Oct. 2, 1951 T. M. RAGAN 2,569,732

SIDE PORTED CASING APPARATUS FOR CEMENTING WELLS

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FIG. 1

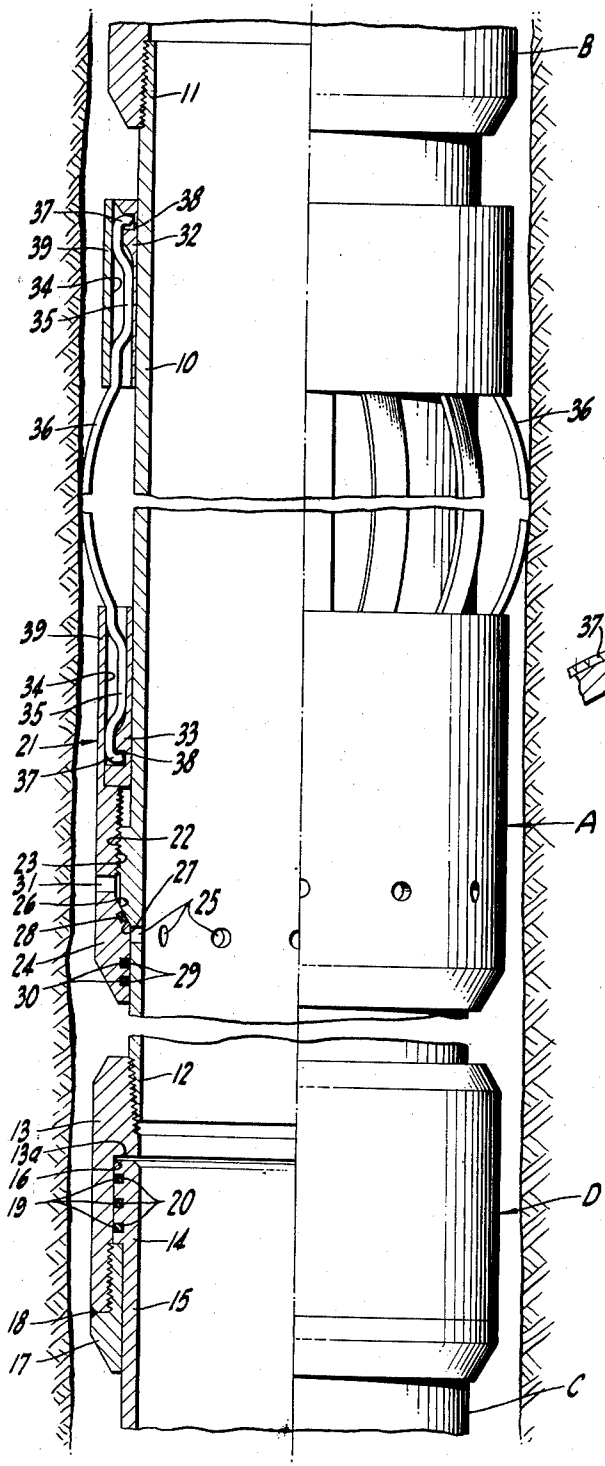


FIG. 2

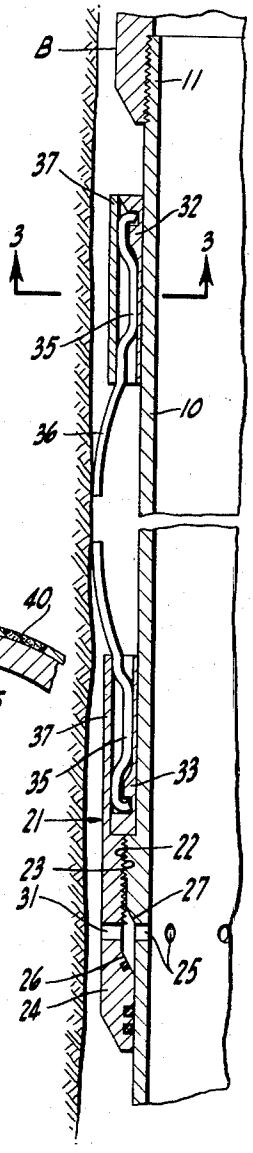
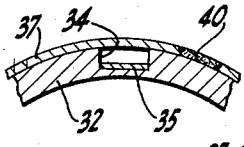


FIG. 3



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SIDE PORTED CASING APPARATUS FOR CEMENTING WELLS

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11 Claims. (Cl. 166—1)

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The present invention relates to well cementing apparatus, and more particularly to apparatus designed to form part of a casing or similar conduit string positionable in a well bore and having side ports adapted to be opened and closed by manipulation of the conduit string.

