

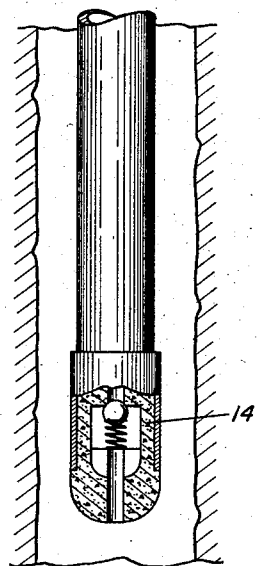
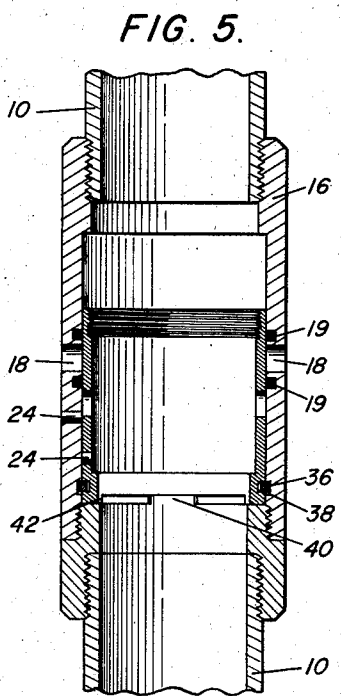
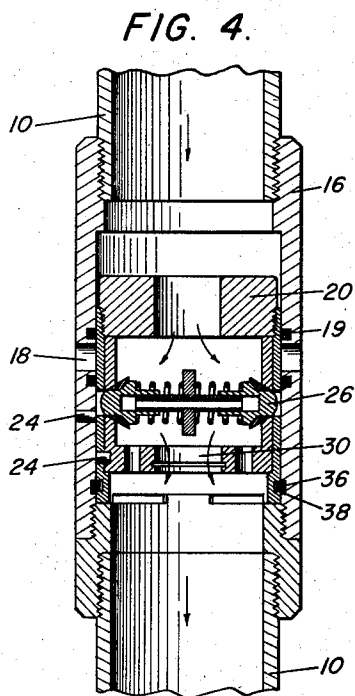
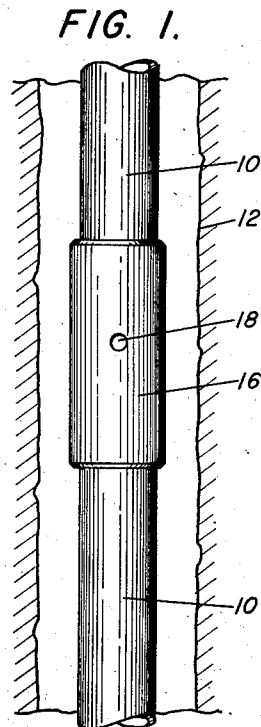
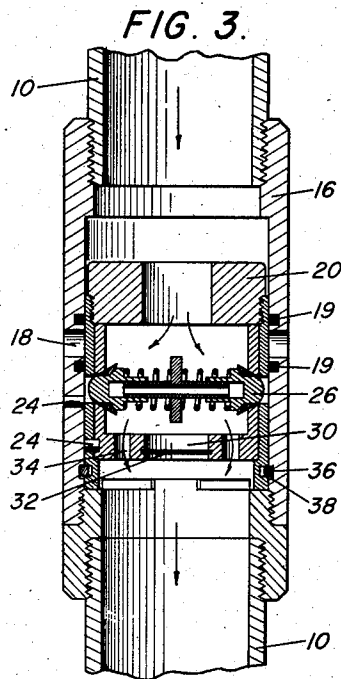
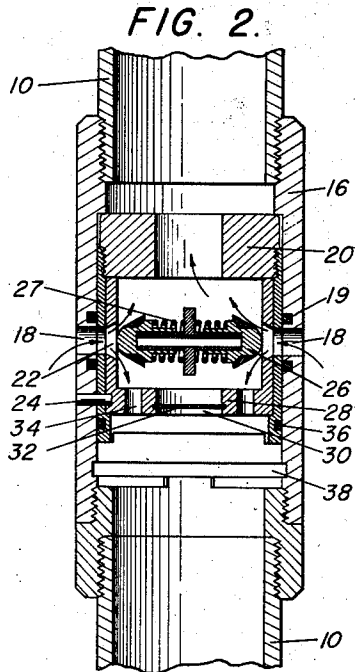
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2,847,074

WELL CASING FILL-UP DEVICE

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2,847,074

WELL CASING FILL-UP DEVICE

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2 Claims. (Cl. 166—224)

This invention relates generally to well casing attachments and more particularly to an improved device suitable for filling a well casing that is being lowered into a well bore.

