Casing Centralizer and Wall Scratcher

Filed April 26, 1954

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The present invention relates to apparatus for centering casing and similar conduits in well bores.

One object of the invention is to provide centralizers to be mounted on conduit strings positionable in well bores, and embodying outwardly bowed springs welded to centralizer collars, in which the necessity for providing very good welds is minimized by virtue of the structure of the centralizers themselves.

Another object of the invention is to provide centralizers to be mounted on conduit strings positionable in well bores, and embodying outwardly bowed springs welded to centralizer collars, in which the possibility of failure of the springs at their welded location is reduced considerably.

A further object of the invention is to provide a rugged and strong centralizer to be mounted on a casing string, and the like, which is economical to manufacture.

Still another object of the invention is to provide a casing centralizer of strong and sturdy construction which can be manufactured from more economical materials without sacrificing the ability of the centralizer to function properly in the well bore. Not only are the materials less costly, but certain components of the centralizer can be made of lighter weight materials without substantially sacrificing strength.

Yet a further object of the invention is to provide a centralizer embodying outwardly bowed springs which do not deflect inwardly against the conduit string on which the centralizer is mounted, thereby avoiding the possibility of the springs binding on the conduit string.

Another object of the invention is to provide an improved apparatus for centering a string of well casing in a well bore and for scrubbing the wall of the well bore.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a side elevation of an embodiment of the invention mounted on a casing string positionable in a well bore;

Fig. 2 is a cross-section taken along the line 2—2 on Fig. 1;

Fig. 3 is an enlarged longitudinal section through the lower portion of the centralizer shown in Fig. 1;

Fig. 4 is a cross-section taken along the line 4—4 on Fig. 3;

Fig. 5 is a side elevation of a modified form of apparatus embodying a combined centralizer and wall scrubber;

Fig. 6 is a section taken along the line 6—6 on Fig. 5;

Fig. 7 is an enlarged fragmentary section of the scrubber portion of the centralizer disclosed in Fig. 5.

As disclosed in the drawings, it is desired to maintain a string of well casing A, or similar conduit string, in a substantially centered location within a well bore B. To achieve this purpose, a casing centralizer apparatus C is mounted on the casing string. This centralizer device includes longitudinally spaced upper and lower collars or generally cylindrical members 10, 11 that are preferably slidably mounted on the casing. Circumferentially spaced, outwardly bowed springs 12 extend between and are secured to these collars, the medial portions of the springs engaging the wall of the well bore B, and by virtue of the force that they exert thereagainst tend to position and maintain the casing string A in a substantially central position within the well bore.

The upper and lower portions of the centralizer are essentially the same, although oppositely disposed. Thus, the lower collar 11 is in the form of a generally cylindrical member, which may be made from the same type of material as the collar 10 for purposes of economy in production. A relatively light gauge of sheet metal may be provided, the diameter of the main cylindrical portion of the collar being slightly greater than the outside diameter of the casing A, enabling the collar to slidably fit the casing section on which it is mounted. In order to increase the strength of the lower portion of the collar, it may be provided with an outwardly directed flange 13 at its inner or upper end and another outwardly directed flange 14 at its outer or lower end. Formed at an intermediate portion of the collar, but preferably closer to its outer flange 14 is an outwardly directed channel or boss 15. The central web 16 of this boss may be substantially cylindrical and parallel to the axis of the collar 11, whereas its outer flange or side 17 and also its inner flange or side 18 are disposed substantially at right angles to the web 16. By virtue of the channel-shaped portion of the collar 15, a circumferential groove 19 is formed therein, the web 16 being spaced outwardly with respect to the main body 20, 21 of the collar by a substantial amount, which need only be slightly greater than the thickness of an outwardly bowed leaf spring 12.

The lower ends of the circumferentially spaced springs 12 extend along the exterior of the collar 11, but their terminal portions 22 project within openings, slots or holes 23 formed in the inner channel flange 18 which are of a size sufficient to allow the springs to pass therethrough. The terminal portions 22 of the springs extend through these slots or openings 23 and into the channel 15, preferably lying flush against the inner wall of the channel web 16 and abutting the outer channel flange 17. The terminal portions of the springs are firmly secured to the web, as by welding them thereto in any suitable manner. As disclosed, the web 16 is provided with holes 24 in alignment with the slots 23 through which welding material may be deposited in the form of plug welds 25 to integrate the terminals 22 of the springs to the web. In this manner, the lower end portions of the springs 12 are attached to the lower collar 11.

The springs extend upwardly from the lower collar 11 their upper portions extending along the exterior of the upper collar 10, with the upper terminals projecting through slots or holes 23 in the inner channel flange 18, the upper terminals of the springs engaging the outer web flange 17 and being secured to the web 16 of the upper collar 10 in the same manner as the lower terminals 22 are secured to the web 16 of the lower collar 11.

