Nov. 19, 1963 W. W. FERRAR ET AL 3,111,171

COMBINATION FLOAT SHOE AND SPIRAL CEMENT MIXER

Filed March 17, 1961

Fig. 1

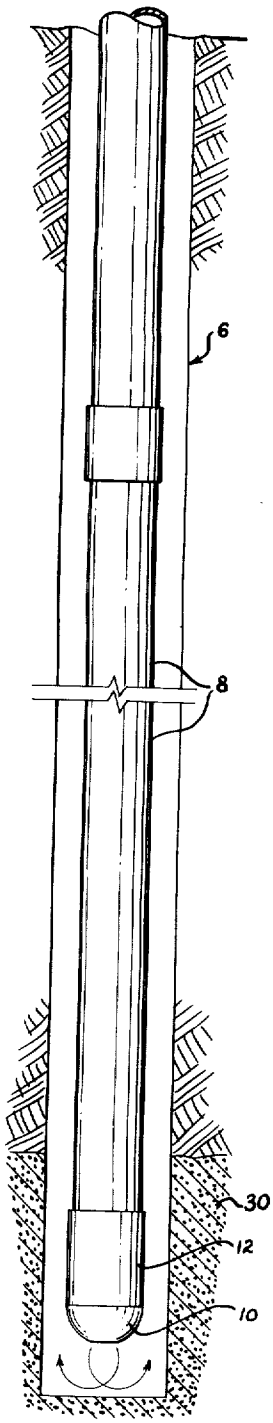


Fig. 2

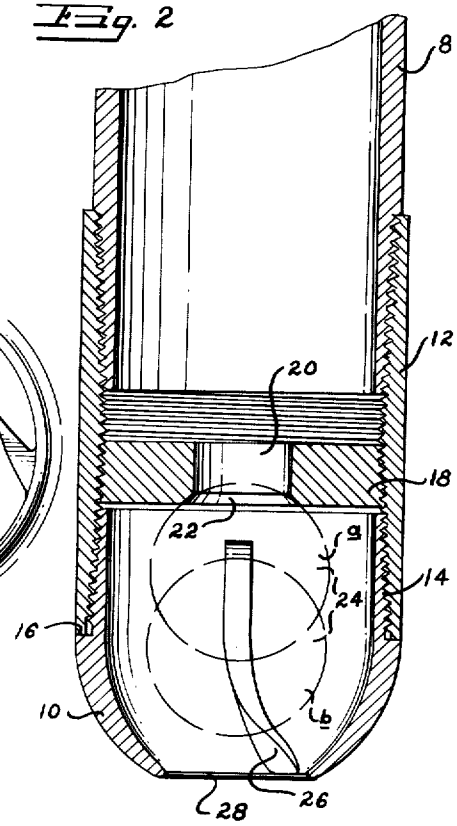


Fig. 3

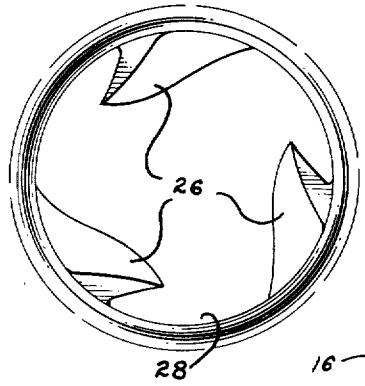


Fig. 4

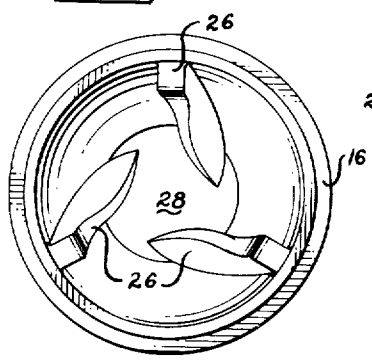
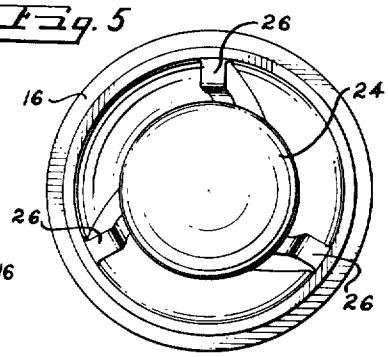


Fig. 5



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COMBINATION FLOAT SHOE AND SPIRAL CEMENT MIXER

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This invention relates to an improvement in a float shoe and more particularly to a float shoe which is used in connection with the cementing of casing in wells, wherein the cement, which passes outward from the lower end of the float shoe, is given a spiral, swirling action in order to agitate the cement and to cause the cement to flow evenly upward in the annulus between the wall of the casing and the wall of the bore hole of the well.

