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2,562,083

CASING CENTRALIZER

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Fig. 1.

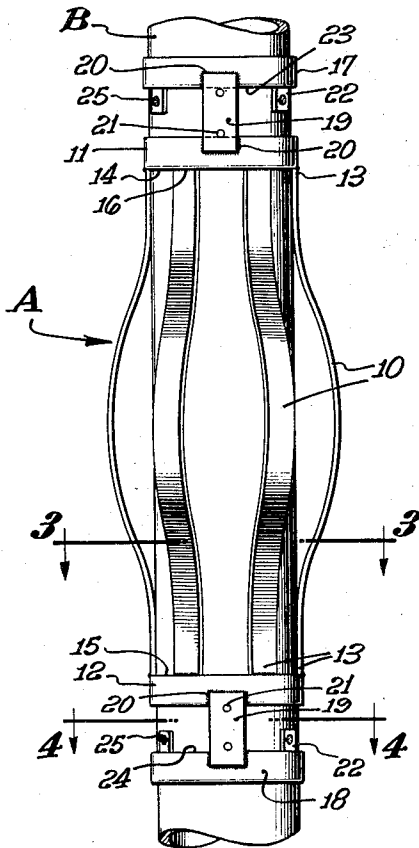


Fig. 2.

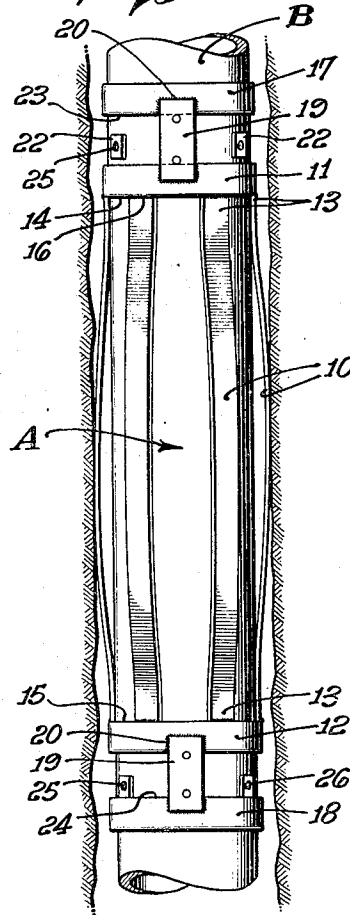


Fig. 3.

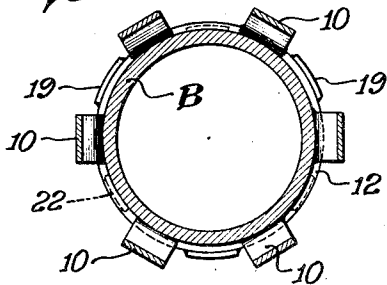
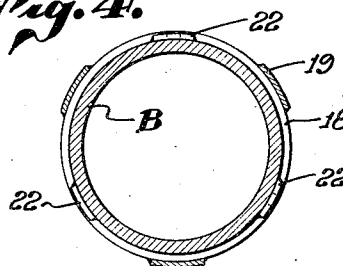


Fig. 4.



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CASING CENTRALIZER

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16 Claims. (Cl. 166—4)

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The present invention relates to centering devices, and more particularly to centralizers for centering casing, liners, and similar conduit strings in well bores.

Centralizing devices employing outwardly bowed springs are used for centering well casings, and the like, in well bores. A preferred arrangement insures the pulling, as distinguished from pushing, of the centralizer through restrictions in the well bore, regardless of the longitudinal direction of movement of the well casings, to avoid buckling of the outwardly bowed springs and their possible breaking. These preferred forms, as heretofore constituted, have inherent limitations on the size bore hole in which they can be used. They cannot be employed in so-called "slim" holes of only slightly greater diameter than the diameter of the casing on which they are mounted. In addition, prior devices have not permitted the well casing to be rotated in the well bore without rotating the centering device, unless the effective minimum diameter of the device is made so large as to prevent its use in "slim" holes.

Accordingly, it is an object of the present invention to provide a casing centering device which can be collapsed inwardly to a comparatively small effective external diameter, and which allows the casing to be rotated without rotating the centering device itself.

Another object of the invention is to provide a casing centering device embodying outwardly bowed springs capable of being collapsed inwardly to a comparatively small effective diameter and of being pulled through a well bore, the centering device allowing the casing to be rotated without rotating the device itself.

A further object of the invention is to provide a casing centralizer that can be easily assembled and placed in operative position on a casing section, or similar conduit, which has an over-all relatively small minimum effective diameter, and which allows the casing to be rotated within it.

