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VALVE FOR OIL WELLS
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Fig. 1.

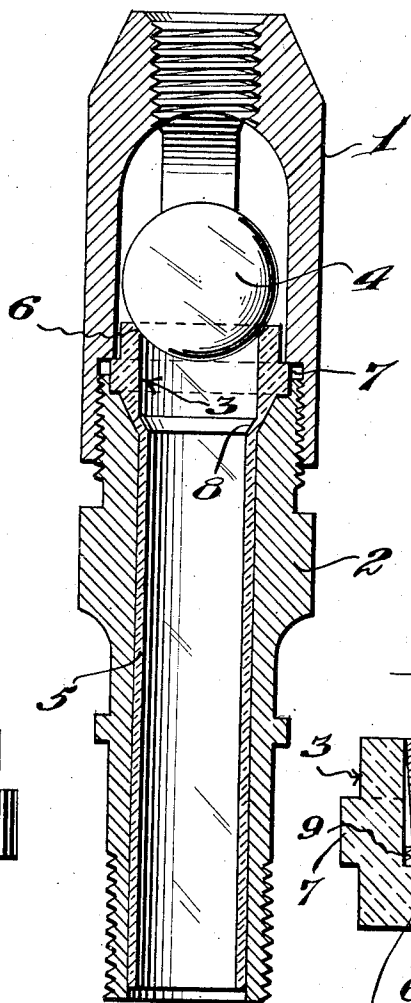


Fig. 3.

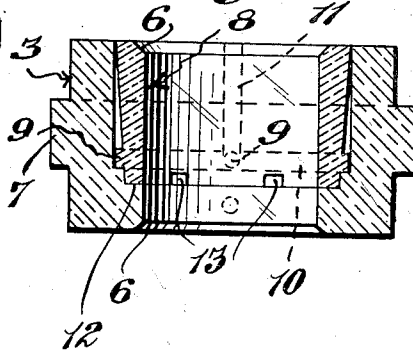
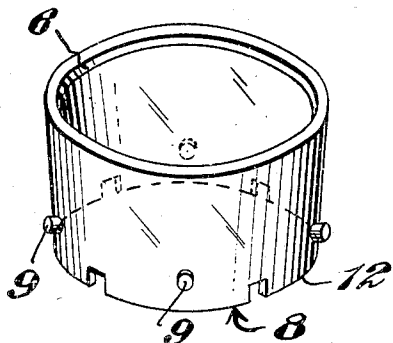


Fig. 4.



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VALVE FOR OIL WELLS

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5 Claims. (Cl. 251-121)

This invention relates to valves for oil wells; and it comprises an improved ball valve for the usual plunger employed, in deep and oil well pumps, having the ball and/or the valve seat bushing constructed of a resilient artificial plastic of certain characteristics which adapt these parts particularly to the service required, the valve seat bushing being advantageously provided with a tubular extension passing downwardly into the pump plunger serving to prevent the accumulation of corrosion products either in the plunger or on the face of the valve seat and usually being provided with a replaceable insert whereby the face of the seat can be renewed, said insert being usually provided with knobs or bosses which cooperate with grooves on the face of the socket into which it fits to hold the insert securely in position; all as more fully hereinafter set forth and as claimed.

In the conventional type of oil well pump a plunger is provided at the top of which is a standing valve of the ball-and-seat type. Owing to the sand, water, sulfur and acids commonly found in oil wells, these valves are subject to abrasion as well as to severe corrosion. The rate of wear is high and the valves frequently become partly plugged with corrosion products which tend to creep over the faces of the valve seats rendering the seal imperfect. Costly shut-downs frequently result from these difficulties. Many attempts have been made to eliminate these difficulties. For example, suggestions have been made to provide valve seats of glass or of various corrosion resistant alloys but, while these expedients partly decreased corrosion, they did not eliminate the difficulties arising from abrasion caused by the sand and other solid impurities present in the crude oil. These expedients have therefore not met with commercial success owing to their increased cost as well as to their failure to solve the problem presented.

I have found that corrosion and abrasion difficulties can be eliminated simultaneously by the use of certain artificial plastics in the valve construction. Several of the relatively new artificial plastics have been found ideally suited for use in the construction of the ball valves which are used in the plungers of oil well pumps. But for satisfactory performance these plastic must conform to certain important specifications. They must be resistant to oil, water, sulfur and weak acids. They must be highly resilient, having a high impact strength and a relatively high tensile strength and they must have no tendency to flow in the cold or to shrink or craze upon aging.

More specifically these plastics should have a tensile strength of at least about 3500 pounds per square inch, a specific gravity of 1.2 or above, an impact strength (Charpy test, foot pounds energy to break a bar $\frac{1}{2}$ by $\frac{1}{2}$ inch) of at least about 0.5, a dielectric strength (60 cycles, volts per mil) of about 450 or above, a modulus of elasticity (pounds per square inch times 10^5) of at least about 3.0, and their water absorption should not be above 2 percent upon 24 hours immersion.

