Sept. 28, 1943. G. N. ANDERSON 2,330,659

CEMENTING PLUG

Filed May 2, 1941

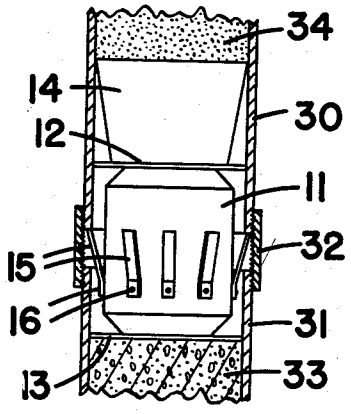


FIG. 1.

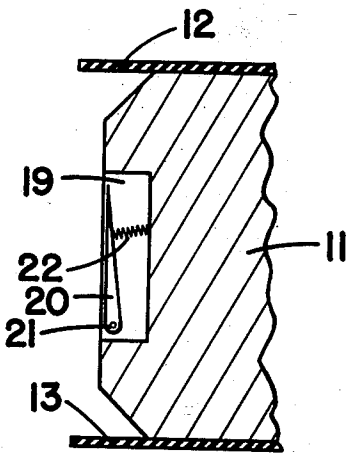


FIG. 3.

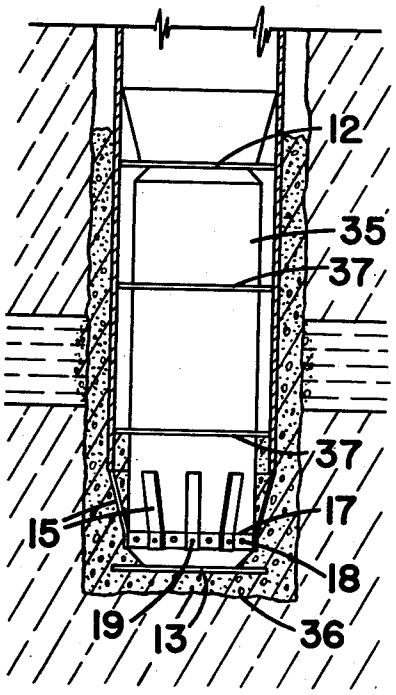


FIG. 2.

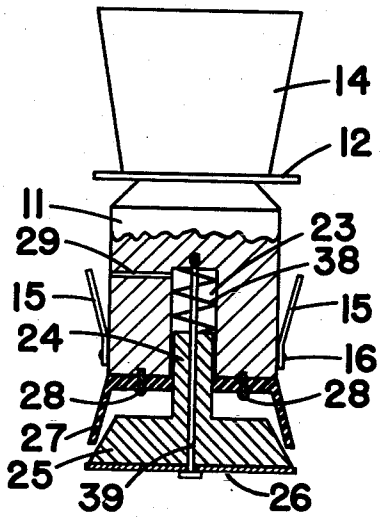


FIG. 4.

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Patented Sept. 28, 1943

2,330,659

UNITED STATES PATENT OFFICE

2,330,659

CEMENTING PLUG

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Application May 2, 1941, Serial No. 391,458

1 Claim. (Cl. 166—1)

The present invention is directed to plugs for use in conduits, particularly in cementing casing in oil wells.

It is usual in setting casing in oil wells to seal the annular space at the lower end of the casing between the casing and the earth with a cement plug. This cement plug is usually placed by forcing a predetermined amount of cement down into the bore hole until it reaches the desired position and then holding it in this position until the cement sets to form a plug. In positioning the cement, it is usual to pump the cement in the casing, then place a cementing plug in the casing at the top of the slurry, and follow the plug with drilling mud which is forced into the well under a high pressure to position the cement slurry. When the slurry has reached the desired position, the pressure is retained on the head of the well so that the slurry will remain in that position until the cement takes its set. In conventional operations it sometimes happens that the cement slurry or the cementing plug or both do not remain in position during the setting time, but instead move upwardly in the bore hole. Such an upward movement may be quite troublesome. If the cement plug floats upwardly in the hole, it will be encountered bythe gun perforator, if an attempt is made to perforate the casing after it has been cemented, and the plug must be displaced to lower the perforator to the desired position. If the cement has moved upwardly before setting, it is possible that not sufficient cement has remained at the lower end of the casing to make a fluid-tight joint between the casing and wall of the hole and, in addition, large amounts of cement may be in the casing to be later drilled out.

An object of the present invention is to devise plugs suitable for use in cementing operations, and which will remain in a desired position.

A further object of the present invention is to devise cementing plugs which will remain in position after they have been placed during the placing of the cement slurry, and, in addition, will prevent undesired upward movement of the cement slurry before its setting is completed.

Other objects and advantages of the present invention may be seen from a reading of the specification taken in conjunction with the accompanying drawing in which

Fig. 1 is an elevation of one embodiment of the present invention as it typically appears in a casing in a cementing job;

Fig. 2 is an elevation of another embodiment of the present invention in position in the lower end of a casing being cemented in place;

Fig. 3 is a fragmentary view illustrating another embodiment of holding means for the cement plug; and

Fig. 4 is a view, partly in cross section, of a further embodiment of the present invention which is provided with a valve to prevent concrete slurry bypassing the plug.

Referring specifically to the drawing and first to Fig. 1, wood plug body 11 is provided with fabric followers 12 and 13 at its upper and lower ends, respectively. In addition, rubber cap 14 is attached to the upper end of the plug to aid in keeping the cement slurry separate from the liquid used to apply pressure to the top of the plug during the cementing operation. The parts above mentioned and their arrangement is conventional in the art.

