

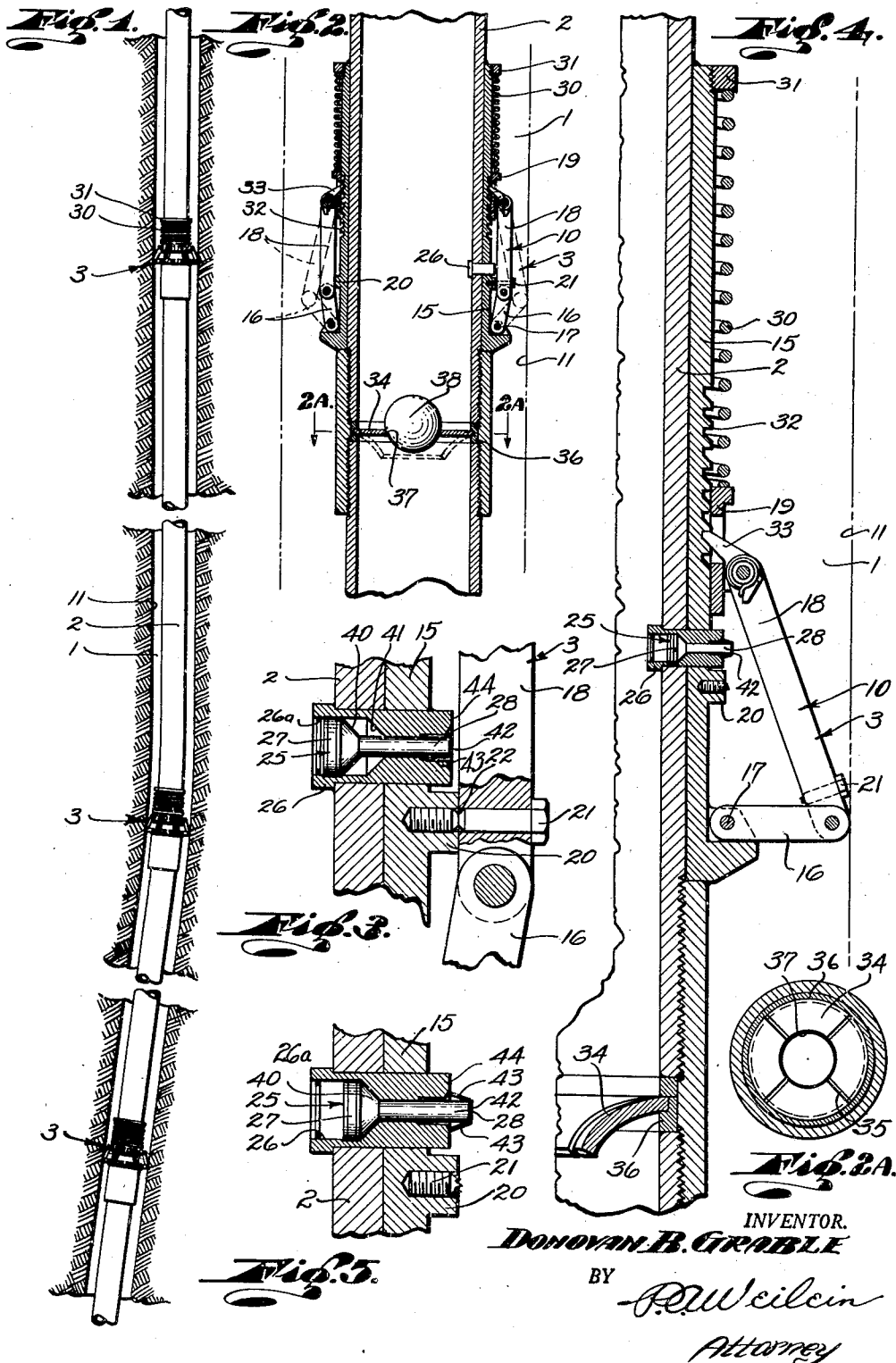
Dec. 6, 1949

D. S. GRABLE
MEANS FOR CENTRALIZING CASINGS
AND THE LIKE IN WELLS

2,490,350

Filed Dec. 15, 1943

3 Sheets-Sheet 1