The above requirements limit the number of plastics which are useful in my invention to a considerable extent but I have found that excellent results can be obtained with the following list: cellulose acetate butyrate, cellulose acetate, styrene resin, ethyl cellulose, methyl methacrylate resin, vinyl chloride resin, and vinyl chloride-acetate resins. This list does not exhaust the useful plastics but I believe that those included are the best at present available. Fillers such as wood flour, paper and fabric, when used in all such molding compositions, usually result in a product which has too high a water absorption.

I have found that several unexpected advantages are gained by the use of my plastic valve seat bushings and balls in oil well pumps. In the first place the rate of wear on the valves is greatly reduced, which results from the substantial elimination of abrasion. I believe this to be due to the resiliency of the plastics which are used in my invention. While sand will abrade a hard surface, such as metal or glass, it has only a slight effect on a resilient surface of less hardness. If abrasion were the only problem encountered in the construction of such valves, rubber would be an ideal material for construction, since rubber withstands abrasion very well. But of course rubber cannot be used in oil pumps because it is damaged by oil.

A second advantageous result obtained by the use of my plastic valve seat bushings and balls is that corrosion difficulties are entirely eliminated. The plastics mentioned are not attacked by oil, sulfur, water or the acids which are encountered in oil wells.

The conventional plunger which is used in oil well pumps is a hollow cylinder of metal which corrodes rather rapidly. The resulting corrosion products collect in the tube and then tend to creep over the surface of the valve seat. This soon produces an irregular working surface on the valve seat which causes leakage and eventual failure of the pumping action. I have found that this difficulty can be entirely eliminated

by a novel construction which comprises an integral, tubular extension of my plastic valve seat bushing which extends downwardly with a sliding fit into the metal plunger forming a lining therefor and being free from threaded connections. The use of this extension prevents the corrosion of the inner wall of the plunger and prevents corrosion products from collecting inside the plunger and from creeping over the working face of the valve seat. This advantage is obtained, of course, whether the ball of the valve is constructed of plastic or metal.

A further surprising discovery in connection with the use of the present invention is that the rate of pumping is appreciably increased when a plastic ball is employed, as in my preferred embodiment. This occurs whether the valve seat is of metal or of plastic and hence must be attributed to the characteristics of the plastic ball itself, rather than to the combination of a plastic ball with a plastic seat. I have found that valves constructed with a plastic ball have less tendency to leak than valves with metal balls and this probably explains at least part of the increased pumping efficiency. It is my belief, however, that this increase is also partly due to the fact that the plastic balls have less inertia and therefore operate more quickly and with less lag to open and to close the valve, thereby increasing the rate of pumping. The resiliency of the plastic, which enables a better contact and a closer fit between the parts, undoubtedly accounts for the lower leakages obtained with my plastic valves. And this lower leakage is obtained when either the ball or the seat is constructed of plastic, the other being constructed of metal. An additional advantage with respect to leakage is obtained when both ball and seat are constructed of plastic.

My invention can be explained in more detail by reference to the accompanying drawing which shows several modifications of my improved ball valve structure. In this showing

Fig. 1 is a vertical section through the plunger of an oil well pump showing my improved valve seat bushing and ball in position,

Fig. 2 is a side elevation of a modified and reversible valve seat bushing structure,

Fig. 3 is a cross section through a further modification which is provided with a removable insert, while

Fig. 4 is a perspective view of the removable insert shown in Fig. 3.

In the various figures like parts are designated by like reference numerals. Referring to Fig. 1, the pump plunger shown is of conventional type. It comprises an upper cage portion 1 serving to hold the ball 4 and a lower plunger section 2 which carries the valve seat bushing shown generally at 3. The upper cage portion is adapted to be thread-coupled to the lower end of a sucker rod, not shown, in the usual manner.

It will be noted that the valve seat bushing of Fig. 1 is provided with a depending integral tubular extension 5, these parts being constructed of an artificial plastic which is usually made separately and used as an insert but which may be press molded into the plunger. The ball 4 is also constructed advantageously either of the same or of a different plastic. The valve seat proper is chamfered at 6 to fit the contour of the ball and these parts may be ground, if desired, to produce a perfect fit. The valve seat bushing shown in Fig. 1 is provided with the conventional rib or peripheral flange 7 which is

clamped between cooperating shoulders formed in the cage portion and the plunger section, respectively. The bushing has a tapered section 8 connecting the valve seat proper with the depending tubular portion 5.

In Fig. 2 a valve seat bushing of conventional form is shown which is constructed of plastic. This bushing is reversible, being chamfered at both ends as shown at 6.

In Fig. 3 a modification is shown which is provided with a removable insert shown generally at 8 which fits tightly into a socket member 3 and bears the valve seat proper, shown at 6. The insert is tapered slightly and is provided with a series of bosses 9 which fit into a groove 10 which is provided in the inner face of the socket member. Vertical grooves 11 in the socket member are also provided which permit replacement of the insert. At the lower edge 12 of the insert, which rests on a shoulder provided in the inner surface of the socket member, several notches 13 are provided, which are adapted to fit a tool which is used for removing the insert. The embodiment shown in Fig. 1 may be provided with an insert such as that shown in Figs. 3 and 4.

