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2,071,390

APPARATUS FOR CEMENTING WELLS

Filed Aug. 6, 1935

2 Sheets-Sheet 1

Fig. 1

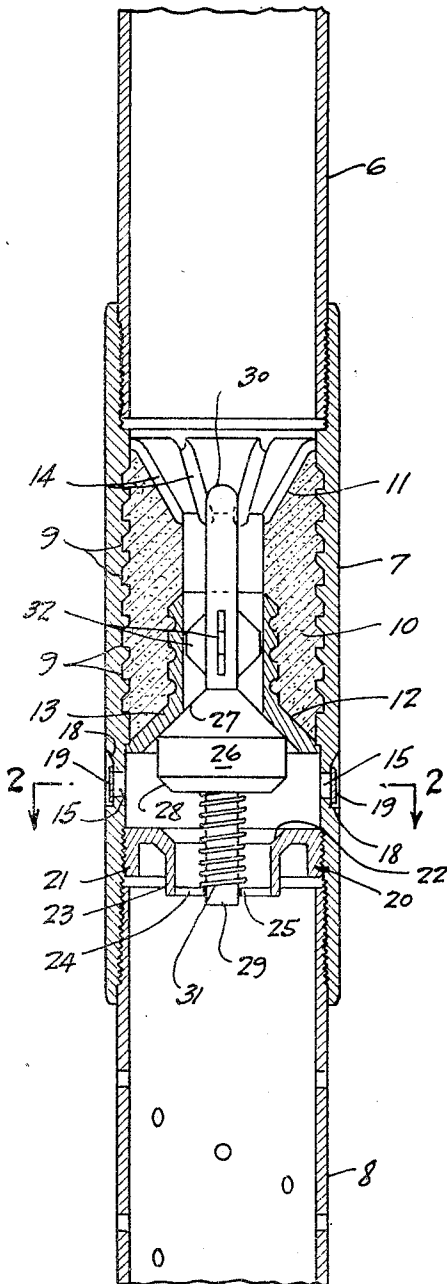


Fig. 3

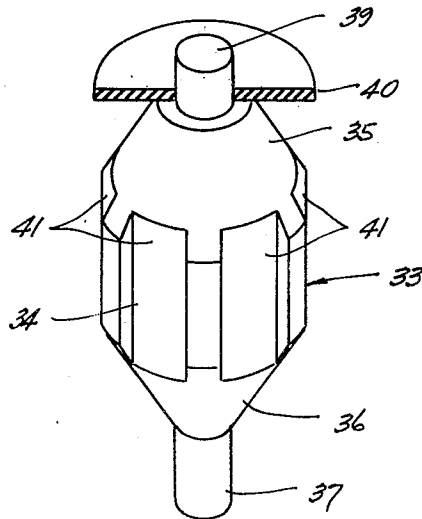
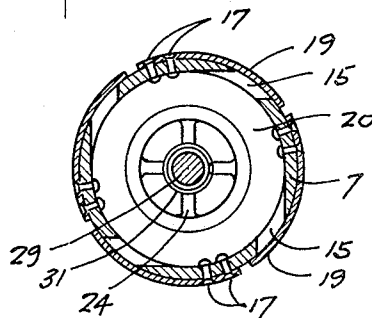