As stated above, the upper and lower portions of the centralizer are alike, although oppositely disposed. The centralizer may be mounted upon a casing section, there being a suitable annular stop member 26 secured to the casing section between the collars 10, 11. Originally, the distance across the intermediate portions 27 of the casing centralizers 12 is substantially greater than the
diameter of the well bore B, so that the insertion of the casing in the well bore will cause the springs to be col-
lected inwardly and exert a reactive force on the wall of the formation, tending to locate the casing A in a
substantially centered position within the bore B. Dur-
ing the lowering of the string of well casing in the well
bore, the annular stop member 26 will engage the inner
flange 13 of the lower collar 11 and exert a pulling ac-
tion on the centralizer, forcing it downwardly in the well
bore. With the intermediate position 27 of its springs 12 sliding along the wall of the hole B. If a restric-
tion in the well bore is encountered, the annular stop ring 26 will still engage and exert a down-
ward force on the lower collar 11, causing the latter
to pull the springs 12 past the obstruction, one or more
of the springs merely being forced inwardly to a greater
extent, until the centralizer has moved beyond the ob-
struction. The downward force is transmitted from the
collar 11 through the welds 25 to the springs 12. The
welds 25, however, have sufficient strength to safely carry
the loads imposed upon them.

As the springs 12 are secured inwardly by the wall of
the formation, or by a restriction encountered therein,
their upper and lower portions will be forced against
the exterior of the collar bodies 20 below and above the
upper and lower channel sections 15, respectively. How-
ever, such forcing action will not produce any binding
effect of the centralizer C on the well casing A since
the springs 12 do not engage the casing, but only the
portions 20, 21 of the collar members 10, 11. Similarly,
as a result of the inward movement of each casing
spring, its terminal portion 22 will be urged in an out-
ward direction. This outward force is not imposed upon
the welds 25, but will be transmitted substantially en-
tirely and directly to the webs 16 of the channel sec-
tions 15. Accordingly, it is evident that substantially
the only load that the welds 25 are required to carry
is a pulling load, necessary to move the centralizer springs
12 longitudinally in the well bore B.
with comparative freedom toward the collar 10, the scratcher imparting very little, if any, scratching action upon the wall of the well bore B during lowering of the casing string A within the latter. However, upon upward movement of the casing string the stop 26 of the engagement head 25 engage the upper collar 10 to move the centralizer C in an upward direction. Such upward movement will also cause the ends of the spring fingers 48 to engage the wall of the well bore B and tend to move in a downward direction. Such downward movement is prevented by engagement of the inner portion of the spring fingers 48 with the sides 45 of the head at the lower ends of the apertures 45. Such engagement, coupled with the engagement of the bases 47 of the spring elements with the collar 10 and the upper inner surface of the bead 44, resists further downward movement. The only manner in which the springs can then be flexed downwardly will be to bend around the bead adjacent the lower ends 45 of the holes as a fulcrum. Such bending action imposes a spring resisting force on the fingers 48 and causes them to dig into the wall of the well bore B, to scratch and remove drilling mud and the like therefrom, which can then be flushed to the top of the hole.

The casing string can be run in the well bore with the desired number of centralizers C disposed thereon at predetermined points. If the scratcher arrangement disclosed in Figs. 5, 6 and 7 is used, then substantially no scratching action will occur during the lowering of the casing string to the desired depth in the well bore. When the wall of the well bore is to be scratched, the casing string A is elevated the desired distance (say 20 to 30 ft.) and then relowered, this action or reciprocation being repeated, the scratchers removing the mud cake from the wall of the well bore during upward movement of the casing string A and having, with little effect on such removal during the lowering movement of the casing string in the well bore. The casing centralizer C will maintain the casing string substantially centered in the well bore and will thereby render the well scratchers 40 most effective for removing the mud cake from the wall of the well bore around the whole circumference of the latter.

In the event the casing centralizers C are made with the hinged construction disclosed in the drawings, then the supporting member 42 for the scratcher elements will also be made in two parts, one part being mounted on each collar section 30 as disclosed in Fig. 5. The parts of the scratcher member 42 can be secured to the collar 10 in any suitable manner, as by spot welding it thereto.

The inventors claim:

1. In apparatus adapted to be mounted on well conduits: a supporting member having a generally cylindrical portion to fit on a well conduit and a laterally outwardly disposed circumferential channel-shaped portion comprising longitudinally spaced flanges separated by a web integral therewith which is substantially parallel to said cylindrical portion, one of said flanges being integral with said cylindrical portion and having circumferentially spaced openings; circumferentially spaced spring members disposed around said supporting member and having their end portions overlapping the exterior of said cylindrical portion and extending through said openings into said channel shaped portion and adjacent the other of said flanges and engaging the inner surface of said web; and means for securing said end portions to said web.

2. In apparatus adapted to be mounted on well conduits: a supporting member having a generally cylindrical portion to fit on a well conduit and a laterally outwardly disposed circumferential channel-shaped portion comprising longitudinally spaced flanges separated by a web integral therewith which is substantially parallel to said cylindrical portion, one of said flanges being integral with said cylindrical portion and having circumferentially spaced openings; circumferentially spaced spring members disposed around said supporting member and having their end portions overlapping the exterior of said cylindrical portion and extending through said openings into said channel shaped portion and adjacent the other of said flanges and engaging the inner surface of said web; and means for securing said end portions to said web.

