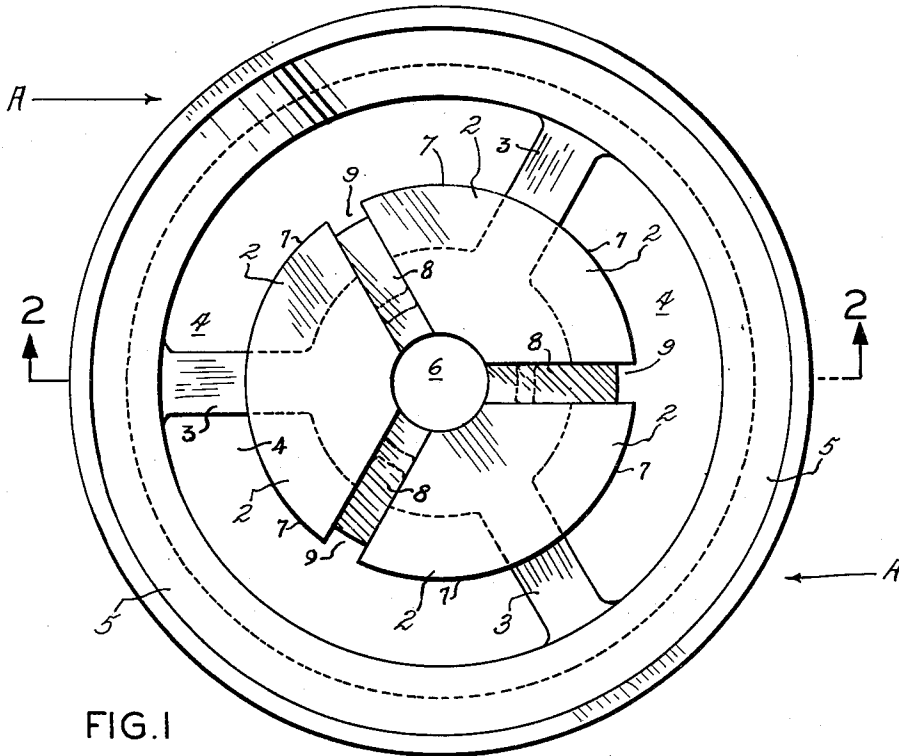


FIG. 1

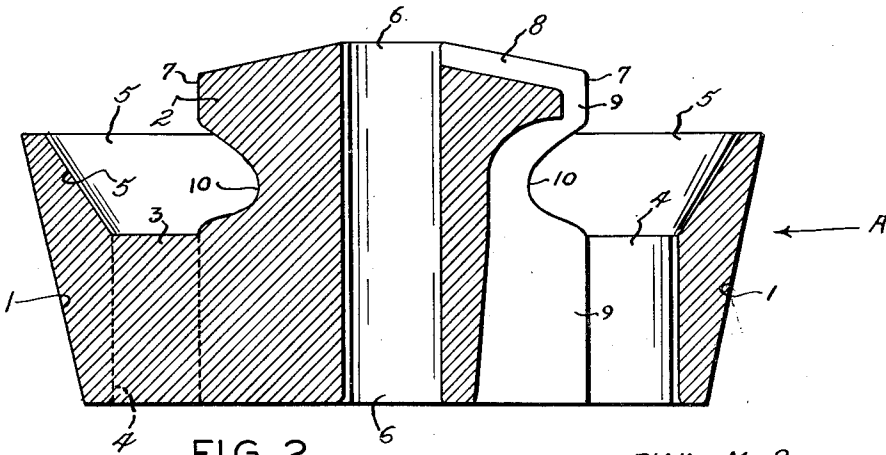


FIG. 2

Philip M. Rea
INVENTOR,

BY

Bernard P. Miller
ATTORNEY

July 29, 1952

P. M. REA

2,605,080

MUD PUMP VALVE AND SEAT

Filed Feb. 24, 1948

2 SHEETS—SHEET 2

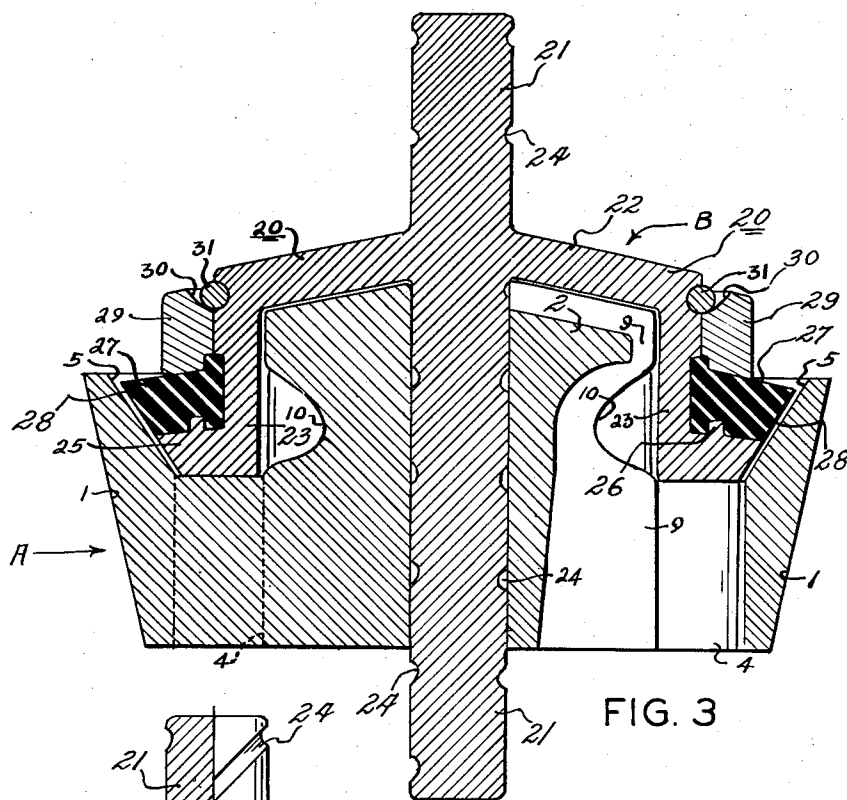


FIG. 3

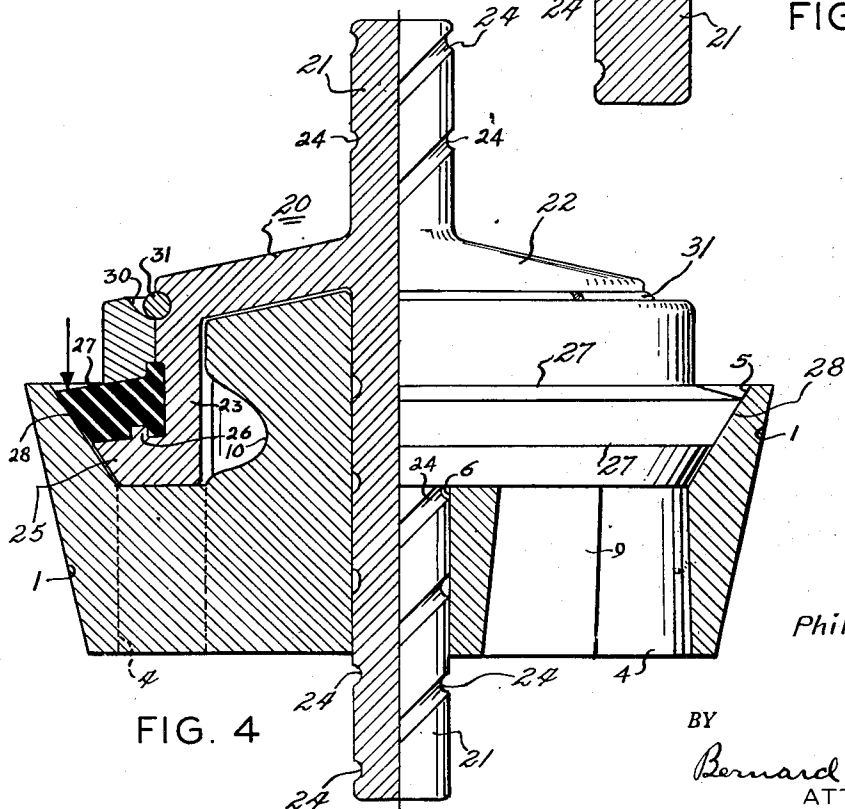


FIG. 4

Philip M. Rea
INVENTOR,

BY

Bernard P. Miller
ATTORNEY

UNITED STATES PATENT OFFICE

2,605,080

MUD PUMP VALVE AND SEAT

Philip M. Rea, Oklahoma City, Okla.

Application February 24, 1948, Serial No. 10,377

1 Claim. (Cl. 251-128)

1

The present invention relates to pumps, and more particularly to pumps used in connection with rotary oil well drilling equipment for circulating the drilling fluid or "mud," as it is commonly called.

In drilling wells with rotary equipment, the drilling fluid is pumped downwardly to the drill bit at the well bottom through the drill-stem string which rotates the bit. The fluid, after leaving the bit, is forced by the mud-pump to return to the earth's surface via the annular space within the well and surrounding the drill-stem string.

The purpose of such circulation is not only to lubricate the bit and to prevent cave-ins, but the drilling fluid also acts to entrain and carry away detritus created by the bit. In order to properly entrain such detritus, the drilling fluid must have a specific gravity greater than that of the detritus, and consequently the fluid is somewhat vicious in nature.