A well casing that is to be lowered into a well bore and cemented therein is ordinarily equipped with a float shoe or collar at its lower end. An upwardly closing check valve, as usually provided in such floating equipment, prevents fluid passage into the well casing. Advantages found in these devices are prevention of blow outs, provision for buoyancy of the casing string, and retention of the placed cement until setting occurs.

When a well casing has been lowered to its final position, cement is pumped down through the casing, out through the check valve and thence into the well bore about the casing. The subsequent setting of this cement bonds the casing to the surrounding formation.

As is well known, the casing may be and usually is overly buoyant when lowered entirely empty. In response to such an undesirable condition a common practice is to partially fill the casing with fluids as said casing is being assembled and lowered into a well bore. Such filling is usually performed manually by the drilling crew and requires considerable extra time and effort. Various well casing attachments have been devised to have this filling operation performed as needed and without effort on the part of the crew. The most common of such attachments are devices incorporated into the previously mentioned float shoes. Problems confronting such devices have been only partially solved. One of such problems is that, as each section of casing is added, the somewhat abrupt drop of the casing string causes a high impact pressure or "ramming" effect at the guide shoe and results in overfilling and overflow of the casing. Another such problem is that cuttings and other detritus suspended in the drilling fluids sometimes wedge or block such devices.

It is therefore the general object of this invention to provide a fill-up device for well casings which will have reliable means for the controlled filling of a casing string with well fluids, positive means of retaining such fluids within the casing, permanent means for preventing further filling of the casing with well fluids when at its final position, and means for providing a full flow opening through the device at such time as cementing operations are to be performed.

In accordance with the present invention an improved well casing fill-up means is provided having in combination a tubular body having a passage therethrough and at least one transverse port through the walls thereof, with a sleeve-like member mounted within said body and adapted to be moved longitudinally to a first and second position therein. The sleeve has at least one transverse port therein which is adapted to be in registry with said body port only when said sleeve is in said first position. Said sleeve port has check valving means responsive to a predetermined differential pressure created across said

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registered ports from outside the body. Said sleeve also has a yieldable closure member responsive to pressure through said body. A yieldable means is provided for supporting said sleeve in said first position against pressure applied through said body. Means for latching said sleeve in said second position is provided, the arrangement being such that pressure applied through said body and to said sleeve member overcomes said yieldable sleeve support and moves said sleeve from said first to said second position and a higher pressure through said body overcomes said sleeve closure member, thus providing a full opening through said sleeve.

Other objects and advantages reside in certain novel features of construction and arrangement as will be more apparent from the following description made in accordance with the accompanying drawing in which:

Figure 1 is a view in elevation of the lower portion of a well casing provided with a float shoe and the fill-up device as provided by the invention.

Figures 2, 3, 4, and 5 are longitudinal cross sectional views of the fill-up mechanism, which is connected in the lower portion of the well casing and above a float shoe, the mechanism being shown in positions assumed during its operation as later described.

Referring to the drawing in detail, and first to Figure 1, it will be seen that a well casing string 10 is illustrated as being lowered into a well bore 12. Connected to the lower end of this well casing 10 is a float shoe 14 of any conventional and reliable design. Above this float shoe 14, at such an interval as may be desired, is the fill-up device herein embodied as a casing collar 16 forming a part of the casing string 10.