Various float shoes for use in the cementing of casing in wells, such as oil wells, have been proposed heretofore, but these, for the most part, directed the cement downward without regard to the mixing of the cement and water into a slurry, as it is passed outward from the lower end of the casing, which would cause improperly mixed cement to be directed around the casing.

The present device allows the cement to be homogenized into a smooth consistency as it is directed spirally upward around the casing.

An object of this invention is to provide a float shoe for well casing and the like, which will serve several purposes; that of closing the lower end of the casing to allow the casing to be lowered into a mud-filled hole, so that the mud will buoy up the casing to lighten the load of the casing, as the casing is being run into the hole; that of excluding the mud from the interior of the casing, so that the cement run into the casing will not be diluted with mut; and that if providing for the spiral discharge of the mud out through the lower end of the plug, when it is desired to force cement downward through the casing and out through the lower end thereof, to fill the annulus between the exterior of the casing and the wall of the well, preparatory to anchoring the casing in the well when the cement has set.

Another object of the invention is to provide a low cost, drillable, metallic float shoe, with a drillable seating valve element therein, so when the casing has been anchored in place by cement, the well can be readily completed by drilling the cement therein and the plug out of the lower end of the casing.

Still another object of the invention is to provide a float shoe and valve combination, which is low in the cost of manufacture, and which is effective as a float shoe and as a cement mixing device.

With these objects in mind, and others which will become manifest as the description proceeds, reference is to be had to the accompanying drawings, in which like reference characters designate like parts in the several views thereof, in which:

FIG. 1 is a vertical sectional view through the lower portion of a well, showing a well casing therein having a casing float shoe secured to the lower end thereof, which float shoe is the basis of the present application, the casing and the float shoe being shown in elevation;

FIG. 2 is an enlarged, longitudinal, sectional view through the lower end of the well casing, showing the float shoe installed thereon, and showing the ball valve removed, in order to bring out the details of construction, but two positions of the ball valve being shown in dashed outline;

FIG. 3 is a fragmentary view of the lower end of the float shoe, which is enlarged further, and particularly showing the opening through the float shoe and the spiral fins, as seen through the opening;

FIG. 4 is a top plan view of the float shoe removed from the casing, and showing the ball valve removed therefrom in order that the details of construction may be readily viewed; and

FIG. 5 is a top plan view, similar to FIG. 4, but with the ball valve in place.

With more detailed reference to the drawing, the numeral 6 designates generally the lower portion of the bore hole of a well, which bore hole has a casing 8 therein. A float shoe, designated generally at 10, is screw threaded into the lower end of coupling 12, which coupling 12 is secured on the lower end of casing 8. The float shoe 10 is preferably made of metallic alloy, the principal material thereof being aluminum, which has been alloyed with other materials so it will be readily drillable.

The float shoe 10 is screw threaded, as indicated at 14, so as to threadably engage the lower threaded end of coupling 12, so that the shoulder 16 of the float shoe 10 will abut with the lower end of the coupling 12, to form a fluid tight joint therewith.

A valve plate 18 is screw threaded into the coupling 12 above the float shoe 10, so that the axial opening 20 formed in the plate 18 will be in axial alignment with the opening through the float shoe 10. The valve plate 18 has a valve seat 22 therein, so as to complementally seat a spherical ball 24 therein, when the ball 24 is positioned as indicated at *a* in FIG. 2, in dashed outline. When the ball is in this position, as the casing is being run into the well, the ball 24 is buoyed up into seating relation with seat 22 of the valve plate 18, thereby a portion of the weight of the casing to be buoyed up, is buoyed up by the mud in the bore hole of the well.