Fig. 2



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Fig. 4

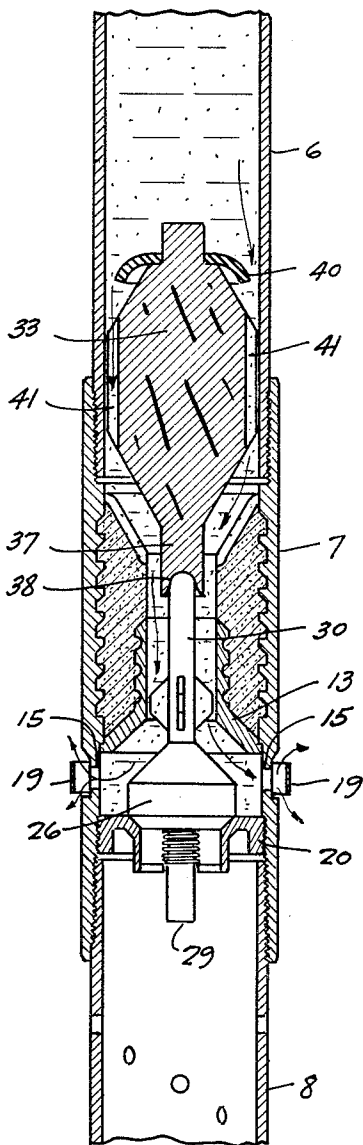
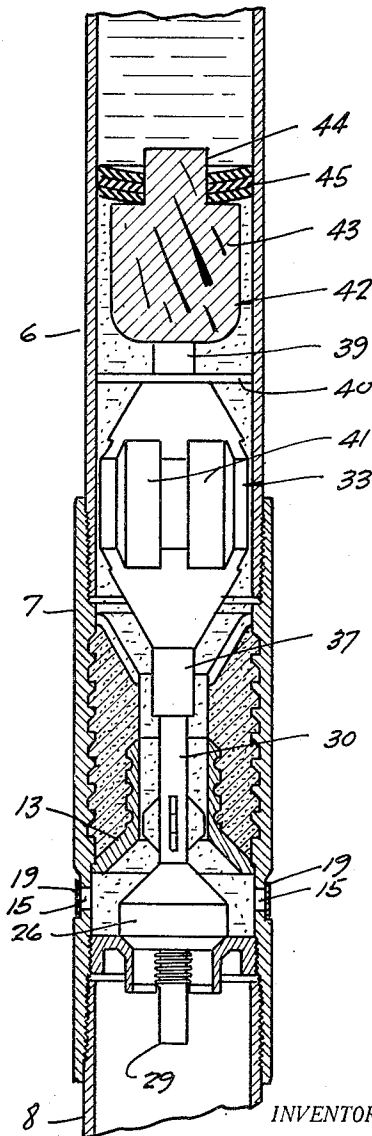


Fig. 5



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APPARATUS FOR CEMENTING WELLS

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15 Claims. (Cl. 166—1)

This invention is an improvement of the invention of my co-pending application, Serial No. 27,041, series of 1935, relating generally to apparatus for cementing oil wells, and is specifically directed to a resiliently-supported float valve adjacent a series of lateral ports in a casing, adapted to close the casing bore from either pressure above or below said ports depending upon differentials in pressure.

The cementing of combination strings of casing, i. e., those composed of casing proper and screen pipe, principally to shut out water or to prevent debris and drillings from above the screen to gravitating to the oil sands, may most effectively accomplish its purpose when performed directly above the sands to be protected, thus to isolate the oil sands from other strata.

However, in the art prior to my invention, float valves, invariably used in deep wells to facilitate control and positioning of the casing while lowering the same, must necessarily be placed above cement discharge ports to insure positive closure of the casing, which requires cement slurry intended for discharge from said ports to be forced by the float valve.

The considerable amount of time necessarily consumed in the process of mixing and pumping in; the increasing temperature encountered at great depths; the friction of the heavy cement slurry passing through several thousand feet of casing; the consequent enormous pump pressure required, combined with the thickening effect of the obstructions of the float valve, particularly the latter, tends to hasten coagulation or partial setting of the cementitious mixture and to prevent free flow thereof into recesses of the well bore around the casing.

It is therefore a general object of the present invention to provide a side-ported cementing device comprising a tubular member having a stationary valve seat fixed in its bore for a float valve resiliently supported adjacent the seat which may be actuated by a plug to release and depress the valve for closing the bore of the tubular member below the ports thus deflecting the flow of cement outwardly through the ports, which obviates the usual necessity of forcing the fluent cement by a float valve.

Another object of my invention is to provide an improved floating and cementing device which may be incorporated in a combination string of casing, adapted to float the casing to position in a well while permitting gases and expelling fluids in the screen to escape through lateral ports of the casing into the well shaft during the lowering

operation; and to subsequently run cement into the annular space around the casing above the screen to prevent surface materials and debris within the bore thereabove from gravitating to the oil sands.

A specific object hereof is to provide a variable float valve resiliently supported adjacent a series of lateral ports in the casing, between a pair of valve seats, adapted to, 1st, close the bore above the ports to pressure below the valve while positioning the casing in the well shaft, 2nd, to permit a balance in fluid pressure differentials above said resiliently-supported valve to be released through the bore of the casing proper and into the screen or through lateral ports in the casing to obtain circulation preliminary to cementing, and 3rd, by alteration of its position relative to the lateral ports to close the bore through the casing below the ports thus permitting cement to be discharged through said ports.