An object of the invention is to provide side ported apparatus adapted to form part of a casing string whose ports can be opened and closed simply by rotary manipulation of the casing string, without the necessity for moving the string longitudinally.

Another object of the invention is to provide side ported apparatus adapted to form part of a casing string whose ports can be opened and closed simply by rotary non-longitudinal movement of the casing string without the necessity for rotating or otherwise moving that portion of the casing string located below the apparatus.

A further object of the invention is to provide side ported well casing apparatus embodying elements for opening and closing the ports which also function to center the apparatus and casing of which it forms a part in a well bore.

This invention has other objects and aspects which will become apparent from a consideration of the embodiment shown in the drawings accompanying and forming part of the present specification. This form will now be described in detail, but it is to be understood that such detailed description is not to be taken in a limited sense, since the scope of the invention is best defined by the claims appended hereto.

Referring to the drawings:

Fig. 1 is a longitudinal view, partly in section and partly in elevation, disclosing the apparatus located in a well bore, with its side ports closed.

Fig. 2 is a partial longitudinal section similar to Fig. 1, illustrating the parts of the apparatus in their relative position, opening the side ports of the apparatus.

Fig. 3 is a cross-section taken along the line 3—3 in Fig. 2.

The apparatus exemplifying the invention in the drawings is a collar A adapted to connect upper and lower casing sections B, C of a casing string in longitudinal spaced relation. The collar proper may be connected directly to the lower casing section C or indirectly to it through the medium of a tubular swivel D.

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The collar includes a tubular body 10 whose upper pin end 11 is threaded into the upper casing section B, and whose lower pin end 12 is threaded into an outer tubular member 13 of the swivel D which also includes a head 14 on the upper end of an inner tubular member 15 positioned within an internal groove 16 defined by and between the box end 13a of the outer member 13 and a sleeve 17 mounted on the inner member and adapted to engage the lower end of the head 14. This sleeve 17 is threaded into the lower end of the outer member 13 and is prevented from unthreading from the latter by means of welding material 18 or the like.

Leakage between the inner and outer members 15, 13 is prevented by a plurality of seal rings 19, in the form of round rubber seals, engaging the interior of the outer member 13 and carried within peripheral ring grooves 20 in the inner member head 14. It is apparent that the body 10 may be rotated without correspondingly rotating the inner member 15 and lower casing string attached thereto, in view of the swivel connection D just described.

The body 10 has a sleeve 21 threaded to it by means of an external thread 22 on the body engaging an internal thread 23 on the sleeve. These threads 22, 23 are preferably righthand threads, although lefthand threads could be employed if desired. The sleeve 21 extends downwardly from the threaded connection and is provided with a lower head 24 adapted to be disposed over inner ports 25 in the body. When the sleeve is so disposed, the inner ports are closed against passage of fluids between the interior and exterior of the apparatus, leakage of fluids therethrough being prevented by engagement of a tapered surface 26 on the head 24 with a companion tapered valve seat 27 on the body 10 above the inner port 25. As a precautionary measure, an annular seal ring 28 may be mounted in the upper end of the head 24 for engagement with the tapered valve seat 27.

Leakage in a downward direction between the head 24 and body 10 is prevented by one or more suitable side seals 29 in the head slidably engaging the exterior of the body 10. Such side seals may be constituted by round rubber rings 29 carried within internal grooves 30 in the lower portion of the head.

The sleeve 21 is adapted for longitudinal movement along the body 10, upon rotation of the body in response to rotation of the casing string attached to its upper end, in order to move the sleeve between its port opening and closing positions. Friction means are secured to the sleeve 21, which are adapted to engage the wall of the well bore to resist movement of the sleeve, so that rotary movement of the body 10 and upper casing string may produce longitudinal movement in a downward direction of the sleeve to open the inner ports 25 and place circumferentially arranged outer ports 31 in the sleeve substantially in alignment therewith to permit passage of fluids through the ports 25, 31 between the interior and exterior of the apparatus.

Although any suitable device may be employed in resisting movement of the sleeve, the arrangement disclosed in the drawings consists of upper and lower collars 32, 33 rotatable on the body 10 and having circumferentially spaced longitudinally extending grooves 34 in which the ends 35 of outwardly bowed friction springs 36 are received. These ends have hook portions 37 extending into pockets 38 in each collar, the ends of the springs and their hooks being prevented from moving out of the grooves 34 and pockets 38 by a retaining sleeve 39 encompassing each collar 32, 33 and spring members 36. Each sleeve 39 may be integrated to its collar by a plurality of plug welds 40 securing them together. The retaining sleeve 39 for the lower collar 33 may be integral with and extend upwardly from the ported valve sleeve 21.

