March 10, 1964 J. R. SOLUM 3,124,196

HELICAL BOW CENTRALIZER

Filed July 5, 1961

FIG. 1.

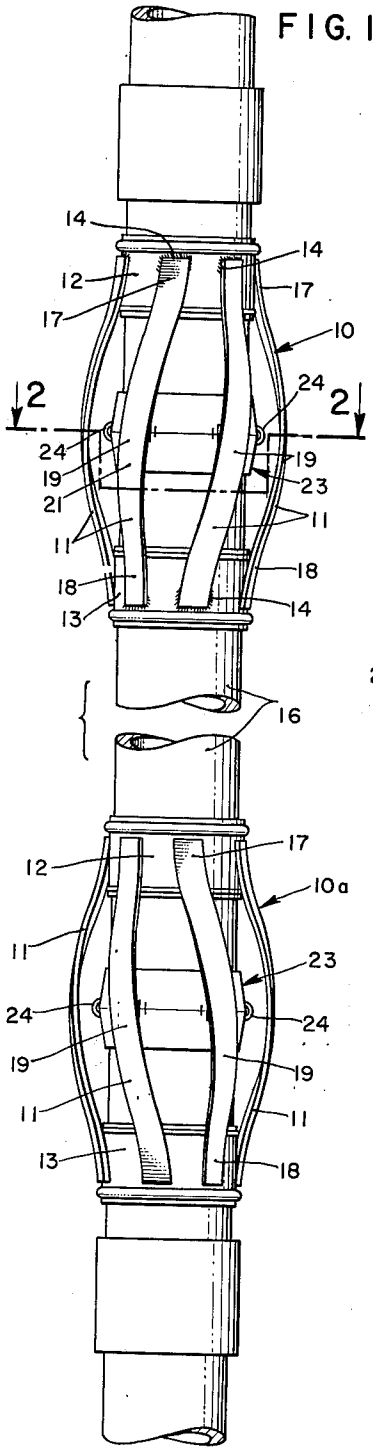


FIG. 3.

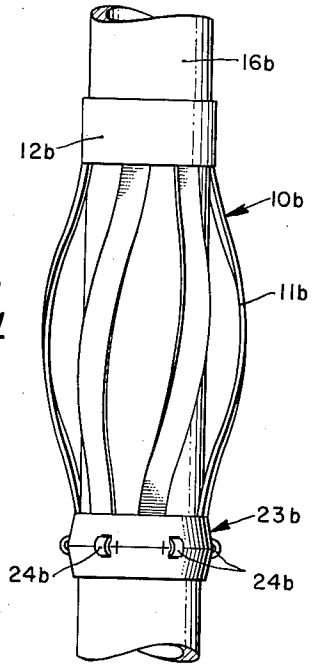
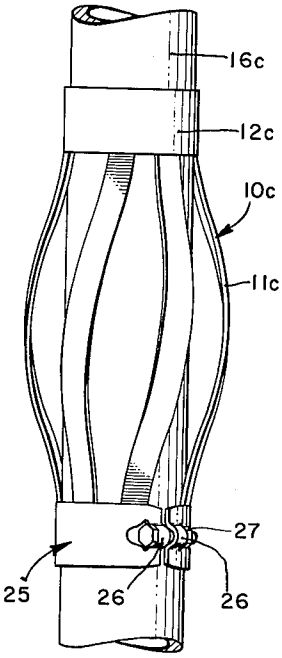


FIG. 4.



