

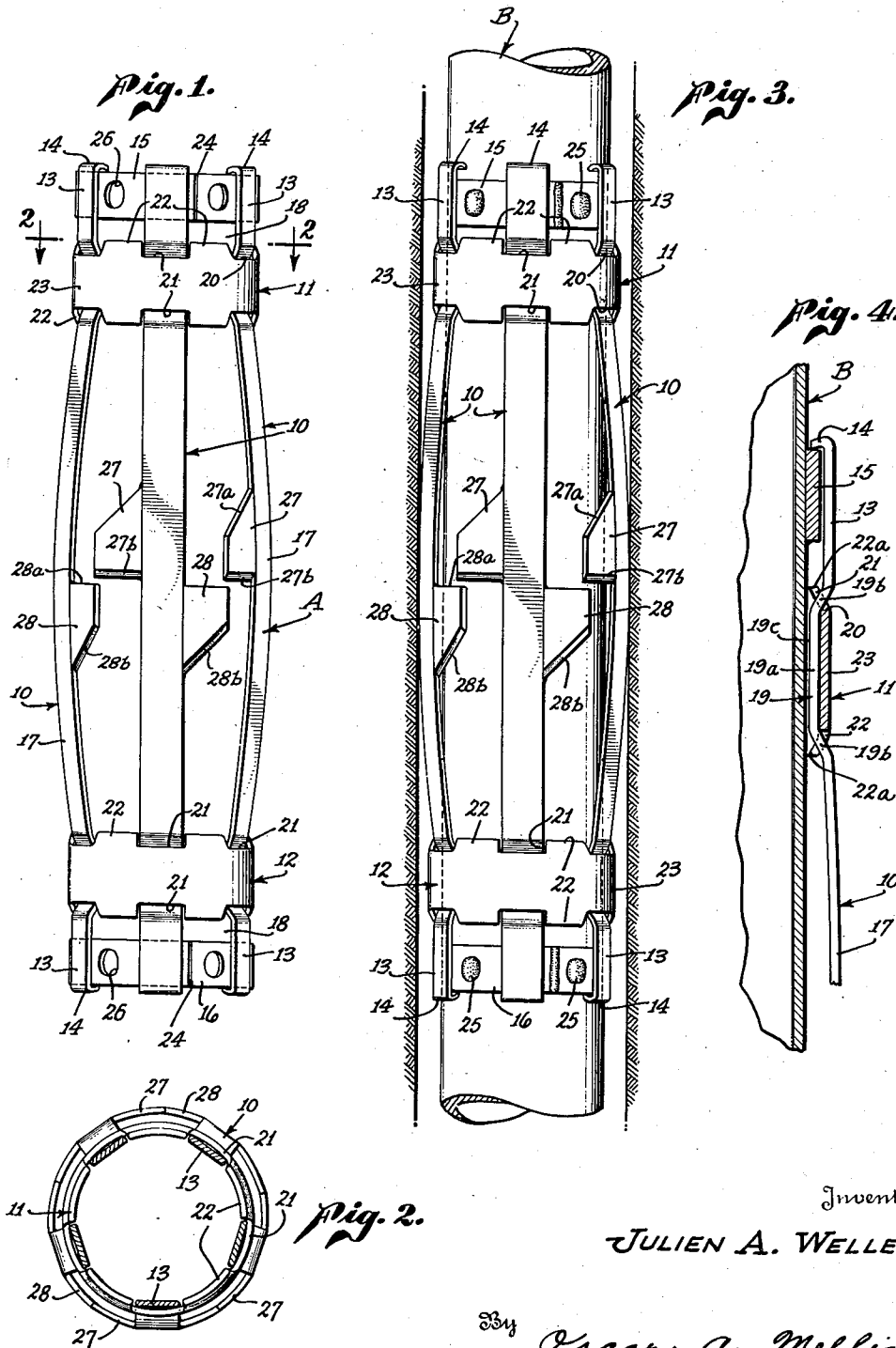
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CASING CENTRALIZER

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CASING CENTRALIZER

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18 Claims. (Cl. 166—4)

This invention relates to casing centralizers, being particularly concerned with centralizers of the spring type, which tend to maintain the casing centered in the bore hole. Such centering is desirable and important to insure that a uniform thickness of cement will be deposited around the casing for the purpose of providing an effective cementitious seal against the passage of encroaching waters on other fluids into the well or casing.

