Aug. 5, 1952 E. H. CLARK, JR. 2,605,844

CASING CENTRALIZER

Filed Oct. 30, 1950

Fig. 1.

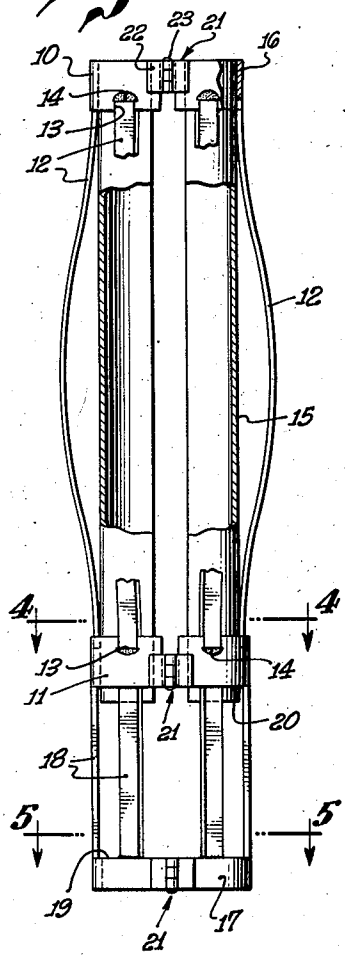


Fig. 2.

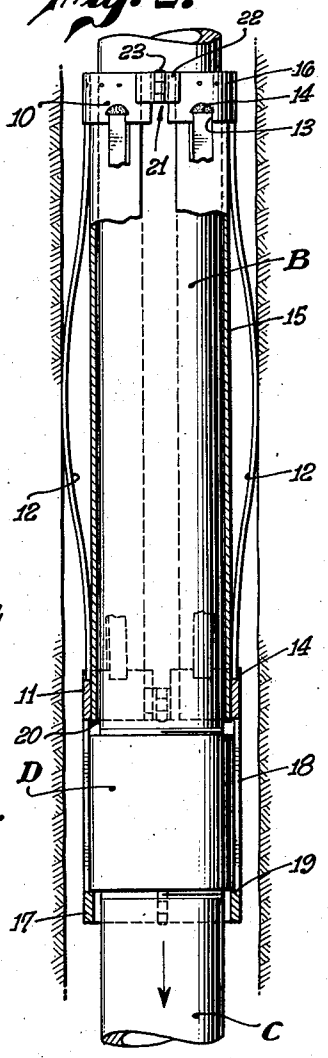


Fig. 3.

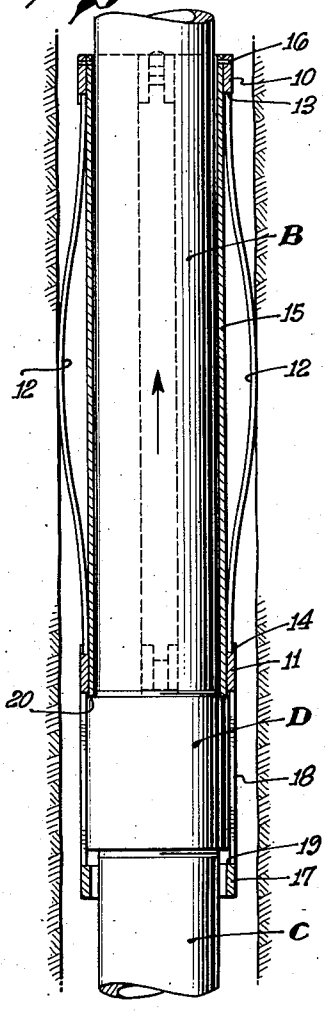


Fig. 4.

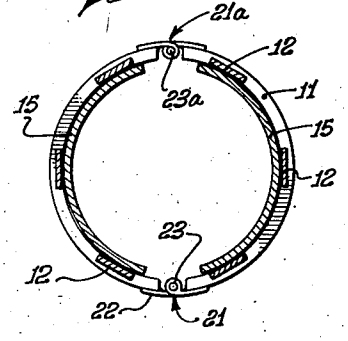
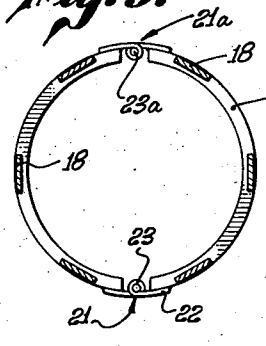


Fig. 5.



EARNEST H. CLARK, JR.,
INVENTOR.