Since the drilling operation requires the continuous movement of a large volume of the drilling fluid, the mud-pump must be capable of delivering large capacities, and due to the nature of the drilling fluid, the pumps must be capable of delivering such capacities at high pressure.

The result is that the pump valves and their complemental seats are not only constantly subjected to the abrasive action of the drilling fluid, but they are also subjected to a terrific pound or hammer each time the valve seats.

The principal object of the present invention is to provide a mud-pump valve and seat assembly, wherein, the hammer of the valve on the seat is reduced to a minimum.

Another important object is to provide a valve and seat structure which is so designed that it will also withstand the abrasive action of the drilling-fluid by providing ample flow opening, thereby eliminating unnecessary turmoil as the fluid passes therethrough.

An additional object is to provide a mud-pump valve and seat assembly, wherein some of the drilling fluid is trapped and acts to cushion the valve, upon each seating movement of the valve.

A further object is to provide an assembly of this class, which is so designed that the forces created by the metal to metal blow of the closing valve, are dispersed or distributed over a large area of the seat member, thus eliminating most of the metal fatigue now present in many conventional mud-pump valve and seat assemblies.

A still further object is to provide an assembly, in which the metal to metal blow is not

2

only dampened by trapped fluid, but in which the undampened forces remaining are taken by parts of the assembly other than the complemental seating surfaces thereof.

Yet another object of the invention is to provide an assembly which will last longer under comparable conditions, than any conventional valve and seat assembly now on the market.

Other objects and purposes will be apparent from the following description, when taken in conjunction with the accompanying two sheets of drawings wherein:

Figure 1 is a top view of the valve seat member of the assembly;

Figure 2 is a vertical sectional view taken substantially along the line 2-2, Figure 1;

Figure 3 is a vertical sectional view of the entire assembly, showing the valve member at the lower end of its stroke, and illustrating the sealing element thereof before it has been deformed by fluid pressure into sealing engagement with the seat member; and,

Figure 4 is an elevational view showing the valve member in partial vertical section, and showing the seat member in entire vertical section, the sealing element of the valve being illustrated as it appears where deformed by fluid pressure into sealing engagement with the seat surface of the seat member.

Like characters of reference designate like parts in those figures of the drawings in which they occur.

In the drawings:

The reference character A indicates, as a whole, an annular valve seat member having a downwardly tapered conical exterior surface 1 adapted to be pressed downwardly into a circular part, not shown, but which forms a part of a conventional oil field mud-pump.