Another object is to provide in a cementing barrel a series of lateral ports extending through the wall of the barrel at an angle with respect to its diameter so as to swirl cement forcibly discharged from said ports around the casing to effect an even distribution thereof.

Another object is the provision of a series of spring valves to close each of the lateral ports in the tubular member to pressure outside thereof and which are adapted to deflect circulating fluid or cement, discharged from said ports, around the casing to augment the swirling action of the ports above referred to.

It is a further object to provide a seat above lateral discharge ports in the casing for an indicator plug to be forced down the well casing in back of a quantity of cement to close the bore of the casing to fluid pressure thereabove.

Still another object is the provision of a device, simple in construction, which may be utilized by operators of ordinary skill in the art to facilitate accurate discharge and distribution of cementing material outside of the casing.

In the drawings:

Fig. 1 is a view, in section and elevation, illustrating the various parts of my invention as positioned in a casing for lowering within a well bore;

Fig. 2 is a sectional view on line 2—2 of Fig. 1; Fig. 3 is an enlarged perspective view of the lower plug showing its packer in section;

Fig. 4 is a reduced view, similar to Fig. 1, illustrating the lower plug and float valve in position while cementing;

Fig. 5 is a view, in section and elevation, of

my invention, showing parts thereof as in position at the conclusion of the cementing operation.

Referring to the drawings:

5 6 designates a section of well casing having threaded to its bottom a cementing barrel 7. A section of casing screen 8 is threaded to the lower end of barrel 7, which is adapted to be lowered to position at the end of the string opposite the oil-producing sand. The bore through barrel 7 is horizontally grooved at 9 to retain a cast lapidaceous valve body 10 having upper and lower edges bevelled at respectively 11 and 12. The lower portion of valve body 10 is of reduced width and has an aluminum valve seat 13 cast therewith so as to conform to the downwardly directed bevelled edges 12 of the body 10. The bevelled edge 11 of body 10 is radially grooved at 14 for a purpose hereinafter described.

20 A series of lateral ports 15 in the same horizontal plane and bored at an angle with respect to the diameter of barrel 7 are provided through the wall thereof. Circulating fluid under pressure within the barrel will be discharged adjacent the exterior wall of the barrel, that is to say, more nearly tangentially than radially, so as to swirl around the casing and barrel, removing debris, loose shale, etc. A peripheral indentation 18 in barrel 7 is provided into which ports 15 extend to permit a series of valves 19 to be located therein, flush with the wall of barrel 7, said valves each comprising a strip of spring metal having one end secured by rivets 17 in the indentation 18 at the side of each port opposite to the direction of inclination thereof so as to normally close the ports. Fluid discharged from the ports 15 is deflected by the valves 19 to augment the swirling action above noted. Cement subsequently pumped through the casing and through lateral ports 15 will be similarly circulated, thus filling the crevices and cavities of the well shaft, and providing a more stable foundation for a successful cementing operation. The cement is prevented from flowing back through the ports upon any decrease in pressure within the casing by the closure of valves 19.

Threaded into the lower end of the cementing barrel and below ports 15 is a cast aluminum valve seat 20 comprising integrally, a threaded collar 21, an upwardly facing bevelled portion 22 on which a valve hereinafter described is adapted to seat and, a downwardly extending circular section 23. A web, 24, secured by well known means to the lower end of section 23, supports a collar 25 in its center.

60 A float valve 26 having bevelled upper and lower faces 27 and 28 to correspond to valve seats 13 and 22 respectively, is also provided with two vertical valve stems 29 and 30 protruding from opposite sides of the valve. Valve stem 29 slidably extends through collar 25 and has a spiral spring 31 located thereon between collar 25 and the body of the valve 26 to resiliently urge said valve against its upper seat 13. The upper valve stem 30 which extends into the bore of the valve body 10 has secured to its sides by welding, or the like, a plurality of wing guides 32 adapted to slidingly engage the wall of body 10 to prevent tilting of the valve when not actively in operation.