BY

Mellin and Hanscom

ATTORNEYS

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CASING CENTRALIZER

Earnest H. Clark, Jr., Huntington Park, Calif., assignor to Baker Oil Tools, Inc., Vernon, Calif., a corporation of California

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12 Claims. (Cl. 166—4)

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The present invention relates to devices for centering casing, liner, tubing and similar conduit strings in well bores.

An object of the invention is to provide improved casing centralizers embodying bowed springs that are pulled and not pushed through restrictions in the well bore, for both longitudinal directions of movement of the centralizers through the well bore.

Another object of the invention is to provide casing centralizers that are easily mounted on a casing string.

A further object of the invention is to facilitate rotation of a casing string within a centralizer mounted thereon by precluding the bowed springs of the centralizer from binding on the casing, or parts secured to the casing.

Yet another object of the invention is to provide a casing centralizer embodying bowed springs that are prevented from bending around sharp corners or edges, such as provided by the stop device on the casing that engages and moves the centralizer through the well bore. Accordingly, breaking or permanent deformation of the springs is avoided.

Yet a further object of the invention is to provide a casing centralizer that coacts with a casing coupling or stop ring in being moved through the well bore, and in which the coupling or ring does not interfere with the inward collapsing of the centralizer springs to their fullest extent, thereby enabling the minimum effective collapsed diameter of the centralizer to be less than if an interfering coupling or ring were present.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of 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, with parts broken away, through a casing centering device;

Fig. 2 is a longitudinal sectional and elevational view of the centering device mounted on a casing string which is moving downwardly through a well bore;

Fig. 3 is a view similar to Fig. 2, in which the casing string is moving upwardly in the well bore;

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Fig. 4 is a cross-section taken along the line 4—4 on Fig. 1;

Fig. 5 is a cross-section taken along the line 5—5 on Fig. 1.

As disclosed in the drawings, the casing centering device includes longitudinally spaced upper and lower collars 10, 11 to which circumferentially spaced outwardly bowed springs 12 are attached. The collars may be provided with notches 13 in their confronting ends, into which the ends of the bowed springs 12 are received, in such manner that the outer surfaces of the end portions of the springs do not extend beyond the peripheries of the collars 10, 11. The springs are suitably fastened to the collars, as by use of welding material 14.

The upper collar 10 is mounted upon and encompasses a generally cylindrical stop sleeve 15 to which it is secured, as by the provision of circumferentially spaced spot welds 16. This sleeve extends downwardly through the lower collar 11 a slight distance below the lower end of this collar, the latter being slidable along the exterior of the sleeve. The stop sleeve 15 itself may be made of relatively thin sheet metal; so as to hold the over-all diameter of the device to a low value for a particular casing size.

The stop sleeve 15, as explained in detail below, forms a thrust member for exerting an upwardly directed force on the upper collar 10, but this sleeve does not exert any direct force upon the lower collar 11. Instead, a stop collar 17, is provided below the lower collar, being separated therefrom by a predetermined amount by circumferentially spaced interconnecting bars or straps 18 that are butt-welded to the opposed ends of the lower collar 11 and stop collar 17. The straps preferably do not extend outwardly beyond the peripheries of the lower collar and stop collar, and are thinner than the collar thicknesses themselves; so as to provide a shoulder 19 on the inner edge of the stop collar 17 against which a downward force may be exerted upon the casing centering device, as explained more in detail below. The interconnecting bars 18 serve to hold the lower collar 11 and stop collar 17 in a definite spaced relation, the bars 18 transmitting any downward force exerted on the stop collar 17 to the lower collar 11.

The centering device is mounted on a casing string, and preferably is mounted in association with upper and lower adjacent casing sections B, C that are interconnected by a suitable coupling

D. The coupling not only serves to hold the upper and lower sections B, C together, but it also functions as a stop ring, to transmit the longitudinal movement of the casing string to the centering device, exerting a pulling action on the bowed springs 12, regardless of the direction of longitudinal movement of the casing in the well bore. As disclosed, the centering device is mounted on the casing string, with the coupling D disposed between the lower stop collar 17 and the lower end 20 of the stop sleeve 15. When the casing string is moving in a downward direction (Fig. 2), the lower end of the coupling D engages the stop collar shoulder 19 and moves the collar 17 downwardly. This downward movement is transferred through the interconnecting bars 18 to the lower spring collar 11, and since the lower ends of the springs 12 are secured to this collar, the net result is that an action is exerted on the outwardly bowed springs pulling them through restrictions in the well bore, rather than pushing them through such restrictions. As is well known, a pulling action exerted on the outwardly bowed springs facilitates their passage through the restrictions and minimizes the possibility of breaking or permanently deforming such springs.