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.

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Referring to the drawings:

Figure 1 is a side elevation of a centralizer mounted on a casing section, with the springs occupying their maximum outward position;

Fig. 2 is a view, similar to Fig. 1, of the device disposed in a well bore;

Fig. 3 is a cross-section through the centralizer, taken along line 3—3 of Fig. 1; and

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

The casing centering device A is mounted on a casing section, liner or similar conduit B adapted to be run in a bore hole C. As is well known, the purpose of centering devices is to dispose the casing B centrally of the bore hole C.

The centering device disclosed in the drawings includes a plurality of circumferentially spaced, outwardly bowed leaf springs 10, whose upper and lower ends are attached to upper and lower collars 11, 12, respectively, that are slidable upon the casing section B. The ends 13 of the springs abut the inwardly facing ends 14, 15 of the collars, to which they are butt welded. An efficient weld can be made through use of an atomic hydrogen arc, a bead 16 running along the abutting ends of the collar and each spring, which projects but little, if at all, beyond the outer adjacent surfaces of the collar and spring. The thickness of the springs 10 is approximately equal to, and is preferably no greater than, the thickness of the collars 11, 12, to hold the effective diameter across the springs to a minimum extent, when they are collapsed inwardly against the casing B by the fullest amount.

Rings 17, 18 are disposed above the upper collar 11 and below the lower collar 12, each ring being secured in spaced relation with respect to its adjacent collar by a plurality of circumferentially spaced connecting elements 19, which may be in the form of relatively short bands or straps engaging the periphery of the collar and ring, and welded thereto, as by running a bead 20 around the edges of the connecting element 19 which overlap the ring and collar.

The inside and outside diameters of the rings 17, 18 are substantially the same as the inside and outside diameters of the collars 11, 12; whereas the thickness of the connecting elements 19 may be substantially less than the thickness of the collars and rings, since these connecting elements are only subjected to a tensile pull or strain, as hereinafter described.

Longitudinally spaced holes 21 may be provided in each connecting element 19 to facilitate assembly of the centralizer parts, and welding

of the connecting elements 19 to the collars 11, 12 and the rings 17, 18, with each ring spaced from its adjacent collar by a predetermined amount. Pins (not shown) may extend through the holes 21 in the connecting straps, and the opposing ends of a collar and ring at each end of the casing centralizer placed in engagement with these pins, whereupon the straps 19 can be welded to the peripheries of the collar and ring, as indicated above, and the pins then removed.

The casing centralizer A may be placed upon a casing section B that is to form part of a casing string to be disposed in a well bore. After being placed on the casing section, circumferentially spaced stop members 22, in the form of lugs, are placed through the arcuate spaces between the connecting elements 19 into engagement with the edge of each stop ring which is opposed to its adjacent collar. That is, the stop members or lugs 22 are placed in engagement with the lower end 23 of the upper ring 17 and with the upper end 24 of the lower ring 18. These lugs are then welded to the casing section, as by depositing welding material 25 within a hole 26 in each lug 22, which integrates the latter to the casing section B.

It is to be noted that both the upper and lower sets of lugs 22 engage the stop rings 17, 18 when the outwardly bowed springs 10 are unconfined, and that there is substantial distance between each set of lugs and the adjacent collar member 11 or 12 (Fig. 1). The lugs 22 are preferably thinner than the collars 11, 12 and rings 17, 18, so that they do not project beyond the peripheries of the latter and will not engage the interconnecting strap elements 19.

When the casing centralizer has been assembled on the casing section B with the stop members 22 welded in place, as illustrated in Fig. 1, the casing section B may be connected to the other sections constituting the casing string, and the latter lowered through the well bore. During this lowering operation, the lower set of lugs 22 engages the lower ring 18 and exerts a pulling action on the interconnecting straps 19 and lower collar 12, which is transmitted to the bowed springs 10, in order to pull these springs through the well bore. Such pulling action facilitates inward collapsing of the outwardly bowed springs 10 to a minimum effective diameter. During such inward collapsing, the upper collar 11, ring 17 and straps 19 are shifted upwardly along the casing (Fig. 2). However, such upward shifting can occur without interference from the upper stop lugs 22 welded to the casing section, since sufficient space is allowed between these members 22 and the upper collar 11 when the centering device is assembled on the casing section, as is evident from Fig. 1.

