June 2, 1953 R. C. BAKER 2,640,544

CASING CENTRALIZER

Filed Dec. 27, 1949

Fig. 1.

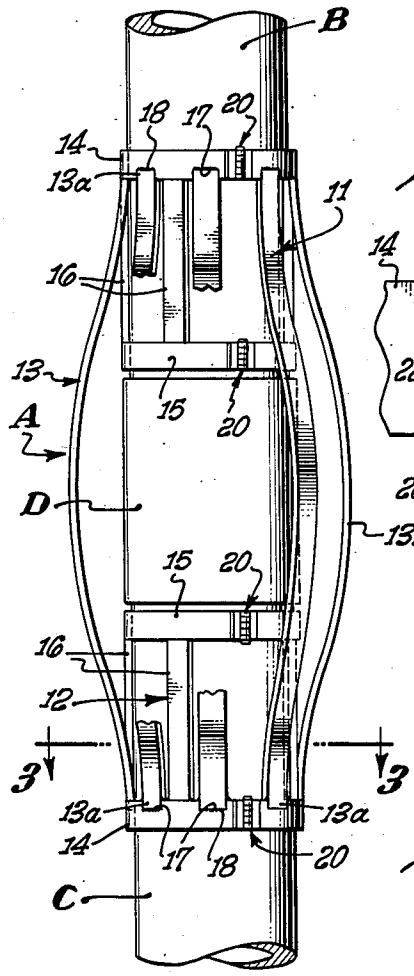


Fig. 4.

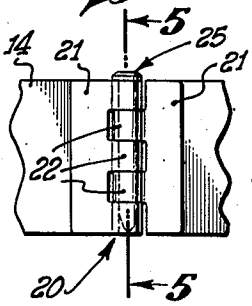


Fig. 2.

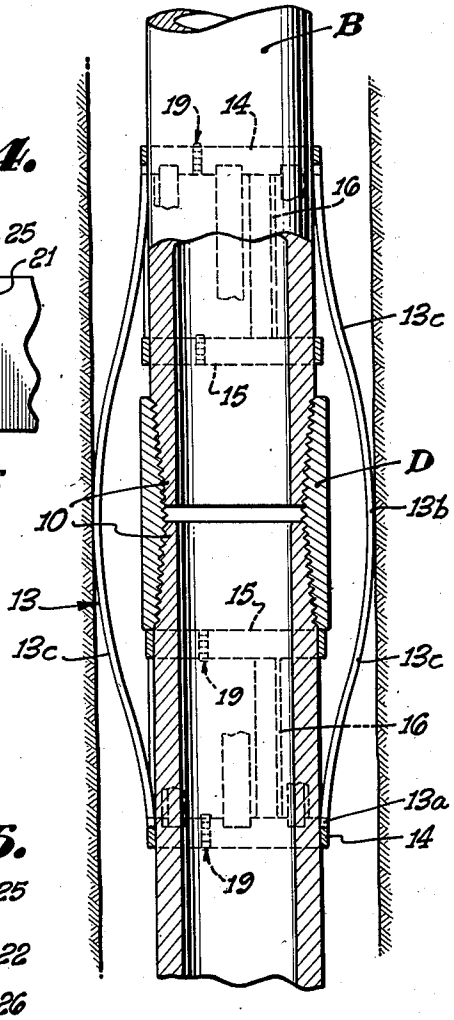


Fig. 5.

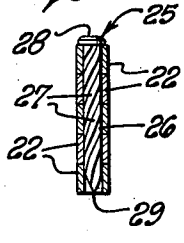
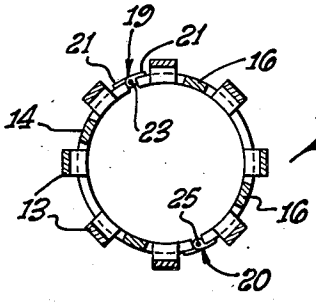


Fig. 3.



INVENTOR.