In my application Serial No. 296,099, filed September 22, 1939, for "Casing centralizers," a centralizer has been described and claimed embodying leaf springs yieldably engageable with the sides of the casing or hole. These springs are pulled and not pushed through any restrictions or obstructions as the casing is raised or lowered in the hole, to prevent their buckling or collapsing. The leaf springs are shown in the application as arranged circumferentially around the casing by being welded to axially spaced collars. Such mode of securing the springs decreases their spring properties in the region of the welds, with attendant limitations on their loading capacity. Moreover, the labor time consumed in welding the springs to the collars is a large item of expense in the cost of production of the centralizers.

Accordingly, it is an object of the present invention to provide a centralizer of the leaf spring type in which the springs can be arranged circumferentially around axially spaced collars and secured thereto without resort to any additional holding means, as welding material. More specifically, this invention contemplates forming the collars and springs so that they interlock when assembled together and retain such interlocking relationship while in operation within a well bore or casing.

As aforementioned, centralizing of the casing is important to obtain a circumferentially uniform cementitious seal around the casing, and thus prevent migration of waters past this seal. Although casing centralization is important, it has been found that in many instances the mud cake on the wall of the bore hole breaks down to form a channel around the cement seal through which migrant waters can flow. Removal of the mud cake in the region at which cement is to be deposited prevents such channeling by allowing the cementitious material to bond firmly with the formation itself, rather than coating with the fine, low strength, and easily broken down mud cake.

It is another object of the invention to provide a device which not only serves to center the cas-

ing in the hole, but which also embodies mechanical means for scraping the mud cake or sheath from the wall of the bore hole. The scraping members are preferably designed to slide over the mud cake when moved downwardly in the bore and to remove the mud cake by a scraping action when moved upwardly in the hole.

The invention has other objects that will become apparent from a consideration of the embodiment shown in the drawing accompanying and forming part of the present specification. This form will now be described in detail, but it is to be understood that such detailed description is not to be taken in a limited sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawing:

Figure 1 is a side elevational view of a centralizer prior to its assembly on a casing;

Figure 2 is a cross-sectional view taken generally along the line 2—2 of Figure 1;

Figure 3 is a view similar to Figure 1, showing the centralizer assembled on a casing within a bore hole; and

Figure 4 is a longitudinal section on an enlarged scale through part of the centralizer and casing shown in Figure 3.

As shown in the drawing, and as described and claimed in my above-identified application, the centralizer A includes a plurality of outwardly bowed leaf springs 10 secured to and spaced circumferentially around a pair of axially separated collars 11, 12. The ends 13 of each spring extend beyond the collars and terminate in inwardly bent stop portions 14 adapted to cooperate with stop rings 15, 16 attached to the casing B. When assembled on the casing and with the springs under no-load, the rings 15, 16 are spaced outwardly from the collars and abut the stops 14 on the end of the springs. In moving in either direction within a well bore, the leading stop ring 15 or 16 engages the spring stops or abutments 14 to pull the springs 10 through any restrictions in a well bore or casing, the bowed portions 17 of the springs moving radially inwardly toward the casing and shifting the trailing collar 11 or 12 toward the trailing stop ring. The spaces 18 initially allowed between the collars 11, 12 and stop rings 15, 16 should preferably be sufficient to allow the bowed spring portions 17 to be flattened into contact with the casing B without engagement occurring between the collars and rings.

Heretofore, the outwardly bowed leaf springs 10 have been rigidly welded to the collars 11, 12 in order to maintain their assembled relationship.

The welds decrease the resilient properties of the springs, limiting their load carrying capacity, and the deflection to which they can be subjected before failure occurs. By means of the present invention, the springs are secured to the collars, performing their same functions as before without resort to welding or impairing their physical properties.