Similarly, upward movement of the casing string B causes the upper set of stop members 22 to engage the upper ring 17, to exert the pulling action on the straps 19 and outwardly bowed springs 10, in order to facilitate their passage through restrictions in the well bore, without buckling and breaking. During such upward movement, the lower collar 12 may shift toward the lower set of stop members 22 without interference, in view of the initial space allowed therebetween.

The minimum diameter of well bore C through which the casing centralizer A can pass is determined by the extent that the interconnecting strap elements 19 project beyond the periph-

eries of the collars 11, 12 and rings 17, 18. Since these straps have only a tensile load imposed upon them, they can be made of comparatively thin metal. Their thickness is much less than the thickness of the collars and rings themselves. Accordingly, the minimum effective diameter of the casing centralizer is but very little more than the external diameter of the collars and rings themselves.

There are no elements disposed within the outwardly bowed springs 10 which will deter or interfere with their complete collapsing against the casing section. Accordingly, the centering device can be run in well bores, such as "slim" holes, that have only a slightly greater diameter than the full collapsed diameter across the outwardly bowed springs.

It is also to be noted that the arrangement allows the casing string B to be rotated within the casing centralizer A, and without rotating the latter. This latter action, if it occurred, would drag the springs 10 around the wall of the well bore, scraping drilling mud and formation material from the latter, and also possibly damaging the springs. There are no elements in the present casing centralizer interfering with rotation of the casing section within the centering device. The stop members 22 can slide freely along the stop rings 17, 18 and collars 11, 12, and since they do not project beyond the periphery of the stop rings and collars, they can pass freely under the interconnecting strap elements 19.

It is, accordingly, apparent that a simple and inexpensive casing centralizer has been provided, capable of use in "slim" holes, and in which the outwardly bowed springs 10 are pulled through the well bore upon longitudinal movement of the casing string through the well bore in both directions. In addition, the casing string can be rotated without rotating the casing centralizer.

The inventor claims:

1. A centering device; including a pair of longitudinally spaced generally cylindrical members; circumferentially spaced outwardly bowed springs having their end portions fastened to said members; a ring spaced longitudinally outwardly from each member; means securing each ring and member together in spaced relation; and stop means disposed between each ring and its adjacent member and engageable with the inner end of said ring to exert a pulling action on said springs.

2. A centering device; including a generally cylindrical member; circumferentially spaced outwardly bowed springs having their end portions fastened to said member, said springs extending from said member in one longitudinal direction; a ring secured to said member and spaced longitudinally therefrom in a direction opposite from the direction in which said springs extend from said member; means securing said ring and member together in spaced relation; and stop means disposed between said member and ring and engageable with the inner end of said ring to exert a pulling action on said springs.

3. A centering device; including a pair of longitudinally spaced generally cylindrical members; circumferentially spaced outwardly bowed springs having their end portions fastened to said members; a ring spaced longitudinally outwardly from each member; means secured to the exteriors of each ring and member for securing said ring and member together in spaced relation; and stop means disposed between each ring and its adjacent member and engageable with the inner end

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of said ring to exert a pulling action on said springs.

4. A centering device; including a generally cylindrical member; circumferentially spaced outwardly bowed springs having their end portions fastened to said member, said springs extending from said member in one longitudinal direction; a ring spaced longitudinally from said member in the direction opposite to the direction in which said springs extend from said members; means secured to the exteriors of said ring and member for securing them together in spaced relation; and stop means disposed between said member and ring and engageable with the inner end of said ring to exert a pulling action on said springs.

5. A centering device as defined in claim 3; in which said stop means do not extend beyond the peripheries of said members and rings.

6. A centering device as defined in claim 4; in which said stop means does not extend beyond the peripheries of said member and ring.

7. A centering device; including a pair of longitudinally spaced generally cylindrical members; circumferentially spaced outwardly bowed springs fastened to said members; a ring spaced longitudinally outwardly from each member; circumferentially spaced straps engaging the exteriors of each member and its associated ring and secured to said member and ring; and stop means disposed between each ring and its adjacent member and engageable with the inner end of said ring to exert a pulling action on said springs; said stop means extending outwardly no further than the peripheries of said members and rings.

8. A centering device; including upper and lower spaced generally cylindrical members; circumferentially spaced outwardly bowed springs disposed between said members with their upper and lower end portions substantially abutting and secured to the inner portions of said upper and lower members, respectively; an upper ring disposed in spaced relation above said upper member; a lower ring disposed in spaced relation below said lower member; circumferentially spaced straps welded to the exteriors of said upper member and upper ring; circumferentially spaced straps welded to the exteriors of said lower member and lower ring; stop means disposed between said upper member and upper ring and engageable with the inner edge of said upper ring; and stop means disposed between said lower member and lower ring and engageable with the inner edge of said lower ring.