The sleeve 21 and friction spring assembly 32, 33, 36 is mounted on the body 10 with the sleeve 21 threaded upwardly along the body to its lowest extent, in which position the tapered seats 26, 27 abut on the upper side of the inner ports 25 to prevent passage of fluids through the ports in conjunction with the seals 28, 29 in the sleeve head 24. The apparatus is made up in the casing string and may include the swivel connection D below the body 10. As such, the casing string, with the apparatus included as a component part thereof, is run in the well bore to the desired location. In the event that it is desired to perform a lower cement job through the casing, circulating fluids and then cement slurry may be pumped down through the collar A, whose ports 25 are closed, for discharge from the casing string at some location below the collar, as, for example, through a casing shoe (not shown).

After the desired quantity of cement slurry has been ejected from the shoe, the collar ports 25 may be opened by rotating the casing string to the left. Since the outwardly bowed springs 36 are engaging the formation wall of the well bore, rotation of the sleeve valve 21 is resisted and left-hand rotation of the casing string and body 10 results in longitudinal feeding of the sleeve valve 21 downwardly to a position in which its tapered surface 26 is disposed below the inner ports 25 to allow fluids to pass from the interior of the body through the inner and outer ports 25, 31 to the exterior of the body. Downward movement of the sleeve 21 along the body is limited by engagement of the lower collar 33 with a shoulder 41 on the body at the upper end of its external threads 22. A second charge of cement slurry may be pumped directly into the casing string for ejection through the open ports 25, 31 and for upward passage around the collar A and casing string. Following discharge of the required amount of cement slurry, the casing string is rotated to the right, which produces upward threading of the sleeve 21 along the body 10 until the seats 26, 27 on the head 24 and body 10 reengage, which locates the head 24 across the inner ports 25 to close them against passage of fluids in both inward and outward lateral directions.

When the swivel D is employed below the body 10, rotation of the casing string above the collar A and the body can take place without rotating the casing string positioned below the collar. Such provision of the swivel prevents agitation or disturbance of the cementitious material deposited around the lower portion of the casing string. However, in the event that no cement is to be discharged from the casing string below the collar, the swivel may be omitted and the lower pin end 12 of the body threaded directly into the lower casing section C. With the apparatus arranged in the manner just described, the casing string throughout its entire length is rotated to produce downward and upward feeding of the sleeve 21 with respect to the body 10, and thereby open and close the inner ports 25.

It is, therefore, apparent that an apparatus has been provided in which longitudinal movement of the casing string is unnecessary in obtaining opening and closing of the side ports 25. Similarly, if the lower portion of the casing string is not to be rotated, the swivel D may be incorporated in the apparatus and the ports 25 opened and closed merely through rotation of the upper portion of the casing string without any movement whatsoever being imparted to the lower casing sections. It is further to be noted that the threading of the sleeve 21 on the body 10 provides a positive means precluding inadvertent longitudinal shifting of the sleeve along the body prior to intentional opening of the ports. Moreover, the drag springs 36 not only resist rotation of the valve sleeve 21, but also serve as a casing centralizer for centering the apparatus and casing string in the well bore to insure the deposition of a uniform body of cement therearound.

The arrangement described is simple and has a comparatively small outside diameter, which is very little more than the outside diameter of the usual couplings in the casing string connecting adjacent casing sections together. The internal diameter of the body 10 through the apparatus is substantially the same as, and preferably no less than, the internal diameter of the casing sections comprising the casing string. The lack of restrictions permits cementing plugs and other apparatus to be moved through the collar A with the same facility as they are moved through the casing sections themselves.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. Apparatus of the character described, including a tubular body adapted to form part of a casing string positionable in a well bore, said body having a lateral port, a sleeve threaded on said body and movable therealong to positions opening and closing said port, a casing centralizer secured to said sleeve for resisting rotation of said sleeve, said centralizer comprising outwardly bowed springs engageable with the wall of the well bore, whereby rotation of said casing string from the top of said well bore rotates said body and effects longitudinal threading movement of said sleeve along said body to selectively open or close said port, and a tubular swivel connected to the lower end of said body.

2. Apparatus of the character described, including a tubular body adapted to form part of

a casing string positionable in a well bore, said body having a lateral port and a valve seat above said port, a sleeve threaded on said body above said seat and having a head adapted to engage said seat when disposed over said port to close the same, and friction means secured to said sleeve and engageable with the wall of the well bore for resisting rotation of said sleeve, whereby rotation of said casing string from the top of said well bore rotates said body relative to said sleeve and effects longitudinal movement of said sleeve and head into or out of engagement with said valve seat to selectively open or close said port.