Similarly, in the event that the casing string is moved in an upward direction, the upper end of the coupling D will engage the lower end 20 of the stop sleeve 15, which extends slightly below the lower collar 11, the upward force being transmitted through this sleeve to the upper collar 10. Since the upper ends of the bowed springs 12 are secured to this latter collar, the net result is the exertion of a pulling action on the outwardly bowed springs 12 during upward movement of the casing and centering device in the well bore.

Thus, a single stop member D is secured to the casing B, C, which may be the coupling disclosed, or some other stop ring mounted on a casing section, that is effective in exerting a pulling action on the bowed springs 12, regardless of the direction of longitudinal movement of the casing in the well bore. It is to be noted that the stop member D is disposed longitudinally to one side of the bowed springs 12, and that it will, therefore, not interfere with the inward collapsing of such springs flatwise against the thrust sleeve 15 to their minimum effective diameter, as when the centering device is being pulled through comparatively small restrictions, such as might be afforded by an encompassing string of casing (not shown).

If the casing coupling D, or corresponding stop ring member, were disposed between upper and lower spring collars, the springs would be collapsed inwardly against the coupling itself. Since this coupling ordinarily has a thick wall, the springs could not be collapsed inwardly to as great an extent, as when collapsed against the relatively thin sheet metal stop sleeve 15 illustrated in the drawings. This sleeve 15 need merely be made thick enough to transmit the force between the coupling D and the upper collar 10 necessary to pull the springs 12 through restrictions in the well bore. Moreover, since the stop sleeve 15 extends completely between the upper and lower collars 10, 11, the collapse of the bowed springs 12 against them to the maximum extent precludes bending of the springs around sharp corners, and the like, such as would be afforded by the ends of the coupling, if such coupling were disposed between the upper and lower

collars. This latter bending action could be productive of permanent deformation and breaking of the springs. In the present case, there are no protuberances on the sleeve 15 against which the spring can bear.

Since the springs 12 are removed from contact with the coupling D, or corresponding stop device, they cannot be forced inwardly into binding engagement with such coupling or stop device. As a result, when it is desired to rotate the casing in the well bore, such rotation can occur without fear of dragging the centering device and its springs 12 around the wall of the well bore, which might result in damage to, or destruction of, the casing centralizer. With the arrangement disclosed, rotation of the casing string within the centralizer is facilitated, since there is a smooth bearing-like contact between casing section B and the inner wall of the stop sleeve 15. In addition, the ends of the coupling D make a smooth surface contact with either the lower stop collar 17 or the lower end 20 of the stop sleeve.

In order to facilitate mounting of the centering device on the casing string, the various collars 10, 11, 17 and stop sleeve 15 can be made sectional, as by forming each of them in two parts. Thus, the upper collar 10 and the stop sleeve 15 welded to it are each composed of two corresponding, and preferably equal, pieces, the sections of the upper collar being secured to one another by a suitable hinge 21, in which the opposed hinge plates 22 are welded to the collar sections, and in which a hinge pin 23 secures the plates together. Similarly, the lower collar 11 and stop collar 17 are each made in two equal parts, such parts being hinged together in essentially the same manner as the upper collar by hinges having their respective pivotal axes coinciding with the axis of the upper collar hinge pin 23.

On the opposite side of each collar 10, 11, 17, a similar hinge 21a may be used for securing the parts of each collar together.

In assembling the device on a casing string, the three hinge pins 23 on one side of the centralizer, if disposed within the knuckles of the hinge plates 22, are removed, which allows the centralizer to be swung open about the common axes of the remaining hinge pins on the opposite side of the centralizer. The centralizer can then be placed transversely over a casing string B, C with the casing coupling D disposed between the stop collar 17 and lower end 20 of the stop sleeve 15. The centralizer can then be swung to closed position, in which the hinges are reclosed, whereupon the hinge pins 23 may be inserted through the knuckle portions of these hinges to produce substantially circumferentially continuous collars 10, 11, 17 and stop sleeve 15, all properly assembled on the casing with the coupling D in position to engage the lower stop collar 17, when the casing string is moved downwardly, and in position to engage the lower end 20 of the stop sleeve 15 in the event the casing string is moving in an upward direction. Accordingly, a pulling action is exerted on the bowed springs 12, regardless of the direction of travel of the casing string longitudinally through the well bore.

