This invention relates to a well cementing shoe, or to a pipe-centralizer for centralizing pipe adapted to be lowered into a well. The application is a continuation-in-part of the subject matter disclosed in my copending application Serial No. 242,337, filed August 17, 1951, which has become abandoned since the filing of this application.

Explanatory of the present invention, wells that are drilled into the earth by means of a rotary well drilling apparatus are seldom absolutely straight. Usually, in the course of drilling the well the bits tend to follow the formations of various strata that are traversed by the well bore so that in the usual well there is considerable deviation from the vertical. When it is desired to set and cement casing in the well the casing being suspended from the surface tends to hang vertically in the crooked bore hole. Consequently, it frequently occurs that at the bottom of the casing or at the point where the cement is discharged one side of the casing is very close to or may even be contacting the walls of the well bore. The cement, when discharged, will naturally follow the course of least resistance and will frequently channel up through the circulation mud in the well on one side of the casing so that an imperfect cement joint is secured.

It has been proposed to equip a casing that is to be cemented with belly springs designed to expand from all sides of the casing to engage the walls of the well. By reaction these belly springs tend to centralize the casing within the well bore. Heretofore such belly springs have been so mounted on the casing as to be fully expanded at the time they are introduced into the well. As the casing is lowered into the well these belly springs merely slide down the walls of the well bore. However, although the belly springs may not be completely worn out in the course of their sliding down the walls of the well bore, there is danger of these springs becoming broken while they are being lowered into the well. This is occasioned by the casing following the crooks or bends in the well which frequently causes the casing to twist. The twisting action set up is frequently apt to cause the belly springs to be broken so that when the casing has been lowered to the proper location the belly springs are no longer available to perform their centralizing action. Broken parts of the belly springs may also involve a fishing job.

An object of the present invention is to provide an improved cementing shoe attachable to a well casing wherein the centralizing belly springs are held in collapsed condition and in positions wherein they may be adequately protected while the casing is being lowered into the well. When the casing has been fully inserted into the well and it is desired to centralize it, a means responsive to downward fluid flow through the device is effective to bring about a release of the belly springs. The springs on expanding engage the walls of the well and are effective to centralize the casing with respect to it. In this manner, it is possible to keep the belly springs fully protected while the casing is being lowered into the well and when the casing shoe has reached the desired level the springs may then be permitted to expand by the forcing of fluid pressure down through the casing.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawing for an illustrative embodiment of the invention, wherein:

Figure 1 is a sectional view through the cementing shoe embodying the present invention, the springs being illustrated in that position wherein they are collapsed;

Fig. 2 is a similar view illustrating the springs in released or expanded position; and

Fig. 3 is a view illustrating an alternative form of construction.

Referring to the accompanying drawing wherein similar reference characters designate similar parts throughout, 10 indicates a casing adapted to be lowered into a well 11 and cemented therein. The shoe embodying the present invention consists of a tubular body 12 threaded at its upper end as indicated at 13 to enable its attachment to the casing. On the exterior of this body there are vertical grooves 14. These grooves are preferably four in number, although the number may be increased or decreased and are equally spaced circumferentially about the body 12. These grooves each receive bowed belly springs 15 which are biased to spring outwardly from the sides of the body 12. At the upper and lower ends of the grooves there may be annular grooves designed to receive the halves of split rings 16 and 17. These rings carry flanges which overlap the upper and lower ends of the belly springs 15, respectively. The halves of the split rings when applied are preferably welded in place. Each belly spring has secured to its inner side adjacent the center thereof a stem 18 that extends inwardly through an aperture 19 in the wall of the body 12. Preferably, the walls of the aperture 19 are...
recessed to accommodate an O-ring or equivalent seal indicated at 20. The inner ends of each of the stems 18 are shaped to provide T-shaped slots formed in the sides of a retainer 22.

The bottom of the body 12 is partially closed by a bullnose 23 formed of readily drillable material such as for example cast iron, cement, plastic, or the like. This bullnose has a central aperture 24 therein, the walls of which are preferably recessed to receive an O-ring or similar seal indicated at 25. A plug 26 is receivable in the aperture 24 and a rod 27 connects the plug to the retainer 22. The retainer 22, the rod 27, and the plug 26 are also preferably formed of readily drillable material such as cast iron, plastic, cement, aluminum, or the equivalent.