3. In apparatus adapted to be mounted on well conduits: longitudinally spaced supporting members, each supporting member having a generally cylindrical portion to fit on a well conduit and a laterally outwardly disposed circumferential channel shaped portion comprising longitudinally spaced flanges separated by a web integral therewith which is substantially parallel to said cylindrical portion, one of said flanges being integral with said cylindrical portion and having circumferentially spaced openings; circumferentially spaced spring members disposed around said supporting members and having their end portions overlapping the exterior of said cylindrical portions and extending through said openings into said channel shaped portions and adjacent the other of said flanges and engaging the inner surfaces of said webs; and means for securing said spring members to said channel shaped portions.

4. In apparatus adapted to be mounted on well conduits: longitudinally spaced supporting members, each supporting member having a generally cylindrical portion to fit on a well conduit and a laterally outwardly disposed circumferential channel shaped portion comprising longitudinally spaced flanges separated by a web integral therewith which is substantially parallel to said cylindrical portion, one of said flanges being integral with said cylindrical portion and having circumferentially spaced openings; circumferentially spaced spring members disposed around said supporting members and having their end portions overlapping the exterior of said cylindrical portions and extending through said openings into said channel shaped portions and adjacent the other of said flanges and engaging the inner surfaces of said webs; and means for securing said end portions to said web.

5. In apparatus adapted to be mounted on well conduits: longitudinally spaced supporting members, each supporting member having a generally cylindrical portion to fit on a well conduit and a laterally outwardly disposed circumferential channel shaped portion comprising longitudinally spaced flanges separated by a web integral therewith which is substantially parallel to said cylindrical portion, one of said flanges being integral with said cylindrical portion and having circumferentially spaced openings; circumferentially spaced spring members disposed around said supporting members and having their end portions overlapping the exterior of said cylindrical portions and extending through said openings into said channel shaped portions and adjacent the other of said flanges and engaging the inner surfaces of said webs; and means for securing said centering members to said channel shaped portions.

6. In apparatus adapted to be mounted on well conduits: longitudinally spaced supporting members, each supporting member having a generally cylindrical portion to fit on a well conduit and a laterally outwardly disposed circumferential channel shaped portion comprising longitudinally spaced flanges separated by a web integral therewith which is substantially parallel to said cylindrical portion, one of said flanges being integral with said cylindrical portion and having circumferentially spaced openings; circumferentially spaced spring members disposed around said supporting members and
having their end portions overlying the exteriors of said cylindrical portions and extending through said openings into said channel shaped portions, said end portions terminating within said channel shaped portions and adja-
cent the other of said flanges and engaging the inner surfaces of said webs and being welded to said webs.

7. In apparatus adapted to be mounted on a well conduit: a supporting member having generally cylindrical portions to fit the well conduit separated by a lateral outwardly disposed circumferentially channel shaped por-
tion comprising flanges integral with said cylindrical portions and separated by a web integral with said flanges, one of said flanges having circumferentially spaced openings; circumferentially spaced spring mem-
bers having end portions overlying the exterior of one of said cylindrical portions and extending through said openings into said channel shaped portion; said end por-
tions terminating within said channel shaped portion; means for securing said spring members to said channel shaped portion; and a wall scratcher mounted on the exterior of the other of said cylindrical portions and having outwardly directed spring fingers adapted to en-
gage the wall of a well bore in which the well conduit is positioned.

8. In apparatus adapted to be mounted on a well conduit: a supporting member having generally cylindrical portions to fit a well conduit separated by a lateral outwardly disposed circumferential channel shaped por-
tion comprising flanges integral with said cylindrical portions and separated by a web integral with said flanges, one of said flanges having circumferentially spaced openings; circumferentially spaced spring mem-
bers having end portions overlying the exterior of one of said cylindrical portions and extending through said openings into said channel shaped portion; said end por-
tions terminating within said channel shaped portion; means for securing said spring members to said channel shaped portion; and a wall scratcher mounted on the other of said cylindrical portions, said wall scratcher including a supporting sleeve secured to the exterior of the other of said cylindrical portions and having a bead formed thereon provided with circumferentially spaced apertures, and scratcher elements disposed in said bead and projecting outwardly through said apertures, said elements having fingers adapted to engage the wall of a well bore in which the conduit is positioned.

9. In apparatus adapted to be mounted on a well con-
duit: a supporting member having generally cylindrical portions to fit a well conduit separated by a lateral outwardly disposed circumferential channel shaped por-
tion comprising flanges integral with said cylindrical portions and separated by a web integral with said flanges, one of said flanges having circumferentially spaced openings; circumferentially spaced spring members having end portions overlying the exterior of one of said cylindrical portions and extending through said openings into said channel shaped portion; said end por-
tions terminating within said channel shaped portion; means for securing said spring members to said channel shaped portion; and a wall scratcher mounted on the other of said cylindrical portions, said wall scratcher including a supporting sleeve secured to the exterior of the other of said cylindrical portions and having a bead formed thereon provided with circumferentially spaced apertures, and scratcher elements disposed in said bead and projecting outwardly through said apertures, said elements having fingers adapted to engage the wall of a well bore in which the conduit is positioned.

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