In furtherance of this end, each spring is formed with an outwardly bowed intermediate section 17 and with an inwardly directed offset 19 formed adjacent each collar 11, 12. The medial portion 19a of each offset is generally straight in longitudinal section so that its inner and outer surfaces are generally parallel to the surface of the casing B on which the centralizer is mounted and to the inner surface of the collar to which the leaf spring is attached. The ends of each offset 19 are constituted by shoulders 19b extending outwardly from the medial portions 19a. These shoulders are adapted to engage the bottoms 20 of aligned notches 21 formed on opposite ends of each collar 11, 12, defined by aligned fingers 22 extending longitudinally in opposite directions from the central body 23 of each collar. These fingers 22 embrace the sides of the springs at their shouldered portions 19b to hold them circumferentially positioned with respect to one another, while the engagement of the outer faces of the shoulders 19b with the collar at the bottoms 20 of the notches prevents axial displacement of the springs 10 after the parts of the centralizer have been assembled together. For the purpose of greater assurance that the circumferential disposition of the springs will be maintained, the fingers 22 may be bent inwardly so as to embrace the shoulders 19b to a greater extent. In any event, the ends 22a of the fingers should preferably not extend inwardly to a greater degree than the inner surfaces 19c of the spring offsets.

The inside diameter of the main body portion 23 of each collar is made greater than the outside diameter of the casing B on which the centralizer is to be mounted by an amount which is approximately equal to twice the thickness of the medial offset portions 19a. Similarly, the end portions 13 of each spring should be spaced from the casing by an amount at least equal to the thickness of the stop rings 15, 16, and the stops 14 at the end of each spring should extend inwardly no greater than the thickness of these rings 15, 16. If these proportions are employed, the medial offset portions 19a of the springs will have a proper sliding fit over the exterior surface of the casing without any binding occurring, and the stop rings 15, 16 will have adequate abutting engagement with the inturned stop fingers 14 at the ends of the springs.

One mode of assembling the casing centralizer A consists in placing the springs 10 within the collars 11, 12 with their medial offset portions 19a engaging the inner surfaces of the collars, and with their shoulders 19b, 19b embraced by the aligned fingers 22 extending in opposite directions from the main body 23 of the collar. After the required number of springs has been thus positioned in both of the collars, the split stop rings 15, 16 are contracted so that they can be moved through the inturned spring abutments 14 into proper position between the outer ends of the collars and the abutments. After clearing the spring stops, each ring 15, 16 can be allowed to expand to its initial shape with its outer surface engaging the end portions 13 of the springs, preventing the spring shoulders 19b

and medial offsets 19a from moving out of assembled relationship with respect to the collar and its fingers.

After both of the split stop rings have been mounted in position at opposite ends 13 of the bowed springs, the entire assembly can be placed on the casing B, with the stop rings 15, 16 moved outwardly into abutting position with the inturned portions 14 of the springs. While in this position and in a no-load condition, the ends of the ring defining the slot 24 are welded together, and the rings themselves are rigidly secured to the casing by welding beads 25 around the circularly spaced holes 26 in each ring. Upon performance of this welding operation, the casing centralizer A has been completely assembled on the casing B and is in condition for being run into the well bore, the stop rings 15, 16 exerting a pulling rather than a pushing action on the bowed springs 10 regardless of the direction of movement of the casing through the hole, as brought out in my prior filed application.

It is to be noted that by the device of embracing the bottoms 20 of the collar notches by the spring shoulders 19b, and confining these shoulders by the collar fingers 22, the collars 11, 12 and springs 10 are interlocked and secured to one another without resort to a welding operation. The metal from which the spring is made is not subjected to high temperatures, resulting in each spring retaining its physical properties throughout its entire length. Moreover, a maximum bow can be given to the spring, permitting the centralizer to be mounted on a casing for effective centralizing over a wide range of bore hole diameters in which the casing can be run.

In addition to providing a device for centering the casing in the hole, the present invention also contemplates a centralizer capable of acting as a scraping tool, whose primary purpose is to remove the mud cake or sheath from the walls of the hole. This is accomplished by welding wings 27, 28 to opposite sides of the bowed portions 17 of each spring. It is to be noted that the wings are axially displaced, with the upper ones 27 extending circumferentially from the same side of each spring, and with the lower wings 28 all extending circumferentially from the other side of each spring so that the wings will not interfere with each other upon radial movement of the spring bows. The upper and lower wings 27, 28 overlap to insure collective contact of the springs 10 and their wings around the entire circumference of the bore hole. Thus, the springs and wings together can operate to scrape the full circumference of the well bore wall, which action is desired in removing the mud sheath therefrom, in order that the cementitious material can bond firmly with the formation rather than with the mud itself.