9. In combination with a casing; upper and lower longitudinally spaced generally cylindrical members slidable on said casing; circumferentially spaced outwardly bowed springs disposed between said members with their upper and lower end portions substantially abutting and secured to the inner portions of said upper and lower members, respectively; an upper ring slidable on said casing and disposed in spaced relation with and above said upper member; a lower ring slidable on said casing and disposed in spaced relation with and below said lower member; circumferentially spaced straps welded to the exteriors of said upper member and upper ring; circumferentially spaced straps welded to the exteriors of said lower member and lower ring; stop means secured to said casing between said upper member and upper ring and engageable with the lower edge of said upper ring; and stop means secured to said casing between said lower member and lower ring and engageable with the upper edge of said lower ring.

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10. A centering device; including a generally cylindrical member; circumferentially spaced outwardly bowed springs having their end portions fastened to said member, said springs extending from said member in one longitudinal direction; a ring spaced longitudinally from said member in the direction opposite to the direction in which said springs extend from said member; circumferentially spaced straps engaging the exteriors of and secured to said member and ring for securing them together in spaced relation; and stop means disposed between said member and ring and engageable with the inner end of said ring to exert a pulling action on said springs, said stop means extending outwardly no further than the peripheries of said member and ring so as to avoid engagement with said straps.

11. A centering device; including a generally cylindrical member; circumferentially spaced outwardly bowed springs having their end portions fastened to said member, said springs extending from said member in one longitudinal direction; a ring spaced longitudinally from said member in the direction opposite to the direction in which said springs extend from said member; circumferentially spaced straps out of alignment with said springs, said straps engaging the exteriors of and secured to said member and ring for securing them together in spaced relation; and stop means disposed between said member and ring and engageable with the inner end of said ring to exert a pulling action on said springs, said stop means extending outwardly no further than the peripheries of said member and ring so as to avoid engagement with said straps.

12. A centering device; including a generally cylindrical member; circumferentially spaced outwardly bowed springs having their end portions fastened to said member, said springs extending from said member in one longitudinal direction, the end portions of said springs extending laterally outward no further than the periphery of said member; a ring spaced longitudinally from said member in the direction opposite to the direction in which said springs extend from said member; means secured to the exteriors of said ring and member for securing them together in spaced relation; and stop means disposed between said member and ring and engageable with the inner end of said ring to exert a pulling action on said springs.

13. A centering device; including a generally cylindrical member; circumferentially spaced outwardly bowed springs having their end portions fastened to said member, said springs extending from said member in one longitudinal direction, the end portions of said springs extending laterally outward no further than the periphery of said member; a ring spaced longitudinally from said member in the direction opposite to the direction in which said springs extend from said member; circumferentially spaced straps out of alignment with said springs, said straps engaging the exteriors of and secured to said member and ring for securing them together in spaced relation; and stop means disposed between said member and ring and engageable with the inner end of said ring to exert a pulling action on said springs, said stop means extending outwardly no further than the peripheries of said member and ring so as to avoid engagement with said straps.

14. A centering device; including a pair of longitudinally spaced generally cylindrical members; circumferentially spaced outwardly bowed springs having their end portions fastened to

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said members; a ring spaced longitudinally outwardly from each member; circumferentially spaced straps out of alignment with said springs, said straps engaging the exteriors of each member and its associated ring and secured to said member and ring; and stop means disposed between each ring and its adjacent member and engageable with the inner end of said ring to exert a pulling action on said springs; said stop means extending outwardly no further than the peripheries of said members and rings.

15. A centering device: including a pair of longitudinally spaced generally cylindrical members; circumferentially spaced outwardly bowed springs having their end portions fastened to said members, said end portions extending laterally outward no further than the peripheries of said members; circumferentially spaced straps engaging the exteriors of each member and its associated ring and secured to said member and ring; and stop means disposed between each ring and its adjacent member and engageable with the inner end of said ring to exert a pulling action on said springs; said stop means extending outwardly no further than the peripheries of said members and rings.

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16. A centering device: including a pair of longitudinally spaced generally cylindrical members; circumferentially spaced outwardly bowed spring having their end portions fastened to said members, said end portions extending laterally outward no further than the peripheries of said members; circumferentially spaced straps out of alignment with said springs, said straps engaging the exteriors of each member and its associated ring and secured to said member and ring; and stop means disposed between each ring and its adjacent member and engageable with the inner end of said ring to exert a pulling action on said springs; said stop means extending outwardly no further than the peripheries of said members and rings.

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