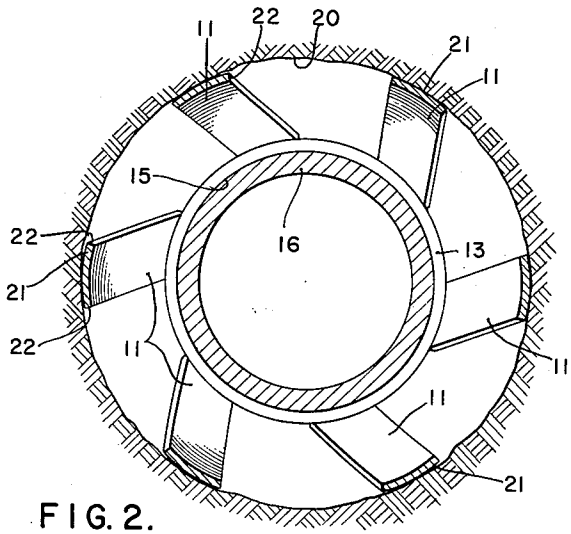


FIG. 2.

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HELICAL BOW CENTRALIZER

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This invention relates to a tool for centering a casing in a well bore and, in particular, is directed to a centralizer having the centering bows inclined at an angle to the axis of the well casing.

During the drilling and completion of a well, there are various steps which require the lowering of well casing or pipe into the well bore. In many such steps, it is advantageous to center the casing within the well bore for restraining the casing from direct contact with the walls of the well bore. One of the commonly employed tools for accomplishing this centering is a centralizer which is mounted on the casing and has a series of circumferentially spaced bows engaging the walls of the well bore to urge the casing toward the center of the well bore.

In the cementing of casing in a well bore preparatory to drilling the well bore deeper or perforating the casing for completion of the well, it is relatively common practice to mount scratchers on the exterior of the casing as well as centralizers. The scratchers serve to agitate the drilling mud and remove the filter cake on the wall of the well bore upon rotation or reciprocation of the casing as determined by the type of scratcher used. It has generally been found advantageous to remove this filter cake in order to obtain a satisfactory bond between the cement and the well bore.

Some centralizers have been constructed with their bows mounted at an angle to the axis of the well casing so that axial movement of the well casing and centralizer relative to the well bore causes a reaming of the well bore to remove the filter cake thus reducing the need for scratchers to perform this function. Such centralizers have been commonly known as "spiral centralizers." It has been found, however, that conventional spiral centralizers tend to cause rotation of the well casing as it is being lowered in the well bore due to the engagement of the inclined bows with the wall of the well bore. This rotation of the casing is objectionable in that it may cause unthreading of the casing joints and a resultant dropping of a portion of the casing.

It is therefore a principal object of this invention to provide a centralizer having its bows inclined to the axis of the casing which does not tend to rotate the casing upon lowering or raising thereof.

Another object of this invention is to provide a centralizer with inclined bows wherein the bows have an arcuate cross-section of sufficiently small radius to present a rounded surface engagement with the well bore wall thereby eliminating the interengagement between the well bore wall and the edge of a flat bow which imposes a turning force on the casing.

Another and more detailed object of this invention is to provide a spiral type centralizer wherein bows have an arcuate cross-section for their entire length, and such cross-section is symmetrical relative to the axis of the well casing for the entire length of the bow before and after mounting thereof whereby residual stresses caused by twisting of the bow to form a spiral during mounting are completely avoided.

Other and more detailed objects and advantages of this invention will appear from the following description and the accompanying drawings.

In the drawings:

FIGURE 1 is an elevation view showing the preferred

embodiments of this invention mounted on a well casing.

FIGURE 2 is a sectional plan view taken substantially on the line 2—2 of FIGURE 1, showing the apparatus positioned in a well bore.

FIGURE 3 is an elevation view showing a modified form of this invention.

FIGURE 4 is an elevation view showing a second modified form of this invention.

Referring now to the drawings, the centralizer, generally designated 10, has a plurality of bows 11 circumferentially spaced and mounted on a pair of collars 12 and 13 by any convenient means such as welding 14. The collars 12 and 13 each have an internal cylindrical surface 15 adapted to slide over the external surface of the casing or well pipe 16.