It is evident, of course, that the valve insert, shown in Figs. 3 and 4 can be replaced when worn. This greatly reduces the over-all cost of my valve seat bushings since these inserts can be made very cheaply. And, owing to the lack of corrosion and the low rate of wear, due to the use of a resilient plastic in my bushings, both of which factors reduce the number of shut-downs, the total savings occasioned by the use of the present invention is substantial.

While I have described what I consider to be the more important embodiments of my invention, it is obvious, of course, that modifications can be made in the valve structures and materials which have been described without departing from the purview of this invention. As mentioned previously, advantages are gained by the use of my plastic valve seat bushings, which may or may not be provided with a plastic valve seat extension, no matter whether the ball employed be of metal or of plastic. And conversely, advantages are gained by the use of a plastic ball whether the valve seat be of plastic or of metal. The invention therefore resides in these parts per se as well as in the combination. The use of my plastic valve seat bushing, with or without the tubular extension, is advantageous even when the conventional hinged-leather or other flap-type of valve is employed.

While it is impossible to give a complete list of the known plastics which are useful in this invention, it is evidently well within the skill of the art, when the characteristic properties of a given plastic are known, to determine whether or not this plastic would be suitable, simply by comparing these properties with those which have been outlined previously. Each of the properties mentioned is of importance. For example the dielectric strength is of importance in the prevention of electrolytic corrosion. Further modifications of my invention which fall within the scope of the following claims will be immediately evident to those skilled in this art.

What I claim is:

1. In a ball valve construction for oil well pumps, a tubular socket member and a replaceable insert carrying a valve seat adapted to fit into and to seat in said socket member, said insert having external bosses and the inner sur-

face of said socket member being provided with a cooperating groove adapted to receive said bosses whereby said insert may be held firmly in position; said socket member and insert being constructed of an artificial plastic having a tensile strength of at least about 3500 pounds per square inch, a specific gravity of at least about 1.2, an impact strength of not less than about 0.5, a dielectric strength of at least about 450, a modulus of elasticity of not substantially less than 3.0×10^5 and having a water absorption not exceeding 2 per cent upon 24 hours immersion, said plastic being resistant to oil, sulfur and acids and having no tendency to flow in the cold or to shrink or craze upon aging, said plastic being selected from a class consisting of cellulose acetate butyrate, cellulose acetate, styrene resin, ethyl cellulose, methyl methacrylate resin, vinyl chloride resin and vinyl chloride-acetate resin.

2. The ball-valve construction of claim 1 wherein the ball of said valve is also constructed of said artificial plastic.

3. A ball-and-seat valve for oil well pumps, which comprises a valve seat bushing having a valve seat formed therein adapted to cooperate with a ball and having an integral tubular extension adapted to retard the creeping of corrosion products across the surface of said valve seat, said valve seat bushing and extension being constructed of an artificial plastic having a tensile strength of at least about 3500 pounds per square inch, a specific gravity of at least about 1.2, an impact strength of not less than about 0.5, a dielectric strength of at least about 450, a modulus of elasticity of not substantially less than 3.0×10^5 and having a water absorption not exceeding 2 per cent upon 24 hours immersion, said plastic being resistant to oil, sulfur and acids and having no tendency to flow in the cold or to shrink or craze upon aging, said plastic being selected from a class consisting of cellulose acetate butyrate, cellulose acetate, styrene resin,

ethyl cellulose, methyl methacrylate resin, vinyl chloride resin and vinyl chloride-acetate resin.

4. A valve seat bushing for oil well valves of the ball-and-seat type, which comprises a cylindrical bushing having a valve seat formed in at least one end thereof and adapted to cooperate with a ball, said bushing being adapted to be mounted in an oil well pump and being constructed of an artificial plastic having a tensile strength of at least about 3500 pounds per square inch, a specific gravity of at least about 1.2, an impact strength of not less than about 0.5, a dielectric strength of at least about 450, a modulus of elasticity of not substantially less than 3.0×10^5 and having a water absorption not exceeding 2 per cent upon 24 hours immersion, said plastic being resistant to oil, sulfur and acids and having no tendency to flow in the cold or to shrink or craze upon aging, said plastic being selected from a class consisting of cellulose acetate butyrate, cellulose acetate, styrene resin, ethyl cellulose, methyl methacrylate resin, vinyl chloride resin and vinyl chloride-acetate resin.

5. A valve seat bushing for oil well valves of the ball-and-seat type, which comprises a cylindrical bushing having a valve seat formed in at least one end thereof and adapted to cooperate with a ball, said bushing being provided with a peripheral flange adapted to support said bushing and being constructed of the plastic cellulose acetate butyrate, said plastic having a tensile strength of at least about 3500 pounds per square inch, a specific gravity of at least about 1.2, an impact strength of not less than about 0.5, a dielectric strength of at least about 450 volts per mil, a modulus of elasticity of not substantially less than 3.0×10^5 and having a water absorption not exceeding 2 per cent upon 24 hours immersion, said plastic being resistant to oil, sulfur and acids and having no tendency to flow in the cold or to shrink or craze upon aging.

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