75 As the combination string, with the cementing barrel threaded between the casing proper and screen, is lowered to position the valve 26 being held against seat 13 by spring 31, and pressure therebelow, functions as a float valve permitting

the lowering of the casing to be accomplished with a minimum of strain on the derrick, elevator, and equipment in a manner well known in the art.

The usual circulation may then be established through the casing by pumping fluid under sufficient pressure to overcome the tension of spring 31 and gas or fluid pressure below the valve. After passing through the float valve, the circulating fluid will then be normally discharged through the ports 15 and into the well bore around the casing removing cavings and debris which would otherwise interfere with cementing, and principally, establishes the fact that the cementing operation is in order. If the casing or the bore of the hole below the ports is clogged or obstructed the fluid may be released through the lateral ports by overcoming the tension of valves 19 and circulation thus established upwardly around the casing above the ports.

Cement is then run in between plugs. The lower plug 33 comprises a cylindrical body 34 having its upper and lower faces bevelled at 35 and 36 respectively.

25 A stem 37 is provided on the lower end of plug 33 having a concave indentation 38 which is adapted to seat on the upper end of stem 30 of valve 26 as will hereinafter appear. The upper end of said plug 33 is also furnished with a stem 39 on which a packer 40, slidable with the casing wall, is mounted, a facilitating movement of the plug through the bore ahead of the cement. When the lower plug 33 reaches stem 30, continued pressure from the top of the well will cause the valve 26 to be held positively against the lower seat 22 thus opening the float valve and exposing ports 15 to the upper bore.

40 A series of longitudinal grooves 41 on the periphery of plug 33 permits cement under pressure to deflect packer 40, pass plug 33 through the grooves 41 and float valves 26, and thence through lateral ports 15 to position outside barrel 7. While a fracture in stem 30 might permit plug 33 to seat on valve body 10 a series of radial grooves 44, above generally referred to, disposed in the bevelled face 11 of body 10 insures passage of cement therebetween.

50 An indicator plug 42, is inserted in the casing on the cement, which comprises a body 43, to loosely slide through the bore of the casing, and an upper portion 44 of reduced diameter on which is mounted a packer 45 to slidably engage the casing wall. The column of fluent cement between plugs 33 and 42 is forced down through the casing by pump pressure as is well known. When all the cement between plugs 33 and 42 has been discharged below plug 33, indicator plug 42 will seat on stem 39, and, as it closes the bore, pressure above will build up, causing the pump at the surface of the well to stall and thus indicate to the operator the completion of the discharge.

65 A tight head on the casing will then augment the function of valves 19 by maintaining a constant pressure within the well, to prevent disturbance of the cement, permitting the cement to set and harden; the tailings or washed cement left in the casing between plug 42 and valve 26 being later drilled out, together with lapidaceous valve body 10, plug 33, and seat 20, in accord with general well known practice.

70 It will thus be seen that I have provided a simple device adapted for use in combination strings of casing to cement directly above the screen, in which a float valve resiliently functions above a series of lateral ports in the casing prior

to cementing, yet will permit cementing through said lateral ports without the slurry having to pass through the restrictive mechanism of a float valve structure. The flow of circulating fluid, while preferably around the valve into the screen or lower casing 8, may be through the yieldably-closed ports 15, depending upon pressure influences.

While I have illustrated and described a specific embodiment of my invention, various changes may be made in relative size and arrangement of the parts, specific shape of the plugs, and kind of material employed, without departing from the spirit of my invention. It should also be noted that while it is described above that plug 33 is normally inserted in the casing after circulation is established said plug may precede the circulating fluid as well as the cement to prevent fluid from being pumped into the screen.

What I claim and desire to secure by Letters Patent is:

1. In a cementing apparatus, a ported casing coupling, a valve body formed in said coupling above and below the port in said coupling, a valve between said valve bodies adapted to be urged against said lower valve body by pressure from above, and resilient means to return said valve against said upper valve body.

2. In a cementing apparatus, a section of well casing, a pair of valve seats formed in said casing, a valve between said seats adapted to contact either seat by variance in pressure differentials above and below said valve.

3. In a cementing apparatus, a well casing section having a port therein, a valve seat formed in said casing on each side of said port, a valve between said seats adapted to contact either of said seats in response to a balance of pressure on opposite sides of said valve.

