July 29, 1958 E. H. CLARK, JR., ET AL 2,845,128

CASING CENTRALIZER AND WALL SCRATCHER

Filed April 26, 1954 2 Sheets-Sheet 1

Fig. 1.

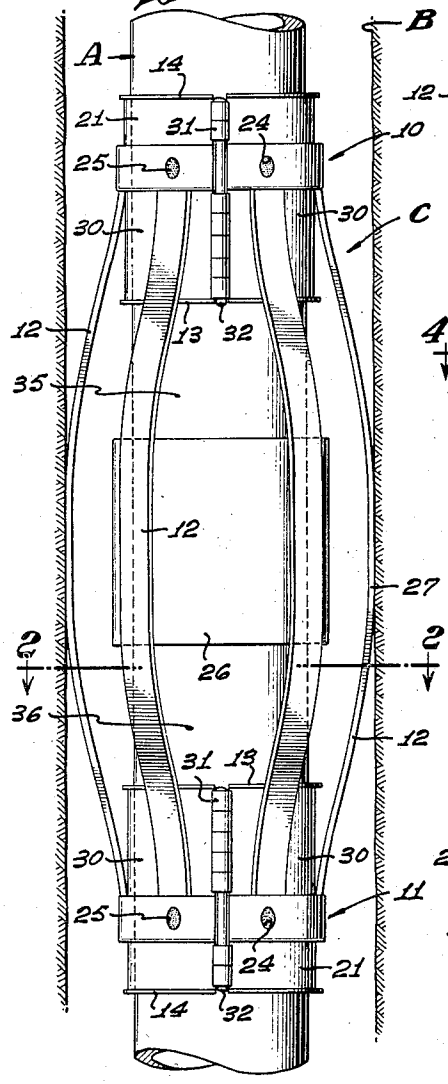


Fig. 3.

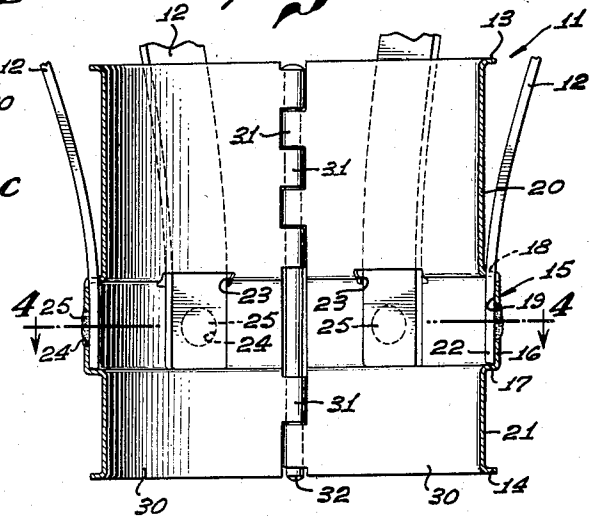


Fig. 4.

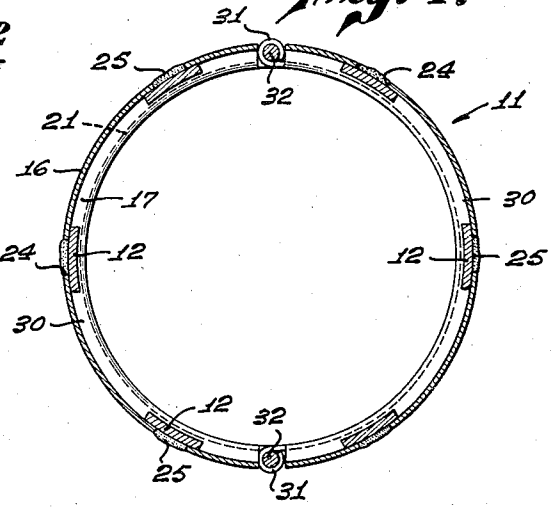
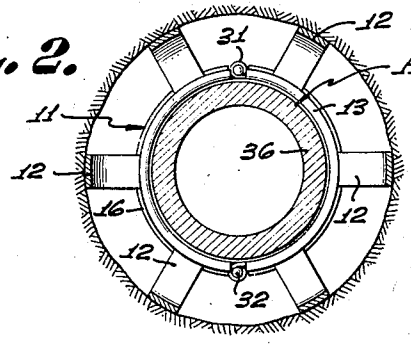


Fig. 2.



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CASING CENTRALIZER AND WALL SCRATCHER

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Fig. 5.