As best illustrated in Figure 1, the seat member A has a concentrically centered upstanding boss or table 2 which is rigidly connected thereto by a plurality of outwardly radiating ribs or webs 3. In the embodiment illustrated in the accompanying drawings, there are three of such webs 3 shown, and consequently, there are provided therebetween three arcuate flow openings 4.

The upper inside surface of the bore of the annular seat member A is machined to form an outwardly flared annular conical valve seating surface 5.

The table 2 has an axial through bore 6, and the upper surface thereof is preferably bevelled continuously downward from its center to its peripheral edge 7.

3

The upper bevelled surface of the table 2 has a plurality of radially extending grooves 8, and each groove 8 terminates at its outer end in communication with the upper end of a vertical slot 9. The slots 9 are machined into the peripheral or side surface of the table 2, and extend therealong the entire vertical length of said table. It is preferable that the peripheral side surface of the table also have an encircling annular indentation 10.

The functions of the grooves 8, the slots 9, and the indentation 10 will be more fully described hereinbelow.

The valve assembly further includes a valve member which is indicated, as a whole, by the reference character B.

The valve member B consists substantially of a heavy metal inverted cup shaped body 20, having an axially located vertical valve stem 21 integral with the floor 22 thereof. The inside surface of the floor or bottom 22 of the inverted cup-shaped body 20, is bevelled to coincide with the upper surface of the table 2 of the valve seat member A. The cup-shaped body 20 has an annular side wall 23 integral with the outer annular edge portion of the cup bottom 22, and the inside surface of the wall 23 is of sufficient diameter to barely clear the periphery of the table 2. The stem 21 extends above and below the cup-bottom 22 for a considerable distance, as shown in Figures 3 and 4, and its outside surface is equipped with spiral grooves 24. The function of the spiral grooves 24 will be more fully described hereinbelow.

The valve member B further includes an outwardly projecting annular flange 25 which is integral with the lower edge port ear of the cup wall 23. The exterior edge surface of the flange 25 is tapered to substantially coincide with the taper of the seating surface 5 of the seat member A. The upper surface of the flange 25 has an upwardly projecting annular rib 26 extending therearound in spaced relation to the outer surface of the cup wall 23.

Seated upon the upper surface of the flange 25, is a removable annular valve rubber or sealing element 27. The sealing element 27 has an outer bevelled or tapered edge surface 28, which normally coincides with and forms a continuation of the tapered edge of the flange. The innermost surface of the element 27 seats within a suitable groove which is formed in the peripheral surface of the wall 23 of the inverted cup-shaped member 20, and a metal ring 29 surrounds the cup wall 23 and seats upon the sealing ring 27, to hold the same in place.

The upper end surface of the metal ring 29 has an annular groove 30 which lies adjacent its bore. The outer edge of the cup-bottom 22 has an annular groove which lies adjacent and communicates with the groove 30 when the ring 29 is in place. A resilient split metal retaining ring 31 is adapted to be snapped into the groove 30, and when positioned therein, acts to retain the ring 29 in its installed position.

In assembling the parts of the valve member B, the sealing element 27 is first pressed downwardly over the cup-shaped body 20 until it snaps into the peripheral groove in the outside of the body. The ring 29 is then placed upon the sealing element 27, and the retaining ring 31 is then snapped into place.

The groove in the body 20 into which the retaining ring 31 nests, is sufficiently deep to envelope slightly more than one hundred eighty

4

degrees of the cross-sectional diameter of the material of which the ring 31 is formed. The inherent resilient action of the sealing ring 27, which tends to move the ring 29 upwardly, therefore also acts to keep the retaining ring 31 seated within its groove. Since the retaining ring 31 is made of the spring steel, there is no possibility of it being jarred out of place during operation of the valve.

In installing the valve B operatively in the seat member A, it is only necessary to insert the lower end of the stem 21 into the central bore 6 in the table 2.