Each of the bows 11 has end portions 17 and 18 for mounting on the collars 12 and 13, respectively, and an outwardly bowed midportion 19 for engaging the well bore wall 20. The midportion 19 is bowed outwardly from the casing in an amount sufficient to cause centering of the casing 16 within the well bore. The bows 11 are of adequate thickness and strength to maintain the desired space between the casing and the well bore wall in an inclined well bore where the casing, by its own weight, tends to rest against one side of the well bore.

In order to effect a surface contact between the outer surface 21 of the bow 11 and the well bore wall 20, the bow is formed with an arcuate cross-section to thereby form a convex outer surface 21 as best shown in FIGURE 2. The radius of curvature of the bow cross-section is less than the radius of the well bore, thereby causing a space between the edges 22 of the bow and the well bore wall 20 rather than an engagement of the edges of the bow with the well bore wall if the bow cross-section were straight or of a radius greater than the radius of the well bore.

The end portions 17 and 18 of each bow are circumferentially offset from each other resulting in the length of the bow being inclined at an angle to the axis of the collars 12 and 13 and casing 16. Due to this inclined position of the bow, as the casing and centralizers are lowered into the well bore, the bows pass through the drilling fluid or mud present in the annular space between the casing and the well bore wall 20 resulting in agitation of the drilling fluid or mud, and the removal of a certain amount of drilling mud filter cake present on the wall of the well bore. This agitation and removal of filter cake has been found advantageous in many situations such as where the casing is to be cemented in the well bore.

The arcuate cross-section of the bows 11 is preferably substantially the same along the entire length and symmetrical relative to the axis of the casing 16, and since the radius of curvature of the bow cross-section is less than the radius of the well bore, the center of such radius of curvature lies on a line between the axis of the collars 12 and 13 and that bow.

While it is not essential, I prefer to install centralizers 10 and 10*a* alternately along the casing with the bows 11 of centralizers 10 and 10*a* inclined at opposite angles to the axis of the casing. In all other respects, centralizers 10 and 10*a* may be identical. As shown in FIGURE 1, the bows of centralizer 10 have their lower end 18 to the left of their upper end 17 whereas the bows of centralizer 10*a* have the lower end 18 to the right of the upper end 17. Thus, it is apparent that the bows of centralizer 10 form substantially a right-hand helix relative to the casing whereas the bows of centralizer 10*a* form a left-handed helix relative to the casing. This alternate installation of right and left hand centralizers 10 and 10*a* on the casing promotes greater agitation of the drilling

mud in the annular space between the casing and the well bore wall and, in addition, tends to balance any possible rotational forces imparted to the casing by each of the centralizers.

In order to prevent the centralizers from substantial axial movement along the casing a stop collar **23** is installed on the casing between the upper and lower collars **12** and **13** of the centralizer. This stop collar **23** may be a plain collar welded to the casing or of the type described in Patent No. 2,872,226 entitled "Stop Collar for a Well Pipe," issued February 3, 1959, wherein there are provided wedge-shaped slips **24** which may be appropriately actuated to secure the collar to the casing to prevent axial movement of the centralizer.

In the modified form of my invention shown in FIGURE 3, the bows **11***b* are butt welded to the edges of the upper collar **12***b* and a stop collar **23***b* rather than being welded on the exterior of the collars as in my preferred ambodiment. By this butt welding a very minimum annular dimension of the centralizer is obtained thereby permitting use in a well bore of only slightly greater diameter than the diameter of the centralizer collars. The lower collar **23***b* may be substantially the same as stop collar **23** as described in the heretofore referred to patent and have wedge shaped slips **24***b* which may be actuated to secure the collar **23***b* to the casing to prevent axial movement of the centralizer. The upper collar **12***b* is free to slide along the casing **16***b* as the bows **11***b* are flexed inwardly or outwardly thereby causing a change in the overall length of the centralizer **10***b*.