For a particular thickness of bowed spring 12, the arrangement illustrated allows the centering device to have a lesser minimum spring collapsed diameter than if the casing coupling D were disposed within the springs and between the upper and lower spring collars 10, 11. To obtain a proper centering force of the springs upon the

casing string, the thickness of the springs should be made substantially greater than the thickness of the interconnecting bars 18, since the latter are in tension in transmitting the pull between the stop collar 17 and lower spring collar 11 and can be made comparatively thin. As a result, the minimum diameter of the device is the diameter across the interconnecting bars; whereas, the disposition of the coupling within the bowed springs 12 would result in the minimum diameter being the diameter across the springs, which are thicker than the interconnecting bars, when collapsed flatwise against the coupling. As a practical matter, the minimum effective diameter just referred to was much greater than has just been indicated, since the coupling contacted a collar, or the like, of the centering device near the ends of the springs, rather than at the central bowed portions, and precluded the springs 12 from collapsing flatwise against the collar unless the springs were broken or permanently deformed.

The inventor claims:

1. In a centering device for well conduits: an upper collar; a lower collar; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a stop collar below said lower collar; means connecting said stop collar in longitudinally spaced relation to said lower collar; and a stop member secured to said upper collar and extending downwardly into, and movable longitudinally with respect to, said lower collar.

2. In a centering device for well conduits: longitudinally spaced collars; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a first stop member disposed outwardly of one of said collars; means securing said first stop member to said one collar; and a second stop member secured to the other of said collars and extending into, and movable longitudinally with respect to, said one collar.

3. In a centering device for well conduits: an upper collar; a lower collar; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a stop collar below said lower collar; means connecting said stop collar in longitudinally spaced relation to said lower collar; and a stop sleeve secured to said upper collar and extending downwardly into, and movable longitudinally with respect to, said lower collar.

4. In a centering device for well conduits: longitudinally spaced collars; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a stop member disposed outwardly of one of said collars; means securing said stop member to said one collar; and a stop sleeve secured to the other of said collars and extending into, and movable longitudinally with respect to, said one collar.

5. In combination: a conduit having stop means thereon; longitudinally spaced collars disposed around said conduit to one side of said stop means and movable longitudinally with respect to said conduit; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a first stop member on one side of and engageable by said stop means and secured to one of said collars; and a second stop member on the other side of and engageable by said stop means and secured to the other of said collars, said second stop member extending along and being movable longitudinally with respect to said one collar.

6. In combination: a conduit having stop means thereon; longitudinally spaced collars disposed around said conduit to one side of said stop means and movable longitudinally with respect to said conduit; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a first stop member on one side of and engageable by said stop means and secured to one of said collars; and a second stop member secured to the other of said collars and extending into and movable longitudinally with respect to said one collar, said second stop member terminating on the other side of and being engageable by said stop means.

7. In combination: a conduit having stop means thereon; longitudinally spaced collars disposed around said conduit to one side of said stop means and movable longitudinally with respect to said conduit; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a first stop member on one side of and engageable by said stop means and secured to one of said collars; and a sleeve secured to the other of said collars and extending into and movable longitudinally with respect to said one collar, said sleeve terminating on the other side of and being engageable by said stop means.

8. In combination: a conduit including upper and lower sections secured together by an intervening coupling; longitudinally spaced collars disposed around said conduit to one side of said coupling and movable longitudinally with respect to said conduit; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a first stop member on one side of and engageable by said coupling and secured to one of said collars; and a sleeve secured to the other of said collars and extending into and movable longitudinally with respect to said one collar, said sleeve terminating on the other side of and being engageable by said coupling.

9. In a centering device for well conduits: a first sectional collar; a second sectional collar longitudinally spaced from said first collar; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a first sectional stop member disposed outwardly of said first collar; means securing said first stop member to said first collar; a second sectional stop member secured to said second collar and extending into, and movable longitudinally with respect to, said first collar; and detachable means securing the respective sections of said collars and stop members together to enable transverse mounting of said centering device on a well conduit.

10. In a centering device for well conduits: a first sectional collar; a second sectional collar longitudinally spaced from said first collar; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a first sectional stop member disposed outwardly of said first collar; means securing said first stop member to said first collar; a second sectional stop member secured to said second collar and extending into, and movable longitudinally with respect to, said first collar; and hinge means securing the respective sections of said collars and stop members to each other.

11. In a centering device for well conduits: longitudinally spaced collars; circumferentially

spaced outwardly bowed leaf springs disposed between and secured to said collars; a first stop member disposed outwardly of one of said collars; means securing said first stop member to said one collar; and a second stop member secured to the other of said collars and terminating adjacent said one collar, said second stop member being movable longitudinally with respect to said one collar and being in longitudinal alignment with said springs.

12. In a centering device for well conduits: longitudinally spaced collars; circumferentially spaced outwardly bowed leaf springs disposed between and secured to said collars; a stop member disposed outwardly of one of said collars; means securing said stop member to said one collar; and a stop sleeve secured to the other of said collars

and terminating adjacent said one collar, said stop sleeve being movable longitudinally with respect to said one collar.

EARNEST H. CLARK, JR.

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