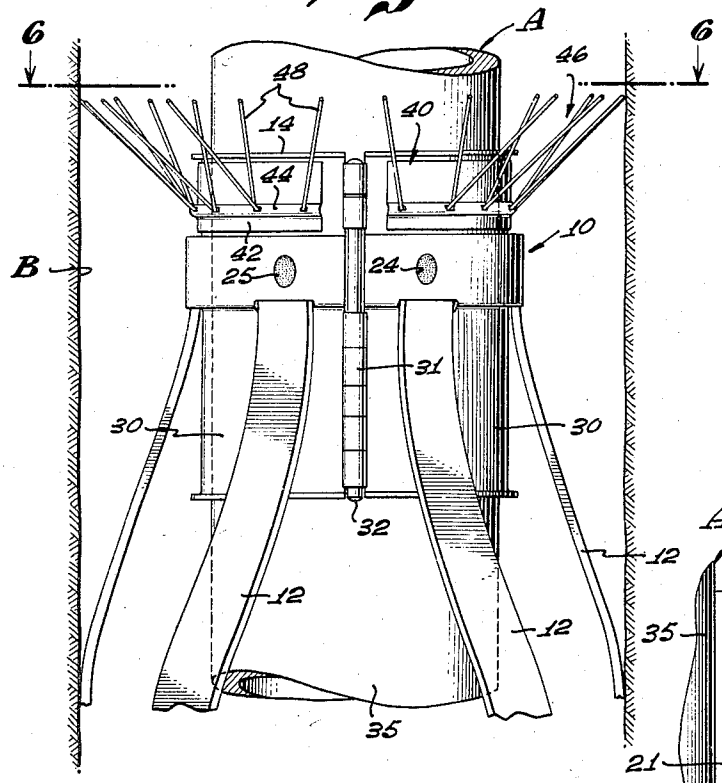


Fig. 7.

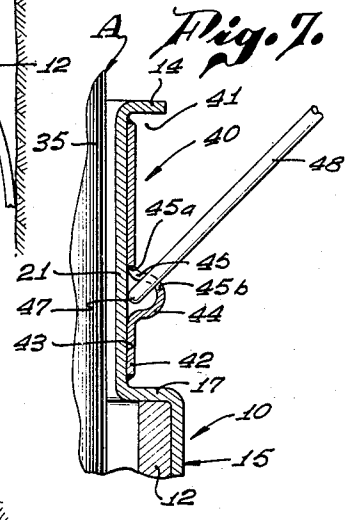
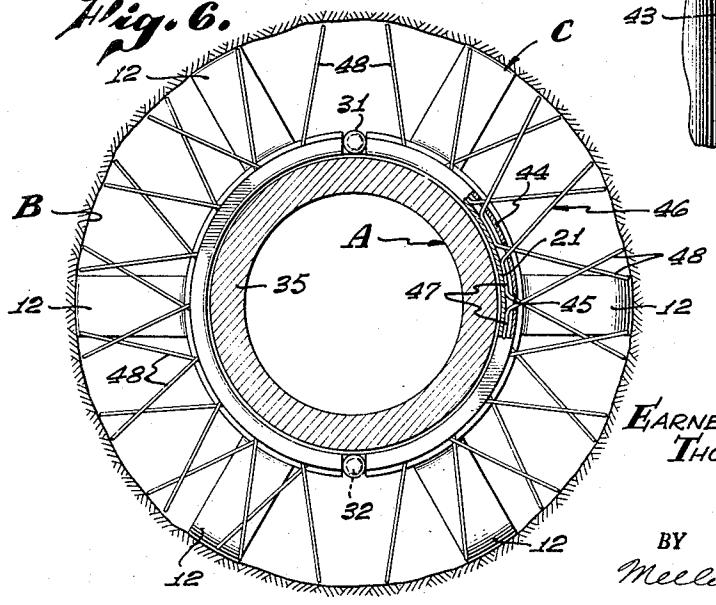


Fig. 6.



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CASING CENTRALIZER AND WALL SCRATCHER

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Application April 26, 1954, Serial No. 425,642

9 Claims. (Cl. 166—173)

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

An 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 scratching 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 scratcher;

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

Fig. 7 is an enlarged fragmentary section of the scratcher 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 sheet metal 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 and stiffness 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 bead 15. The central web 16 of this bead 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 centralizer springs 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 collapsed 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. During 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 action on the centralizer, forcing it downwardly in the well bore with the casing A, with the intermediate portions **27** of its springs **12** sliding along the wall of the hole B. If a restriction in the well bore is encountered, the annular stop ring **26** will still engage and exert a downward 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 obstruction. 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 urged 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. However, 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 outward direction. This outward force is not imposed upon the welds **25**, but will be transmitted substantially entirely and directly to the webs **16** of the channel sections **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.

Similarly, if the casing string A were to be elevated, the stop ring **26** would engage the upper collar **10**, shifting the latter in an upward direction and moving the springs **12** in an upward direction through the agency of the upper plug welds **25**, which secure the springs to the collar. Inward collapsing movement of the springs will cause their upper and lower portions to merely flatten somewhat against the exterior of the collar bodies **20**. The springs will not bind upon the well casing, since they will only contact the latter upon extreme inward deflection toward the well casing. The webs **16** will resist outward movement of the terminal portions **22** of the springs upon their inward deflection.