REUBEN C. BAKER,

BY

Mellin and Hanscom

ATTORNEYS

Patented June 2, 1953

2,640,544

UNITED STATES PATENT OFFICE

2,640,544

CASING CENTRALIZER

Reuben C. Baker, Coalinga, Calif., assignor to Baker Oil Tools, Inc., Los Angeles, Calif., a corporation of California

Application December 27, 1949, Serial No. 135,135

6 Claims. (Cl. 166—4)

1

The present invention relates to devices for centering casings, liners and similar well conduits in well bores.

An object of the present invention is generally to improve centering devices of the character above indicated.

Another object of the invention is to provide a casing centralizer embodying outwardly bowed springs, in which the springs are subjected to a minimum bending moment and minimum deformation under extreme loading conditions.

A further object of the invention is to provide a casing centralizer that can be mounted easily on a casing string, to which a stop member is secured for pulling the centralizer through the well bore.

Still a further object of the invention is to provide a casing centralizer that can be easily mounted on the casing string on oppsite sides of a casing coupling collar, in order that the collar can function as a stop member for pulling the centralizer through the well bore.

Another object of the invention is to provide an improved hinge type casing centralizer, in which the hinged portions can be secured together, after the centralizer has been mounted on the casing string, in a rapid and facile manner.

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, of a casing centralizer mounted on a string of casing, prior to running of the casing in the well bore;

Fig. 2 is a longitudinal elevational and sectional view, similar to Fig. 1, disclosing the casing string and centralizer in a well bore;

Fig. 3 is a cross-section taken along the line 3—3 on Fig. 1;

Fig. 4 is an enlarged fragmentary side elevation of one of the hinges forming part of the centralizer;

Fig. 5 is a longitudinal section taken along the line 5—5 on Fig. 4.

2

A casing centralizer A is illustrated in the drawings as mounted upon a casing string, which includes an upper casing section B, a lower casing section C, and an intervening coupling collar D threadedly secured to the opposed pin ends 10, 10 of the casing sections, in order to hold them rigidly together. In the specific form of the invention illustrated, the coupling collar D functions as a stop member, tending to pull the casing centralizer A through the well bore, regardless of the longitudinal direction of movement of the casing string therein.

The casing centralizer includes an upper cage assembly 11, that can be mounted on the upper casing section B above the coupling collar D, and a lower cage assembly 12, that can be mounted on the lower casing section C below the coupling collar D. These cage assemblies 11, 12 are secured to one another by intervening outwardly bowed leaf springs 13, which extend completely across the coupling collar or stop member D.

Each cage assembly 11 or 12 includes an outer spring annulus or collar 14 and an inner stop annulus or collar 15, these two collars being connected together by rigid interconnecting members or bars 16, whose inner and outer ends abut and are welded to the inside surfaces of the collars. The interconnecting bars 16 preferably do not extend laterally beyond the inner or outer surfaces of the collars 14, 15. Sufficient bars are provided, circumferentially spaced from one another, to form a comparatively rigid cage assembly 11 and 12.

The outwardly bowed springs 13 are preferably uniformly spaced around the cage members 11, 12 and have their end portions 13a secured to the spring collars 14. As an example, the ends 13a may be disposed in inner notches 17 in the collars 14, and they may be welded to the spring collars, as by the aid of welding material 18 extending across their outer ends.

For the purpose of enabling the casing centralizer A to be mounted upon an assembled casing string, which already possesses a stop member, such as the coupling collar D, each cage member is made sectional, with its spring collar 14 and stop collar 15 composed of two main or substantially semi-circular pieces. These pieces can be secured together by hinges 19, 20 to form a circumferentially continuous spring collar and stop collar. As disclosed in the drawings, at one side of the cage the two parts of the spring collar 14 are secured to one another by a hinge 19. The leaves 21 of the hinge are spot welded, or otherwise suitably secured, to the outer surface of

the collar sections, whereas the knuckle or barrel portions 22 of the hinge are interleaved with respect to one another, and are disposed between the adjacent ends of the collar sections. A suitable hinge pin 23 extends through the knuckles 22, to pivotally secure the collar sections to one another.