Spaced circumferentially around the body of the plug are metal fingers 15 secured to the plug by suitable means as, for example, nails 16. As appears in the drawing, the lower ends of the fingers are secured to the plug body, while the upper ends are left free and arranged to extend outwardly from the plug body so that there is a space between the upper ends of the fingers and the plug body. As appears in the drawing, the fingers are all arranged with the outwardly extending ends in the same or substantially the same plane. By such an arrangement all of the fingers catch in a casing collar to prevent the plug moving upwardly.

In Fig. 1 the plug is shown in the position it will generally assume when it is used to follow a batch of cement pumped down a string of casing. In this view joints 30 and 31 of the casing are joined by coupling 32. Cement slurry 33 precedes the plug and mud 34 follows the plug down the bore hole to force the cement in position. In using this embodiment the plug is pumped down the casing beyond the joint at which it is desired to have it positioned; thereupon, a slight release of the pressure above the plug allows the plug to move upwardly until the ends of fingers 15 extend in the space between casing joints 30 and 31 and effectively prevents further upward movement of the plug.

In the embodiment illustrated in Fig. 2 the device is provided with an elongated body 35 provided with a circumferential metal band 17 to which fingers 15 are attached by a suitable means, such as rivets 19. Band 17 fits into a recessed groove in the lower end of the body and is secured thereto by suitable attaching means, such

as nails 18. In addition to upper and lower followers 12 and 13 a plurality of followers 37 are spaced along body 35. This embodiment is particularly suitable for placing cement in the lower end or around the lower end of the casing which is being cemented adjacent the bottom 36 of a bore hole. As a typical example it is customary in constructing wells to cement a surface string of casing into the well with the lower end of the casing adjacent the lower end of the bore hole and then drill out the plug of cement and extend the hole to greater depth.

In the embodiment shown in Fig. 2 the elongated body prevents the plug from leaving the end of the casing, the dimensions of the body being such that its length is greater than the space between the lower end of the casing or casing shoe and the bottom of the bore hole. The size and proportions of the elongated body may be varied in accordance with the circumstances. It has been found in usual operations that a body length of five feet is suitable in cementing the surface casing giving a ratio of length to diameter of approximately 5:1. In placing the cement slurry with the plug following the slurry the plug will be moved downwardly until its end comes in contact with the bottom of the bore hole. A slight release in pressure will then allow the plug to return until fingers 15 catch at the end of the casing, retaining the cement at the lower end of the bore hole and reducing the amount of cement to be drilled out in extending the bore hole.

Fig. 3 is a fragmentary view showing another modification of the present invention. Plug body 11 is provided with spaced recesses 19, each recess containing a dog 20 pivotally secured to body 11 at its lower end by pin 21. Spring 22 is arranged between dog 20 and the plug body to bias the upper end of the dogs in an outward direction. In this modification the dogs serve the same purpose as the spring fingers illustrated in the preceding figures.

Fig. 4 is another embodiment of the present invention similar to that shown in Fig. 1, but provided with a suitable bypass control. In this figure, like parts are given the same numbers as corresponding parts in Fig. 1. In addition to the plug body provided with the fingers, followers and cap shown in Fig. 1, the plug is provided with means for preventing the cement bypassing the valve. The lower end of the plug is provided with a central cavity 23 having arranged therein a mandrel 24 to which is secured mandrel head 25. Secured to the mandrel head is a wiper 26 made to fit in the casing in which the plug is to be used so that there will be substantially no clearance between the casing and the wiper. Flexible cup 27 is attached to the lower end of body 11 by suitable means, such as screws 28, is preferably made with somewhat more taper than the mandrel head as appears in the drawing, and is arranged to cooperate wth mandrel head 25. Spring 38 is arranged in cavity 23 to hold the mandrel head away from cup 27 until pressure of a suitable amount is applied to the mandrel head with bolt 39 holding the mandrel in the extended position prior to the compression of the spring. Orifice 29 is provided to allow the removal of fluid from cavity 23 when the mandrel head is compressed against head 27.

In this embodiment the plug is used as conventional in the cementing art being placed above the column of cement and followed by a column of fluid, generally drilling mud. However, when the plug has reached its desired position in the well and the pressure at the top of the well is kept at a constant state to allow the cement to set, any upward movement of the cement slurry will cause the plug to move upwardly until the ends of fingers 15 reach the first joint in the casing and until they will catch in the casing and prevent upward movement. Upward pressure against wiper 26 will then be great enough to overcome spring 28 and will force mandrel head 25 against cup 27 so that it will be in contact with the wall of the casing and form a seal to prevent any upward passage of fluid. Under these circumstances the cement slurry will be held in its desired position until it takes its permanent set.

While specific embodiments of the present invention have been given, it will be obvious to the skilled worker that various changes may be made. For example, while I have shown the plugs as provided either with fingers or with dogs for holding them in position, it will be apparent that both fingers and dogs may be used in a single plug. It will also be evident that various changes in the proportions and size of the parts may be made and it is my intention to embrace such changes in the hereto appended claim.

I claim:

A cementing plug comprising a plug body adapted for longitudinal movement in a well casing, spring fingers secured to said body adapted to engage the ends of casing sections to prevent return movement of the plug in the casing, a packing disk secured to an upper portion of said plug body, a packing cup secured to the lower end of said plug body with its free end downwardly extending, a mandrel head slidingly secured to said plug body arranged to assume a lower and an upper position and to expand said packing cup when in said upper position, and means biasing said mandrel head toward said lower position.

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