Since the welds **25** need not resist outward movement of the spring terminals **22**, very good and strong welds are not essential to the proper fabrication and operation of the apparatus. Since the welds are not critical, a less expensive spring steel can be used for the outwardly bowed spring members **12**. Despite the use of a more economical spring steel, the springs themselves will still possess the proper and desirable spring characteristics. It is only necessary for the steel to have good weldability characteristics. Moreover, in view of the construction described, the collars **10**, **11** can be made of lighter gauge material and still be of strong, sturdy and rugged construction. The inner and outer flanges **13**, **14** on each collar will contribute to its strength, as well as the circumferential channel section **15** between the inner and outer flanges. Here again, the lack of necessity for providing welds capable of withstanding great forces makes it possible to use a less expensive steel for the collars, as well as steel of lighter gauge.

In order to facilitate assembly of the centralizer C on the casing string A, it is preferred to make the upper and lower collars **10**, **11** in sections **30** that are hinged to one another, allowing the collar sections to be spread apart for transverse disposition around the casing string. As disclosed, each collar is made of two like halves **30**, **30** having hinge knuckles **31** at their circumferential ends which are substantially diametrically opposite one another. The hinge knuckles **31** on one collar section **30** will interleave with the hinge knuckles **31** on the other collar section **30**, after which a suitable hinge pin **32** can be inserted through all of the hinge knuckles to secure the sections **30** together. In effect, each centralizer collar is made of two main parts **30** that have the springs **12** welded thereto. The two parts **30** can be placed around the casing section A, the hinge knuckles **31** being interleaved and the hinge pins **32** on diametrically opposite sides of each collar inserted through all of the knuckles. The knuckles **31** are disposed above and below the channel section **15**, but in view of the outward extension of the channel web **16**, no knuckles will be present at the channel section itself. However, the hinge pin **32** will extend across the channel section, the hinge pin being disposed slightly outwardly of the inner surface of the collar, so as not to interfere with the ability of the latter to slide relative to the well casing A.

With the hinged arrangement disclosed, a stop ring need not be placed on a casing section by welding or otherwise. Instead, the upper and lower collars, **10**, **11** can be placed on opposite sides of a casing coupling **26**, which secures adjacent casing sections **35**, **36** together. The casing coupling will then act as the annular stop member **26** engageable with either the lower collar **11** or the upper collar **10**, to pull the centralizer in either a downward or upward direction within the well bore, depending upon the direction in which the casing string is moved.

In the form of invention disclosed in Figs. 5, 6 and 7, the casing centralizer is the same as the one described in connection with Figs. 1 to 4, inclusive. However, a wall scratcher **40** has been added to the upper casing collar **10** on the upper portion **21** of the latter between the outer flange **14** and the outer flange **17** of the channel section **15**. These two flanges **14**, **17**, in effect, form an outwardly directed circumferential groove or channel **41** in which the wall scratcher can be mounted.

The wall scratcher **40** includes an annular member **42** lying against the exterior of the base **43** of the circumferential groove **41**, this supporting member having an outwardly directed intermediate bead **44**, the upper portion of which is provided with circumferentially spaced apertures or holes **45**. A plurality of scratcher elements **46** are carried in the supporting member **42**, each scratcher element being of generally U-shape, with its base portion **47** disposed within the bead **44** and with its spring finger portions **48** extending outwardly through adjacent bead apertures **45**. The desired number of scratcher elements may be disposed around the supporting member **42**, with the fingers **48** projecting outwardly through the apertures **45**, the fingers being of sufficient length as to engage the wall of the well bore and impose a scratching or scraping action thereon. The fingers **48** of each element may diverge in an outward direction with respect to each other so as to overlap the fingers of adjacent elements **46**, as disclosed most clearly in Fig. 6. The base **47** of each scratcher element will engage the bead **44** between adjacent apertures **45** and be prevented from moving outwardly of the supporting members **42**. Its inward movement will be prevented by engagement with the base **43** of the external channel portion **41** of the collar.

It will be noted that the bead apertures **45** are disposed in the upper portion of the bead, the upper ends **45*a*** of the apertures being located adjacent the base **43** of the channel member, and the lower ends **45*b*** being disposed substantially midway of the bead **44**. Accordingly, the spring fingers **48** can fold in an upward direction

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, its stop **26** will 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 portions of the spring fingers **48** with the sides **45***b* of the bead 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***b* 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 very 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 wall 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**, in the manner 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 lateral 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 end portions overlying the exterior of said cylindrical portion and extending through said openings into said channel shaped portion, said end portions terminating within said channel shaped portion and adjacent the other of said flanges and engaging the inner surface of said web; and means for securing said spring members to said channel shaped portion.

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 lateral 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 end portions overlying the exterior of said cylindrical portion and extending through said openings into said channel shaped portion, said end portions terminating within said channel shaped portion 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.

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 lateral 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 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 lateral 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 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 lateral 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, outwardly directed centering 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 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 lateral 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 adjacent 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 circumferential channel shaped portion 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 portions 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 engage 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 portion 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 portions 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 conduit: a supporting member having generally cylindrical portions to fit a well conduit separated by a lateral outwardly disposed circumferential channel shaped portion 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 portions 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, said other of said cylindrical portions being engageable with said scratcher elements to limit movement of said scratcher elements inwardly of said supporting sleeve.

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