A similar hinge arrangement is provided on the same side of the cage for the stop collar 15. The hinge arrangements are provided on both the upper and lower cages, the hinges 19 all being in alignment with one another; so as to enable the centralizer to be swung between open and closed positions about the hinge axis of the pins 23 in mounting the centralizer on the casing string, with the upper and lower cages 11, 12 on opposite sides of the coupling collar D.

The other side of the cages 11, 12 are similarly provided with hinges 20 in alignment with one another, the hinge leaves 21 being spot welded, or otherwise suitably secured, to the exteriors of the collars 14, 15 and the knuckles or barrels 22 being disposed between the adjacent ends of the collar sections.

The hinge pins 23 at one side of the casing centralizer are in place and form the pivotal axis for swinging the casing centralizer between open and closed positions. The other hinge members 20 originally do not have a hinge pin extending through their interleaved barrel portions 22. After the centralizer has been swung to open position about the hinge axis on one side containing the hinge pins 23, and has been placed around the casing string, it can be swung to closed position with the barrels 22 of the hinges 20 interleaved with respect to one another. A pin 25 may then be inserted within the knuckles 22 of each hinge 20, for the purpose of holding the collars 14, 15 of the cages 11, 12 snugly around the casing sections B, C in slidable relation with respect thereto.

A rapid assembly can be made by constituting each of the last-mentioned hinge pins 25 as a drive screw or nail, whose shank 26 has steeply pitched, helically arranged ribs 27 that are adapted to cut grooves in the inner surfaces of the barrel portions 21 of the hinge 20. Each drive screw has a head 28 at one end of the shank and a tapered point 29 at the other end of the shank. The point of the drive screw is inserted in the outer knuckle 22 of a hinge 20, and the head 28 struck by a hammer. The tapered point 29 automatically aligns all of the knuckle members 22 with respect to each other, and the helical ridges or threads 27 cause the screw to turn slightly as the companion groove is formed in the knuckles 22. A tight fit is insured when the drive screw 25 is driven into the hinge members 21, the pin 25 remaining firmly in place during use of the centering device in the well bore.

The drive pins 25 for the spring collars 14 may be inserted through the knuckles 21 in either an upward or a downward position. However, since the length of the coupling collar D is preferably only slightly less than the distance between the stop collars 15, the drive screw or pin 25 for the lower stop collar 15 must be inserted through the knuckles 21 of the lower stop collar hinge 20 in an inverted position, inasmuch as sufficient clearance may not remain between the coupling collar D and the lower stop collar 15 to allow insertion of the drive screw through the upper end of this hinge. Regardless of the direction in which any of the drive screws are inserted through the hinge, they cut their own threads on the hinge knuckle members 22, and hold the assembly permanently in place on the casing string.

Each cage assembly 11, 12 is relatively long. As disclosed in the drawings, a cage assembly may be approximately one-third of the over-all length of the casing centralizer. Such elongate cage assembles are preferred, so as to dispose the stop collar members 15 closer to the central portions 13*b* of the leaf springs 13. They also result in the disposition of the stop or coupling collar member D opposite the central portions 13*b* of the leaf springs. This arrangement is preferred, since it provides a minimum interference with the inward collapsing of the springs to the maximum extent, and places a minimum of deformation on the springs 13 under extreme loading conditions, as when the springs are pressed inwardly to their fullest extent against the casing string.

After the casing centralizer A has been mounted on the casing string, the combination is lowered through the well bore. During this lowering movement, the coupling collar D engages the lower stop collar 15, the downward movement or force being transmitted through the rigid bars or columns 16 to the lower spring collar 14. Since the lower ends 13*a* of the springs are firmly secured to the lower spring collar 14, the springs 13 will be pulled through the well bore, and through any restrictions that might be encountered therein. When a restriction or tight place is encountered, the springs are urged inwardly toward the casing string, which shifts the upper cage 11 relatively in an upward direction away from the coupling collar D.