3. Apparatus of the character described, including a tubular body adapted to form part of a casing string positionable in a well bore, said body having a lateral port and a valve seat above said port, a sleeve threaded on said body above said seat and having a head adapted to engage said seat when disposed over said port to close the same, and a casing centralizer secured to said sleeve, said centralizer comprising outwardly bowed springs engageable with the wall of the well bore for resisting rotation of said sleeve, whereby rotation of said casing string from the top of said well bore rotates said body relative to said sleeve and effects longitudinal threading movement of said sleeve and its head into or out of engagement with said valve seat to selectively open or close said port.

4. Apparatus of the character described, including a tubular body adapted to form part of a casing string positionable in a well bore, a tubular swivel connected to the lower end of said body, said body having a lateral port, a sleeve threaded on said body and adapted to close said port, and friction means engageable with the wall of a well bore in which said apparatus is located for resisting rotation of said sleeve, whereby rotation of said casing string from the top of said well bore rotates said body and effects longitudinal movement of said sleeve along said body to selectively open or close said port.

5. Apparatus as defined in claim 3, including a tubular swivel connected to the lower end of said body.

6. Apparatus of the character described, including a tubular body adapted to form part of a casing string positionable in a well bore, said body having a lateral port and a valve seat above said port, a sleeve surrounding said body over the body port and having a head adapted to engage said seat when disposed over said port to close the same, means on said body above said port providing a threaded connection between said sleeve and body, said sleeve having fluid passage means communicable with said port when the sleeve head is spaced from said seat, and means secured to said sleeve and engageable with the wall of the well bore for resisting rotation of said sleeve, whereby rotation of said casing string from the top of said well bore rotates said body relative to said sleeve and effects longitudinal movement of said sleeve and head into and out of engagement with said valve seat to selectively open or close said body port.

7. Apparatus of the character described, including a tubular body adapted to form part of a casing string positionable in a well bore, said body having a lateral port and a valve seat above said port, a sleeve threaded on and surrounding said body over said body port and having a head adapted to engage said seat when disposed over said port to close the same, said sleeve having a

port communicable with said body port when said head is disposed below said body port, and means secured to said sleeve and engageable with the wall of the well bore for resisting rotation of said sleeve, whereby rotation of said casing string from the top of said well bore rotates said body relative to said sleeve and effects longitudinal movement of said sleeve and head into and out of engagement with said valve seat to selectively open or close said body port.

8. Apparatus of the character described, including a tubular body adapted to form part of a casing string positionable in a well bore, said body having a lateral port and a valve seat to one side of said port, a sleeve threaded on and surrounding said body over said body port and having a head adapted to engage said seat when disposed over said port to close the same, said sleeve having a port communicable with said body port when said head is disposed on the other side of said body port from said valve seat, and means secured to said sleeve and engageable with the wall of the well bore for resisting rotation of said sleeve, whereby rotation of said casing string from the top of said well bore rotates said body relative to said sleeve and effects longitudinal movement of said sleeve and head into and out of engagement with said valve seat to selectively open or close said body port.

9. Apparatus of the character described, including a tubular body adapted to form part of a casing string positionable in a well bore, said body having a lateral port and a valve seat to one side of said port, a sleeve threaded on and surrounding said body over said body port and having a head adapted to engage said seat when disposed over said port to close the same, said sleeve having a port communicable with said body port when said head is disposed on the other side of said body port from said valve seat, and a casing centralizer secured to said sleeve and engageable with the wall of the well bore for resisting rotation of said sleeve, whereby rotation of said casing string from the top of said well bore rotates said body relative to said sleeve and effects longitudinal movement of said sleeve and head into and out of engagement with said valve seat to selectively open or close said body port.

10. Apparatus of the character described, including a tubular body adapted to form part of a casing string positionable in a well bore, said body having a lateral port and a valve seat to one side of said port, a sleeve threaded on and surrounding said body on said one side of said port and surrounding said seat, said sleeve having a head adapted to engage said seat when disposed over said port to close the same, said sleeve having fluid passage means communicable with said port when the sleeve head is spaced from said seat and disposed on the other side of said port, and means secured to said sleeve and engageable with the wall of the well bore for resisting rotation of said sleeve, whereby rotation of said casing string from the top of said well bore rotates said body relative to said sleeve and effects longitudinal movement of said sleeve and head into or out of engagement with said valve seat to selectively open or close said port.

11. Apparatus of the character described, including a tubular body adapted to form part of a casing string positionable in a well bore, said body having a lateral port, a sleeve threaded on said body above said port and movable along said body to positions opening and closing said port, a tubular swivel connected to the lower end

of said body and adapted for connection to a lower casing string, and a casing centralizer secured to said sleeve for resisting rotation of said sleeve, said centralizer comprising outwardly bowed springs engageable with the wall of the well bore, whereby rotation of said casing string from the top of said wall bore rotates said body and effects longitudinal threading movement of said sleeve along said body to selectively open or close said port, without rotating the lower portion of the casing string secured to the swivel.

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