In the modified form of my invention shown in FIGURE 4, the centralizer **10***c* is relatively similar to the modified form **10***b* shown in FIGURE 3 in that the bows **11***c* are butt welded to the collars **12***c* and **25**, and the collar **12***c* is free to move axially along the casing **16***c*. The collar **25** may be a conventional stop collar of the type shown in U.S. Letters Patent No. 2,983,982 entitled "Friction Clamp Collar," issued May 16, 1961, which is of different design than stop collar **23** and **23***b*. The collar **25** may be a split ring with appropriate juxtaposed end terminals **26** for receiving a nut and bolt assembly **27** which may be tightened to secure the collar **25** to the casing **16***b* thereby preventing axial movement of the centralizer **10***c* along the casing.

While the modified forms shown in FIGURES 3 and 4 have been illustrated with "right-hand" bows similar to centralizer **10** in FIGURE 1, these modified forms may also be provided with "left-hand" bows as illustrated by centralizer **10***a* as shown in FIGURE 1.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth or to the details illustrated in the drawings, but my invention is of the full scope of the appended claims.

I claim:

1. In a tool for use on the exterior of a well casing in a well bore, the combination of: a pair of axially spaced and aligned collars adapted to encircle the well casing, a plurality of bows each having two ends and an outwardly bowed mid-portion, each bow having one end mounted on one of said collars and the other end mounted on the other of said collars, the said ends of each bow being circumferentially offset from each other, and at least the mid-portion of each bow having a generally arcuate lateral cross-section forming a convex outer surface.

2. In a tool for use on the exterior of a well casing in a well bore, the combination of: a pair of axially spaced and aligned collars adapted to encircle the well casing, a plurality of bows each having two ends and an outwardly bowed mid-portion, each bow having one end mounted on one of said collars and the other end mounted on the other of said collars, the said ends of each bow being circumferentially offset from each other, and at least the mid-portion of each bow having a generally arcuate lateral cross-section forming a convex outer surface with a radius of curvature less than the radius of the well bore.

3. In a tool for use on the exterior of a well casing in a well bore, the combination of: a pair of axially spaced and aligned collars adapted to encircle the well casing, means provided on one of said collars for engaging the casing to prevent axial movement of that collar along the casing, a plurality of bows each having two ends and an outwardly bowed mid-portion, each bow having one end mounted on one of said collars and the other end mounted on the other of said collars, the said ends of each bow being circumferentially offset from each other, and at least the mid-portion of each bow having a generally arcuate lateral cross-section forming a convex outer surface with a radius of curvature less than the radius of the well bore.

4. In a tool for use on the exterior of a well casing in a well bore, the combination of: a pair of axially spaced and aligned collars adapted to encircle the well casing, one of said collars having means for tightening said collar onto the exterior of the casing, a plurality of bows each having two ends and an outwardly bowed mid-portion, each bow having one end mounted on one of said collars and the other end mounted on the other of said collars, the said ends of each bow being circumferentially offset from each other, and at least the mid-portion of each bow having a generally arcuate lateral cross-section forming a convex outer surface with a radius of curvature less than the radius of the well bore.

5. In a tool for use in centering a well casing in a well bore, the combination of: a pair of axially spaced and aligned collars adapted to encircle the well casing, a plurality of bows each having two ends and an outwardly bowed mid-portion, each bow having one end mounted on one of said collars and the other end mounted on the other of said collars, the said ends of each bow being circumferentially offset from each other, each bow having a generally arcuate lateral cross-section with a radius of curvature less than the radius of the well bore, and the center of said radius of curvature positioned on a line extending between that bow and the axis of the said collars.

6. In a tool for use in centering a well casing in a well bore, the combination of: a pair of axially spaced and aligned collars adapted to encircle the well casing, a plurality of circumferentially spaced bows extending between and mounted on said collars, each of said bows having two ends and an outwardly bowed mid-portion, each bow having one end mounted on one of said collars and the other end mounted on the other of said collars, the said ends of each bow being angularly offset from each other, each bow having longitudinal edges, and each bow having a generally arcuate horizontal cross-section with a radius of curvature less than the radius of the well bore whereby the said longitudinal edges of each bow are spaced from the wall of the well bore when the bow engages such well bore wall.

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