In a similar manner, upward movement of the casing string will cause the coupling member D to engage the upper stop collar 15, in order to exert a pulling action on the outwardly bowed spring members 13, which facilitates their passage through a well bore and through any restrictions therein that might be encountered.

By making the cages 11, 12 relatively long, the stop collars 15 are brought closer to the central portions 13*b* of the outwardly bowed spring members. As a result, the springs must be deflected inwardly, under high loading conditions, to a substantial extent before a portion of each spring (as the part 13*c*) will engage the stop collar 15. When such engagement occurs, a bending moment is placed on a spring member 13, tending to deform it. However, such bending moment is relatively small in the casing centralizer illustrated, since the placing of the stop collar 15 close to the central portion 13*b* of the spring reduces the moment arm of the inward force urging the spring toward the casing. In addition, the amount of the force tending to bend the spring 13 about the stop collar 15 is less, inasmuch as the spring is almost in its fully collapsed position before it engages the stop collar member 15.

It is also to be noted that the spring does not engage the stop member or coupling collar D itself, until the spring has been almost completely flattened against the casing string. As a result, there is very little opportunity for binding of the spring upon the stop collar, which binding might tend to prevent rotation of the casing string within the centralizer A whenever such rotation is desired. If the springs were to bind upon the stop collar, rotation of the casing string might tend to rotate the leaf springs 13 with it, with potential damage to the centralizer device.

From the foregoing description, it is apparent

that a casing centralizer has been provided that can be mounted on assembled casing sections B, C and which can utilize the casing coupling collar D as a stop member for pulling the centralizer through the well bore, regardless of the direction of longitudinal movement of the casing string. Of course, other stop collars or rings than the coupling collar D can be used, if desired, the centralizer being easily mounted on the casing section merely by first opening it about the axis of the hinges 19, and then moving it to closed position, with the cages 11, 12 on opposite sides of the stop member, whereupon the centralizer can be unitized by forcing the drive screws 25 through the knuckles 22 of the hinges 20 on the side of the centralizer opposite the permanently hinged side. The springs can be loaded to an extreme condition before they will engage the stop members or collars D, and, even when so engaged, the bending moment is comparatively small, so as to avoid permanent deformation of the springs 13, and the tendency for their breaking as a result of being bent around other members, such as the stop rings 15. In addition to the foregoing, the stop member D, which can be made of one or a plurality of parts, is held to a position substantially midway along the centralizer and is only engaged by the springs 13 when they are under extreme loading conditions. Such mid-positioning of the stop member D is assured by making the spacing between the stop collars 15 of the cages 11, 12 only slightly greater than the length of the stop member D itself.

The inventor claims:

1. In a centering device for well conduits: an upper cage assembly; a lower cage assembly; each assembly including an outer collar, an inner stop collar, and circularly spaced substantially rigid bars interconnecting said outer and inner collars; circumferentially spaced outwardly bowed leaf springs having their upper and lower ends immovably secured to the outer collars on said upper and lower cage assemblies, respectively; and stop means between the inner stop collars of said upper and lower cage assemblies; the distance between said inner stop collars being slightly greater than the length of said stop means; said stop collars being disposed adjacent the medial portions of said leaf springs and normally spaced inwardly away from said leaf springs.

2. In combination: an upper conduit section; a lower conduit section; a coupling interconnecting said sections; an upper cage assembly on said upper section above said coupling; a lower cage assembly on said lower section below said coupling; each assembly including an outer collar, an inner stop collar adjacent said coupling and circularly spaced substantially rigid bars interconnecting said outer and inner collars; circumferentially spaced outwardly bowed leaf springs having their upper and lower ends immovably secured to the outer collars of said upper and lower cage assemblies, respectively; the distance between said inner stop collars being slightly greater than the length of said coupling; said stop collars being disposed adjacent the medial portions of said leaf springs and normally spaced inwardly away from said leaf springs.