While running the casing in the hole with one or more centralizers mounted thereon, it is preferred that the mud not be scraped or removed from the wall of the hole along its entire length. It is only desirable or necessary to remove the mud from the region of the hole at which the cementitious material is to be deposited for the purpose of securing a water or other fluid shut-off. This objective can be accomplished by providing scraping edges 27a, 28a at the upper ends of the wings only, the lower ends 27b, 28b being bevelled so that the wings will slide over the mud sheath upon running the casing downwardly in the hole without effecting its removal to any material extent, if at all. After all of the required casing has been run in the hole, the entire casing string can

be elevated and then lowered by slowly reciprocating it from the surface of the bore. In moving upwardly, the scraping edges 27a, 28a will dig into the mud sheath or cake and remove it by disintegration. While moving downwardly, the lower bevelled edges 27b, 28b will cause the wings to slide over the wall of the hole. The casing can be reciprocated as many times as is necessary and through a sufficient length of stroke, until the mud sheath in the region of deposition of the cement slurry has been removed, enabling the cement to contact and bond firmly with the formation itself.

I claim:

1. A centering device, comprising a collar, leaf springs spaced circumferentially around said collar, each of said springs having an offset including shoulders engageable with oppositely facing portions of said collar.

2. A centering device, comprising a collar, bowed springs each having an offset including shoulders engageable with oppositely facing portions of said collar, and means extending from said collar to hold said springs in spaced relation circumferentially around said collar.

3. A centering device, comprising a generally cylindrical member, bowed springs spaced circumferentially around said member, each of said springs having an offset including shoulders engageable with oppositely facing portions of said member, said member having fingers extending therefrom for embracing said shoulders.

4. A centering device, comprising a generally cylindrical member, leaf springs each having an outwardly bowed portion and an inwardly directed offset adjacent said bowed portion, said offset including a medial portion engageable with the inner surface of said cylindrical member and shoulders at opposite ends of said medial portion engageable with oppositely facing portions of said member.

5. A centering device, comprising a generally cylindrical member, leaf springs each having an outwardly bowed portion and an inwardly directed offset adjacent said bowed portion, said offset including a medial portion engageable with the inner surface of said cylindrical member and shoulders at opposite ends of said medial portion engageable with oppositely facing portions of said member, said member having fingers extending longitudinally therefrom for embracing said shoulders.

6. A centering device, comprising a pair of spaced collars, leaf springs spaced circumferentially around said collars, each spring having a bowed portion between said collars and an offset adjacent each collar, each offset including shoulders engageable with oppositely facing portions of said adjacent collar, to prevent relative longitudinal movement between said springs and collars.

7. A centering device, comprising a pair of spaced collars, leaf springs spaced circumferentially around said collars, each spring having an outwardly bowed portion between said collars and an inwardly directed offset adjacent each collar, said offset including a medial portion engageable with the inner surface of an adjacent collar and shoulders at opposite ends of said medial portion engageable with oppositely facing portions of said adjacent collar, to prevent relative longitudinal movement between said springs and collars.

8. A centering device, comprising a pair of spaced collars, leaf springs each having a bowed portion between said collars and an offset adjacent each collar, each of said offsets including

shoulders engageable with oppositely facing portions of an adjacent collar to prevent relative longitudinal movement between said springs and collars, and fingers extending longitudinally from said collars for embracing said shoulders to hold said springs spaced circumferentially around said collars.

9. A casing centering device, comprising a pair of spaced collars, leaf springs each having an outwardly bowed portion between said collars and an inwardly directed offset adjacent each collar, said offset including a medial portion engageable with the inner surface of an adjacent collar and shoulders at opposite ends of said medial portion engageable with oppositely facing portions of said adjacent collar to prevent relative longitudinal movement between said springs and collars, and fingers extending longitudinally from said collars for embracing said shoulders to hold said springs spaced circumferentially around said collars.