The ball 24 is guided within the float shoe 10 by the upright ribs 26, the upper ends of which ribs are substantially parallel, but which ribs extend downward in a spiraling manner, which ribs spiral in the same direction at the lower ends thereof so as to form a seat or resting place for the ball 24, when the ball 24 is in the position as indicated at *b*, in dashed outline, in FIG. 2, so the ball 24 will rest on ribs 26 to enable the cement to be circulated downward through the casing and outward below the ball 24 and through opening 28 in the lower end of float shoe 10. With the ball so positioned, it will not impede the flow of cement through the float shoe.

With the casing 8 lowered into place within well 6, as to a producing zone 30, such as an oil sand or the like, the casing may be held in suspended relation in the well, by slips or the like, whereupon, a mixture of cement and water is introduced into the casing under pressure, the ratio and quantity of which mixture is predetermined. After the slurry mixture of cement and water is introduced into the casing, a conventional cementing plug (not shown) is attached to a measuring line and placed in the casing when the last of the cement is run into the casing. Mud is then pumped into the casing onto the cementing plug to force the cementing plug, the cement slurry and the measuring line downward until the cementing plug has reached a predetermined depth within the casing, or until the plug is pumped into seating engagement with the valve plate 18 within coupling 12 at the lower end of the casing.

In the first instance, if the cementing plug is pumped downward into the casing under pump pressure exerted on the drilling mud, for a given distance, for instance within twenty feet of the lower end of the casing, the measuring line is detached from the cementing plug, as by a specified number of pulls therein, as is well understood in the drilling art, the cement is then allowed to harden or set, whereupon, the cementing plug, the remaining portion of the cement within the casing, the valve plate 18, which is also made of drillable material, the ball valve 24 and the float shoe are drilled out and the

cement below the casing is drilled until the well is completed.

The ribs **26**, which are formed interiorly of the float shoe **10** are so formed as to give a swirling, spiraling movement to the cement slurry as it passes downwardly in the well casing, which movement will give a better mixing to the cement by removing the air therefrom, which results in a more dense mixture. This movement also results in a better flow of the cement upward around the casing to cause the mud thereabove to move upward within the annulus formed between the exterior of the casing and the wall of the bore hole, with the cement being forced into the space occupied by the drilling mud as the drilling mud is forced upward.

Having thus clearly illustrated and described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. The combination of a float shoe and cement mixer for use on the lower end of a well casing, comprising a hollow, threaded, cylindrical member adapted to threadably attach to the lower end of said well casing, a valve seat attachably positioned within said hollow, threaded, cylindrical member below the lower end of said well casing, a screw threaded, hollow body having an axial opening formed therethrough, which hollow body threadably engages the lower end of said hollow, threaded, cylindrical member, a plurality of circumferentially spaced ribs formed on the inner hollow portion of said hollow body and extending inwardly toward the axis for a spaced distance, which ribs extend throughout the greater portion of the length of said hollow, threaded, cylindrical member, the upper portion of which ribs are substantially vertically arranged to form upright guideways, the lower portions of which ribs being spirally arranged to extend over at least

a portion of the lower opening in said hollow body so as to form a ball valve support, a ball valve fitted within said hollow body so as to rest on the upper side of the lower end portions of said support when said ball valve is in one position, and which upper portions of said ribs guides said ball valve to seat upwardly in fluid tight relation on said valve seat when said ball valve is in another position.

2. The combination of a float shoe and cement mixer for use on the lower end of a well casing, comprising a hollow, threaded member adapted to threadably attach to the lower end of said well casing, a valve seat attachably positioned within said hollow, threaded member below the lower end of said well casing, a screw threaded, hollow body having an axial opening formed therethrough, which hollow body threadably engages the lower end of said hollow, threaded member, three circumferentially spaced ribs formed on the inner portion of said hollow body, the upper portion of which ribs form vertical guideways, the lower portions of which ribs extend inwardly with the respective end portions of said ribs being spirally arranged to extend in the same spiral pattern over at least a portion of the opening at the lower portion of said hollow body so as to form a ball valve receiving support, a ball valve fitted within said hollow body so as to rest on said inwardly extending spiral ribs when said ball valve is in one position, and which upper, vertical portions of said ribs will guide said ball valve to seat on said valve seat when said ball valve is in another position.

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