3. In a centering device for well conduits: an upper sectional cage assembly; a lower sectional cage assembly; each assembly including an outer sectional collar, an inner sectional stop collar, and circularly spaced bars interconnecting said outer and inner collars; circumferentially spaced outwardly bowed leaf springs having their upper and lower ends immovably secured to the outer collars of said upper and lower cage assemblies, respectively; a hinge securing the sections of each stop collar together at one side of the device; a hinge securing the sections of each outer collar together at said one side of the device; said hinges all being coaxial; means securing the respective sections of each stop collar and of each outer collar to each other at the opposite side of the device; stop means between the inner stop collars of said upper and lower cage assemblies; the distance between said stop collars being slightly greater than the length of said stop means; said stop collars being disposed adjacent the medial portions of said leaf springs and normally spaced inwardly away from said leaf springs.

4. In a centering device for well conduits: an upper sectional cage assembly; a lower sectional cage assembly; each assembly including an outer sectional collar, an inner sectional stop collar, and circularly spaced bars interconnecting said outer and inner collars; circumferentially spaced outwardly bowed leaf springs having their upper and lower ends immovably secured to the outer collars of said upper and lower cage assemblies, respectively; a hinge securing the sections of each stop collar together at one side of the device; a hinge securing the sections of each outer collar together at said one side of the device; said hinges all being coaxial; hinge means securing the respective sections of each stop collar and outer collar to each other at the opposite side of the device, said hinge means including hinge elements attached to the sections of each stop collar and each outer collar, and a drive screw forced through adjacent hinge elements at each collar; stop means between the inner stop collars of said upper and lower cage asemblies; said stop collars being disposed adjacent the medial portions of said leaf springs and normally spaced inwardly from said leaf springs.

5. In a centering device for well conduits: an upper sectional cage assembly; a lower sectional cage assembly; each assembly including an outer sectional collar, an inner sectional stop collar, and circularly spaced bars interconnecting said outer and inner collars; circumferentially spaced outwardly bowed leaf springs having their upper and lower ends immovably secured to the outer collars of said upper and lower cage assemblies, respectively; a hinge securing the sections of each stop collar together at one side of the device; a hinge securing the sections of each outer collar together at said one side of the device; said hinges all being substantially coaxial; means securing the respective sections of each stop collar and of each outer collar to each other at the opposite side of the device; stop means between the inner stop collars of said upper and lower cage assemblies; said stop collars being disposed adjacent the medial portions of said leaf springs and normally spaced inwardly from said leaf springs.

6. In combination: an upper conduit section; a lower conduit section; a coupling interconnecting said sections; an upper sectional cage assembly on said upper section above said coupling; a lower sectional cage assembly on said lower section below said coupling; each assembly including an outer sectional collar, an inner sectional stop collar, and circularly spaced bars interconnecting said outer and inner collars; circumferentially spaced outwardly bowed leaf springs having their upper and lower ends immovably

secured to the outer collars of said upper and lower cage assemblies, respectively; a hinge securing the sections of each stop collar together at one side of the device; a hinge securing the sections of each outer collar together at said one side of the device; said hinges all being substantially coaxial; means securing the respective sections of each stop collar and of each outer collar to each other at the opposite side of the device; the distance between said inner stop collars being slightly greater than the length of said coupling; said stop collars being disposed adjacent the medial portions of said leaf springs and normally spaced inwardly from said leaf springs.

REUBEN C. BAKER.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,125,885	Rouxel	Jan. 19, 1915
1,773,398	La Velle	Aug. 19, 1930
1,820,391	Hartman	Aug. 25, 1931
2,145,336	Boyd	Jan. 31, 1939
2,228,648	Welles	Jan. 14, 1941
2,228,649	Welles	Jan. 14, 1941
2,290,429	Hartman et al.	July 21, 1942
2,562,083	Clark, Jr.	July 24, 1951