As best shown in Figure 2, the collar 16 may be threadedly or otherwise connected in the casing string 10 and forms a part thereof. Transversely located in collar 16 are ports 18. Axially mounted within collar 16 is a piston-like sleeve 20 having ports 22 adapted to be supported in registry with collar ports 18 by a shear screw 24. Interposed between and circumscribing said ports 18 and 22 are sealing means exemplified by O rings 19. Within sleeve 20 and adapted to close sleeve ports 22 are check valves 26 which have yieldable means, exemplified by coil springs 27, to permit fluid flow through said ports 18 and 22 only upon application of a positive pressure applied outside the collar 16. Valves 26 and springs 27 are supported within collar 20 from a diametral web, shown in section between said valves, on which said valves and springs are laterally supported. Thus, each valve 26 in combination with sleeve port 22, functions as a spring loaded check valve, permitting fluid flow through port 22 only from outside said sleeve. It is then seen that the valves 26 may be repeatedly opened and closed upon discrete applications of positive pressure from outside collar 16, as occurs in operation. Forming a piston-like head on the lower end and transverse to the axis of sleeve 20 is a partition 28. Closing a large flow passage 30 of the partition 28 is a rupture diaphragm 32, said diaphragm being so arranged as to block all axial flow through the casing 10 and sleeve 20 excepting that provided by relief passage 34, also provided in the sleeve partition 28.

As best shown in Figures 3 and 4, a retaining ring 36 is provided about sleeve 20 and confined by the inner wall of collar 16. At such time as sleeve 20 is moved downwardly, said retaining ring 36 engages a recess 38 provided in collar 16, interlinking sleeve 20 and collar 16, and preventing further relative longitudinal movement therebetween. As best shown in Figure 5, a means of preventing relative rotation of sleeve 20 with collar 16 is provided by a lug 40 on collar 16 adapted to engage a lug 42 on sleeve 20.

It is to be clearly understood that various structural modifications may be made and yet conform to the spirit of this invention. For example, the multiple ports, check valves, and passages shown need not be multiple. Also the shear screw 24, retaining ring 36, diaphragm 32 and lugs 40 and 42 are intended to be means for functions later described and may be substituted for equivalent structures by those skilled in this art.

In the usual operational procedure the fill-up collar 16, as embodied by this invention, may be connected in the lower portion of the casing string 10 and above the float shoe 14 a distance of from about twenty to sixty feet. As will be later described, the section of casing 10 found below the fill-up collar 16 will normally be filled with cement after the cementing operation is completed.

As the casing string 10 is lowered into the well bore, the drilling fluid therein creates a hydrostatic pressure greater than the pressure within the casing. This pressure differential increases with well depth, and, at a level determined by the strength of the check valve springs 27, fluid enters casing 10 through the collar ports 18 and sleeve ports 22 as illustrated in Figure 2. Since a definite outside positive pressure is required to open check valves 26, a lower fluid level (hydrostatic head) will always be found within casing 10. As the fluid enters the sleeve 20, the section of casing 10 found below collar 16 is filled by fluid entering through the sleeve relief passages 34.

Since the casing string 10 is assembled and lowered into the well bore section by section, some surging of the fluid within the casing will be evident as the descent of said casing is abruptly checked. It is provided that such fluid surges be admitted through the sleeve relief passages 34 and thence down through the casing and out the check valve provided in float shoe 14. Sufficient flow area is provided in the sleeve relief passages 34 to dissipate such surges without there being a sufficient differential pressure created to rupture the full flow passage diaphragm 32.

It is of note that certain advantages reside in filling the casing string by means of this invention as herein embodied. One such advantage is that the impact or ramming pressures created by the descent of the casing are removed from this device and have little or no deleterious effects. Another advantage is that the ports through which the fluid enters the casing are at right angles to the normal fluid flow in the well bore and thus any suspended cuttings or other detritus will tend to be forced past rather than into said ports.

It is now clear that the casing 10 will fill to a predetermined distance beneath the well bore fluid level and such difference in level will remain relatively constant throughout the entire lowering of the casing.