10. A casing centering device, comprising a pair of spaced collars, outwardly bowed springs arranged circumferentially around said collars and extending therebeyond with their terminal portions disposed inwardly to form abutments spaced longitudinally from said collars, each spring having an inwardly directed offset adjacent each collar, each of said offsets including a medial portion engageable with the inner surface of an adjacent collar and shoulders at opposite ends of said medial portion engageable with oppositely facing portions of said adjacent collar to prevent longitudinal movement between said springs and collars, fingers extending longitudinally from said collars toward said abutments for embracing said shoulders to hold said springs circumferentially disposed around said collars, and stop rings between said abutments and fingers, said rings preventing radially inward movement of said spring offsets.

11. A centering device, comprising a pair of spaced collars, leaf springs each having a bowed portion between said collars and an offset adjacent each collar, said springs extending beyond said collars with their terminal portions disposed inwardly to form abutments spaced longitudinally from said collars, each of said offsets including shoulders engageable with oppositely facing portions of an adjacent collar to prevent relative longitudinal movement between said springs and collars, fingers extending longitudinally from said collars for embracing said shoulders to hold said springs spaced circumferentially around said collars, and a stop ring between each collar and spring abutments.

12. A centering device; comprising a collar; leaf springs each having a bowed portion on one side of said collar, an offset adjacent each collar, and an inwardly directed abutment spaced longitudinally from said collar on the other side thereof; said offset including shoulders engageable with oppositely facing portions of said collar to prevent relative longitudinal movement between said springs and collar; fingers extending longitudinally from said collar for embracing said shoulders to hold said springs spaced circumferentially around said collar; and a stop ring between said collar and abutments.

13. In combination with a casing; a centering device comprising a collar; leaf springs each having an outwardly bowed portion on one side of said collar, an inwardly directed offset adjacent said collar, and an inwardly directed abutment spaced longitudinally from said collar on the other side thereof; each of said offsets including

a medial portion slidable on said casing and engageable with the inner surface of said collar, and shoulders at opposite ends of said medial portion engageable with oppositely facing portions of said collar; fingers extending longitudinally from said collar for embracing said shoulders to hold said springs spaced circumferentially around said collar; and a stop ring fixed to said casing between said collar and abutments.

14. In combination with a casing; a centering device; comprising a pair of spaced collars; leaf springs each having an outwardly bowed portion between said collars, an inwardly directed offset adjacent each collar, and an inwardly directed abutment beyond each collar; each of said offsets including a medial portion slidable on said casing and engageable with the inner surface of an adjacent collar, and shoulders at opposite ends of said medial portion engageable with oppositely facing portions of an adjacent collar; fingers extending longitudinally from said collars for embracing said shoulders to hold said springs spaced circumferentially around said collars; and a stop ring fixed to said casing between each collar and its adjoining abutments.

15. A casing centering device, comprising a pair of spaced collars, circularly spaced outwardly bowed springs secured to said collars, and scraper wings extending from said springs to substantially completely subtend the circumferential spaces intervening between said springs, whereby said springs and wings are operable to scrape the walls of a bore hole over its full circumference.

16. A casing centering device, comprising a pair of spaced collars, circularly spaced outwardly bowed springs secured to said collars, and scraper wings secured on opposite sides of each spring to extend substantially completely across the circumferential spaces intervening between said springs, whereby said springs and wings are operable to scrape the walls of a bore hole over its full circumference.

17. A casing centering device, comprising a pair of spaced collars, circularly spaced leaf springs secured to said collars and bowed outwardly therebetween, a first scraper wing secured to one side of the bowed portion of each spring, a second scraper wing secured to the other side of the bowed portion of each spring, the wings on each spring being longitudinally separated, and the first scraper wing of each spring overlapping the second scraper wing of an adjoining spring when the bowed spring portions are urged toward the casing.

18. A casing centering device, comprising a pair of spaced collars, circularly spaced outwardly bowed springs secured to said collars, and scraper wings extending from said springs to substantially completely subtend the circumferential spaces intervening between said springs, whereby said springs and wings are operable to scrape the walls of a bore hole over its full circumference, the bottom edges of said wings being bevelled to slide over the wall of the bore hole.

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