It is pointed out that the wall 23 of the body 20 is of the exact length necessary, to allow the lower surface of the flange 25 and the lower end of the wall 23 to seat upon the upper edges of the three webs 3 at the same time the lower surface of the cup-bottom 22 contacts the upper surface of the table 2. The shock or blow of the downward moving valve B, is therefore distributed over the entire upper surface of the table 2, and is also partially borne by the three webs.

As best shown in Figure 3, when the valve B is so seated at the lower end of its stroke, neither the tapered outer surface of the flange 25, nor the tapered outer surface of the sealing element 27 are in contact with the seating surface 5 of the seat member A. Consequently, the seating surface 5 is not called upon to withstand any portion of the hammer which is created by the downwardly moving valve B.

When the assembly is operatively installed in a mud-pump, there is a downward acting fluid force which drives the valve B toward its seated position. This fluid force acts upon the upper surface of the sealing element 27, in the direction indicated by the arrow in Figure 4, and is sufficient to bend the outer portion of the sealing element 27 downwardly into sealing engagement with the seating surface 5. Figure 4 illustrates the sealing element 27 when its outer portion is bent downwardly into such position.

As stated hereinabove, the blow of halting the downward movement of the valve B is distributed over the upper surfaces of the table 2 and the webs 3. In the present structure, the force of such a blow is dampened by the action of the fluid being trapped temporarily in the pocket formed between the lower surface of the cup-bottom 22, and the upper surfaces of the table 2.

The fluid thus trapped may escape from between the two surfaces by traveling outwardly along the grooves 8, and thence downwardly through the slots 9. The fluid capacity of the grooves 8 and slots 9, may of course, be varied in manufacture, in order to suitably regulate the speed with which the valve B is permitted to reach its termination.

During operation of the valve B, the helical grooves 24 in the surface of the stem 21 are filled with pump fluid. Therefore, the force of the well fluid upon the grooves 24 acts to create a partial rotative movement of the valve upon each stroke thereof. This eliminates any tendency of the seating surface 5 and the outer edge of the flange 25 to become complementally cut in one place by the abrasive action of the flowing fluid.

From the foregoing description, it is thought to be obvious that a valve assembly has been provided which accomplishes all of the objects and purposes set forth herein.

5

Obviously, the invention is susceptible to some alteration or change without defeating its practicability, and I therefore do not wish to be confined to the single embodiment illustrated in the drawings and described hereinabove, further than I am limited by the scope of the appended claim.

I claim:

In a valve and seat assembly for pumps, the combination of: an annular metal valve seat member having an upstanding central boss surrounded by radially spaced flow passages for fluid, and having an axial bore therethrough; an annular upwardly presented conical valve seating surface formed in said seat member and surrounding said passages; a valve stem reciprocatably mounted in said bore; a valve head integral with the stem at a point intermediate the ends thereof, said head having a downwardly presented cup-shaped recess for closely nesting the boss upon each downward stroke of the head; a rigid annular flange integral with and outstanding from the head for seating upon the smaller lower portion of said conical seating surface; a resilient annular sealing element surrounding said head and resting upon said flange for sealing with the upper larger portion of said conical seating surface; a rigid metal ring dis-

6

posed around the head and resting upon the sealing element; a complemental annular groove in the exterior surface of said head, and in the interior surface of the ring; a spring metal snapping in said groove for holding the rigid ring seated upon the sealing element; and passages formed in the exterior side surface of said boss for permitting the escape of fluid which is trapped in the recess by the boss upon each downward stroke of the head toward valve seating position.

PHILIP M. REA.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
322,270	Engel	July 14, 1885
524,049	Schutte	Aug. 7, 1894
693,513	Gulland	Feb. 18, 1902
1,327,564	McDougall	Jan. 6, 1920
1,484,997	Rossiter	Feb. 26, 1924
2,021,351	Carson	Nov. 19, 1935
2,061,480	Pigott	Nov. 17, 1936
2,197,455	Volpin	Apr. 16, 1940
2,402,713	Volpin	June 25, 1946