When the device is lowered into the well the belly springs 15 are collapsed as shown in Fig. 1, occupying positions wholly within the vertical grooves 14. In this position the stems 18 extend inwardly to the interior of the body 12 and are engaged by the retainer 22 which holds the belly springs in their collapsed positions. When the retainer 22 is in engagement with the stems 18 the plug 26 is occupying its designated position, the plug may have incorporated therein an upwardly opening, downwardly closing check valve to permit entry of fluid into the casing in the event that it is not desired to float the casing into the well. The casing is lowered into the well with the springs retained in their collapsed positions as shown in Fig. 1, and while the casing may engage the walls of the well 11 during its descent, the springs 15 are adequately protected. When the casing shoe has been lowered to the desired location fluid, such as circulation fluid, may be pumped down through the casing so that its downward flow is effective to force the plug 26 out of the aperture 24. This downward movement of the plug causes the retainer 22 to disengage and release the stem 18, allowing the springs 15 to spring outwardly and on engagement with the well walls, to centralize the casing with respect to the well. The retainer 22 is capable of passing downwardly through the aperture 24.

When the springs are fully expanded their heads 21 are intended to assume positions substantially flush with the interior of the shoe 12 so that the conventional or any preferred method of cementing may be performed without interference by the inner ends of the stems. When the cementing operation has been completed drilling operations may be resumed and the bottom of the bullnose 23 can be drilled out due to the readily drillable character of the material from which the bullnose is formed. Likewise the parts of the retainer 22, the rod 27, and the plug 26 can be readily drilled up.

In the alternative form shown in Fig. 3, the casing 29 is illustrated as being equipped with two bodies 31 and 32 in superposed relationship. These may be closely adjacent each other or spaced considerably from each other. Each of the bodies 31 and 32 are constructed substantially the same as previously described. In this form of construction the retainer 33 on the lowermost body 32 is equipped with an extension rod 34 which is equipped at its upper end with a retainer 35 that is engageable with the stems of the springs of the upper body 31. In this form of construction, when the plug in the bullnose is forced out, it serves not only to pull the retainer 33 downwardly, but also the rod 34 and the retainer 35. Consequently, the belly springs on both bodies will be simultaneously released and allowed to expand into engagement with the well walls.

While the invention has been described in terms of several preferred embodiments, the same are to be considered as exemplary rather than restrictive. Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

1. A device for centralizing pipe adapted to be lowered into a well comprising a tubular body attachable to the pipe, belly springs on the exterior of the body biased to spring outwardly to engage the well walls, stems on the belly springs extending inwardly through the walls of the body to the interior thereof, retaining means engageable with the stems to hold the springs collapsed against the exterior of the body while the same are being lowered into the well, means responsive to pressure within the body for causing said retaining means to release the stems, and sealing means on the body adapted to sealingly engage the stems.

2. A device for centralizing pipe adapted to be lowered into a well comprising a tubular body attachable to the pipe, belly springs on the exterior of the body biased to spring outwardly to engage the well walls, stems on the belly springs extending inwardly through the walls of the body to the interior thereof, retaining means engageable with the stems to hold the springs collapsed against the exterior of the body while the same are being lowered into the well, means responsive to pressure within the body for causing said retaining means to release the stems, and sealing means on the body adapted to sealingly engage the stems.

3. A device for centralizing pipe adapted to be lowered into a well comprising a tubular body attachable to the pipe, belly springs on the exterior of the body biased to spring outwardly to engage the well walls, stems on the belly springs extending inwardly through the walls of the body to the interior thereof, retaining means engageable with the stems to hold the springs collapsed against the exterior of the body while the same are being lowered into the well, and means responsive to pressure within the body for causing said retaining means to release the stems, said stems being of such a length that when the springs are expanded their inner ends assume positions flush with the interior of the body.

4. A device for centralizing pipe adapted to be lowered into a well comprising a tubular body attachable to the pipe, belly springs recessed in recesses on the exterior of the body biased to spring outwardly to engage the well walls, stems secured to the springs extending through the walls of the body to the interior thereof, retaining means engageable with the stems to hold the springs in collapsed positions against the exterior of the body, a bullnose on the lower end of the body, a plug closing the bullnose but expellable therefrom by fluid pressure, said retaining means connected to the plug whereby pressure within
5. A device for centralizing pipe adapted to be lowered into a well comprising a tubular body attachable to the pipe, belly springs recessed in recesses on the exterior of the body biased to spring outwardly to engage the well walls, stems secured to the springs extending through walls of the body to the interior thereof, retaining means engageable with the stems to hold the springs in collapsed positions against the exterior of the body, a bullnose on the lower end of the body, a plug closing the bullnose but expellable therefrom by fluid pressure, said retaining means connected to the plug whereby downward fluid flow through the body may expel the plug and cause the retaining means to release the stems, said bullnose, plug, and retaining means being formed of readily drillable material.

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