As best shown in Figure 3, the casing string 10 has been lowered to its final position and fluids are now pumped down through the casing 10 and out through the float shoe 14. Such fluids must pass through the sleeve relief passages 34 of collar 16 and in so doing create a pressure differential across the sleeve partition 28, and a downward force on sleeve 20. Resisting this downward force thus created is shear screw 24. At a predetermined force the shear screw 24 yields and sleeve 20 drops to a lower position; whereupon the sleeve retaining ring 36 engages the collar recess 38. The sleeve, when so engaged in this lower position, is now supported against any further longitudinal movement. In this lowered position of the sleeve 20, collar ports 18 and sleeve ports 22 are no longer in registry and the collar port 18 is further sealed by the O-rings 19. Thus, after the sleeve 20 has been moved to a lower position, a permanent closure to fluid entry or exit is effected.

As best illustrated in Figure 4, a greater pressure differential, applied by an increased flow rate of fluids through the casing 10, is created across the sleeve partition 28. The flow passage diaphragm 32 of said partition 28 ruptures at this greater differential pressure, leaving

the sleeve partition flow passage 30 unobstructed for the impending cementing operation.

The well is then cemented, the upper portion of the sleeve 20 serving as a landing stage for the cementing plugs. It is now seen that the casing 10 provided between the fill-up collar 16 and the float shoe 14 is for the purpose of retaining any cement that may have been contaminated by the displacing fluids. A strong bond in the immediate vicinity of the float shoe 14 is highly desired and a bond of uncontaminated cement is thus insured.

It is of note that the sleeve 20 as illustrated and embodied herein is provided of composite construction, having an outer shell of material similar to that of the collar 16 and an inner construction of some drillable material such as a phenolic resin. When so provided, the previously described supporting web may be integrally cast or molded of the same drillable material. While such construction does not enhance or even affect the operation of the invention as herein described, a considerable advantage is attained when the casing 10 is drilled out preparatory to completion of the well. Figure 5 best illustrates the condition of the fill-up collar after the drilling operation.

In actual practice the springs providing the closing means for the check valves 10 are selected to provide a fluid level within the casing 10 of about eighty feet below that in the well bore 12. The previously described downward surges have been found to seldom exceed 500 p. s. i. and the shear screw 24 and sleeve partition relief passages 34 are sized in accordance. Thus a pressure differential across the sleeve partition of about 550 p. s. i. will shear the screw 24 and force the sleeve to its lower latched position. An increase in pressure differential to about 650 p. s. i. will then rupture the flow passage diaphragm 32 as previously described.

Although only one embodiment of this invention has been shown and described herein, it will be evident to those skilled in the art that other embodiments and arrangements may be used without departing from the spirit of the present invention and the scope of the following claims.

We claim:

1. An improved device for filling a well casing which includes a tubular body adapted to be connected in a well casing, a sleeve movable from an upper to a lower position within said body, said sleeve and said body having transverse ports therein positioned in registry only at said upper position of said sleeve, a check valve controlling inflow of fluids through said registered ports operable in response to a predetermined pressure differential applied across said ports from outside said body, a partition means in the bore of said sleeve having a plurality of orifices therethrough, a yieldable closure initially closing one of said orifices, a releasable support initially holding said sleeve in said upper position, and a latch adapted to retain said sleeve in said lower position, the arrangement being such that a predetermined fluid pressure exerted through the casing moves said sleeve from said upper position to said lower position, and a greater predetermined fluid pressure exerted through the casing opens said yieldable closure.

2. An improved device connected in a well casing suitable for filling a well casing being lowered into a well bore and cemented therein comprising, a tubular body having an axial passage therethrough and at least one transverse port in the wall thereof, a sleeve member having an axial passage therethrough and at least one transverse port in the walls thereof mounted within said body and adapted to be longitudinally moved from a first to a second position therein, said sleeve port and said body port being in registry only at the first position of said sleeve, a check valve for controlling the flow of fluid through said sleeve port into said well casing operable responsive to a predetermined pressure differential applied across said registered ports from outside said body, a partition in said

axial passages having a plurality of orifices therethrough, a yieldable diaphragm mounted on said partition for regulating flow through said sleeve passage, responsive to pressure applied through said body, releasable supporting means initially supporting said sleeve in said first position, and means for preventing relative rotation between said sleeve and said body when said sleeve occupies said second position, the arrangement being such that a fluid pressure exerted through the casing moves said sleeve from said first to said second position and a greater fluid pres-

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sure exerted through the casing opens said yieldable diaphragm.

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