4. In a cementing apparatus, a tubular member having a lateral port therein, a valve body formed within said member on each side of said port, a valve between said bodies, and guides connected to said valve to maintain vertical alignment of said valve with the bore through said valve bodies.

5. In a cementing apparatus, a tubular member having a lateral port therein, a valve body formed within said member on each side of said port, a valve between said bodies, a plug slidably fitting the bore of said tubular member adapted to be actuated by fluid pressure to force said valve to the lower valve body, and resilient means to urge said valve against the upper valve body.

6. In a cementing apparatus, a casing, a valve in the bore of said casing, resilient means variably supporting said valve, and a plug adapted to move said valve downwardly, comprising a fluted body slidable with the casing having a disc connected therewith to receive downward fluid pressure to actuate said plug, said disc being collapsible by an increase of fluid pressure thereon.

7. In a cementing apparatus, a casing, a valve in the bore of said casing, a plug adapted under fluid pressure to move said valve downwardly comprising a fluted body slidable with the casing and having a disc connected therewith to receive downward fluid pressure to actuate said plug, and an indicator plug adapted to seat on said first-mentioned plug so as to close the bore to pressure thereabove.

8. Well casing having a series of ports, means in the casing and immovable with relation thereto above and below said ports forming respectively upper and lower valve seats, a float valve,

means resiliently supporting said float valve against the upper seat, a barrier plug for separating mud fluid and cementing mixture, said plug carrying means forming a fluid-tight but sliding engagement with the bore of the casing to permit said plug to be forced downwardly therethrough by fluid pressure but capable of upwardly by-passing said fluid when anchored in the casing, means carried by said barrier plug to compel said float valve to contact the lower seat while said pressure fluid by-passes said barrier plug downwardly through the casing.

9. Well casing having a series of lateral ports, valvular means controlling said ports, means in the casing and immovable with relation thereto above and below said ports, forming, respectively, upper and lower valve seats, a float valve, means resiliently holding said float valve against said upper seat, and a plug adapted to be driven through the well casing by pressure fluid to compel said float valve to rest on its lower seat while said pressure fluid by-passes said plug downwardly within the casing.

10. In a device of the character described, a tubular member, a barrier plug adapted to separate fluids within said tubular member comprising a body portion, means to maintain axial alignment of said body portion with said tubular member, a by-pass from the space in said tubular member above the plug to the space below the plug, and means to normally maintain closure of said by-pass.

11. In a cementing apparatus, a tubular member, a pair of valve seats formed in said tubular member, a valve between said seats adapted to contact either seat by variance in pressure differentials above and below said valve, and means actuated by fluid pressure to compel said valve to contact its lower seat.

12. In a well cementing apparatus, well casing having a series of ports, outwardly opening valvular means on said casing tending normally to maintain closure of said ports for yieldably directing the flow of pressure fluid downwardly through the casing, a float valve, means in the casing and immovable with relation thereto above and below said ports forming upper and lower seats for said float valve, resilient means supporting said float valve against said upper seat, and means actuated by fluid pressure to compel said float valve to contact the lower seat, thus to direct the flow of said pressure fluid outwardly through the yieldably closed ports due to increased pressure.

13. In a well cementing apparatus, well casing having a series of lateral ports, means in the casing and immovable with relation thereto above and below said ports, forming, respectively, upper and lower valve seats, a float valve, means resiliently supporting said float valve against said upper seat, a plug adapted to be driven through the well casing by fluid pressure to compel said float valve to rest on its lower seat while said pressure fluid by-passes said plug downwardly within the casing, and an indicator plug adapted to seat on said first-mentioned plug so as to discontinue the flow of said pressure fluid downwardly thereby.

14. In a well cementing apparatus, a tubular member, a port in said tubular member, a valve seat formed in said tubular member on each side of said port, a valve between said valve seats adapted to close the bore through said tubular member above or below said port depending upon pressure differentials, and a plug actuated by

fluid pressure to compel said valve to contact its lower seat.

15. In a well cementing apparatus, a tubular member, a port in said tubular member, a valve seat formed in said tubular member on each side
5 of said port, a valve between said valve seats

adapted to contact either seat by variance in pressure differentials on said valve, a plug to urge said valve against its lower seat, and an indicator plug to close the bore of the tubular member above the port to pressure thereabove.

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