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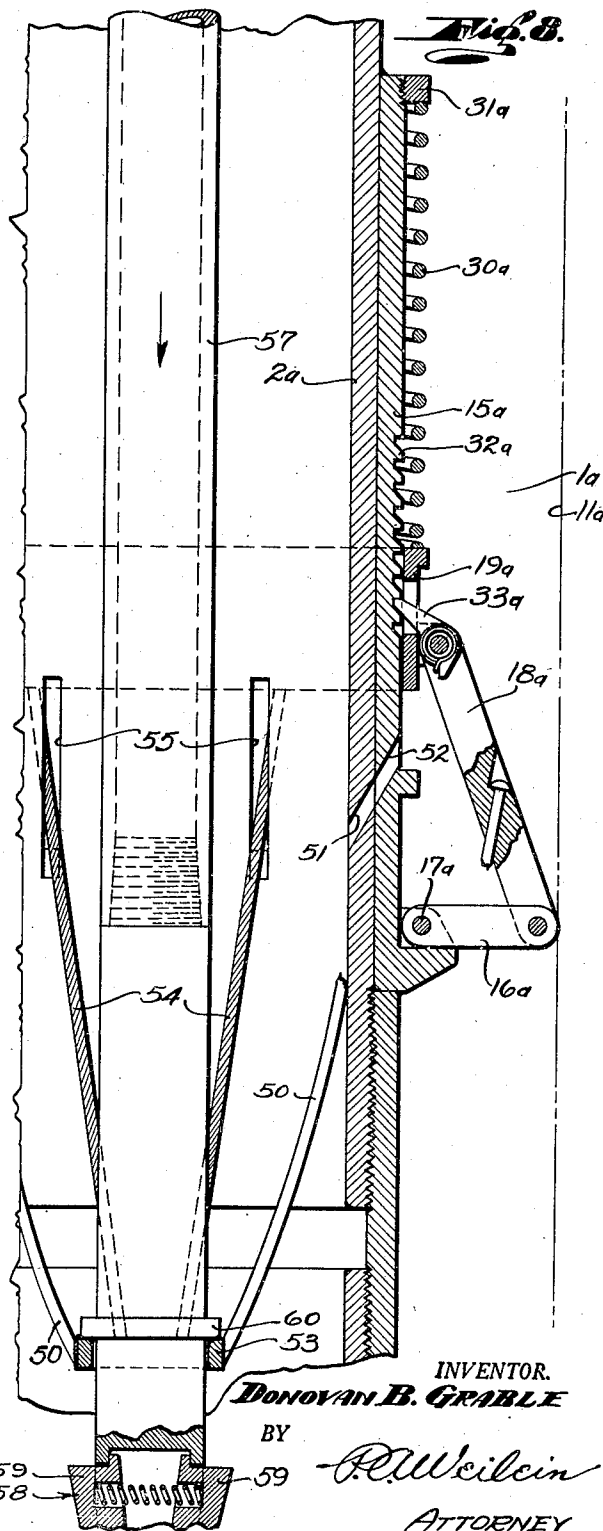
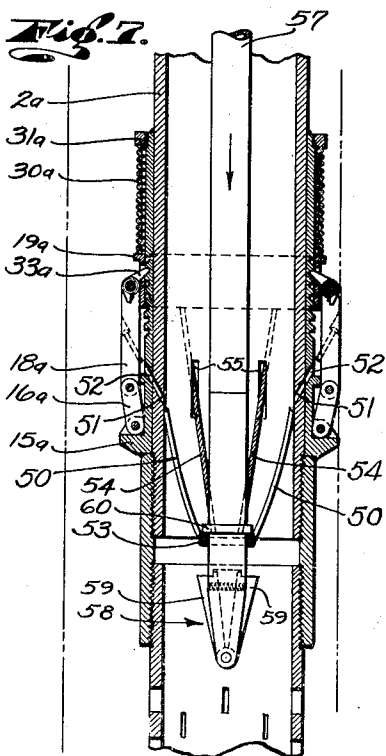
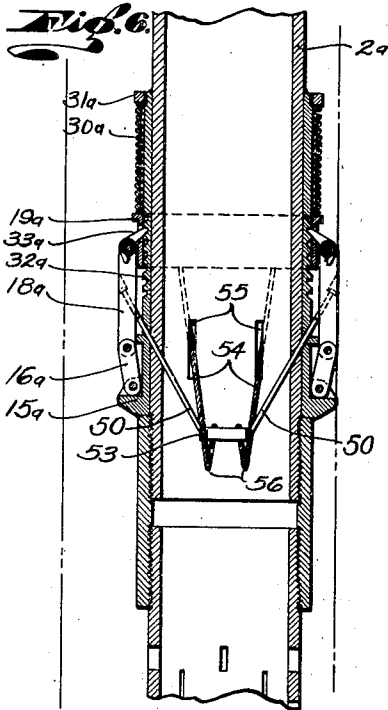
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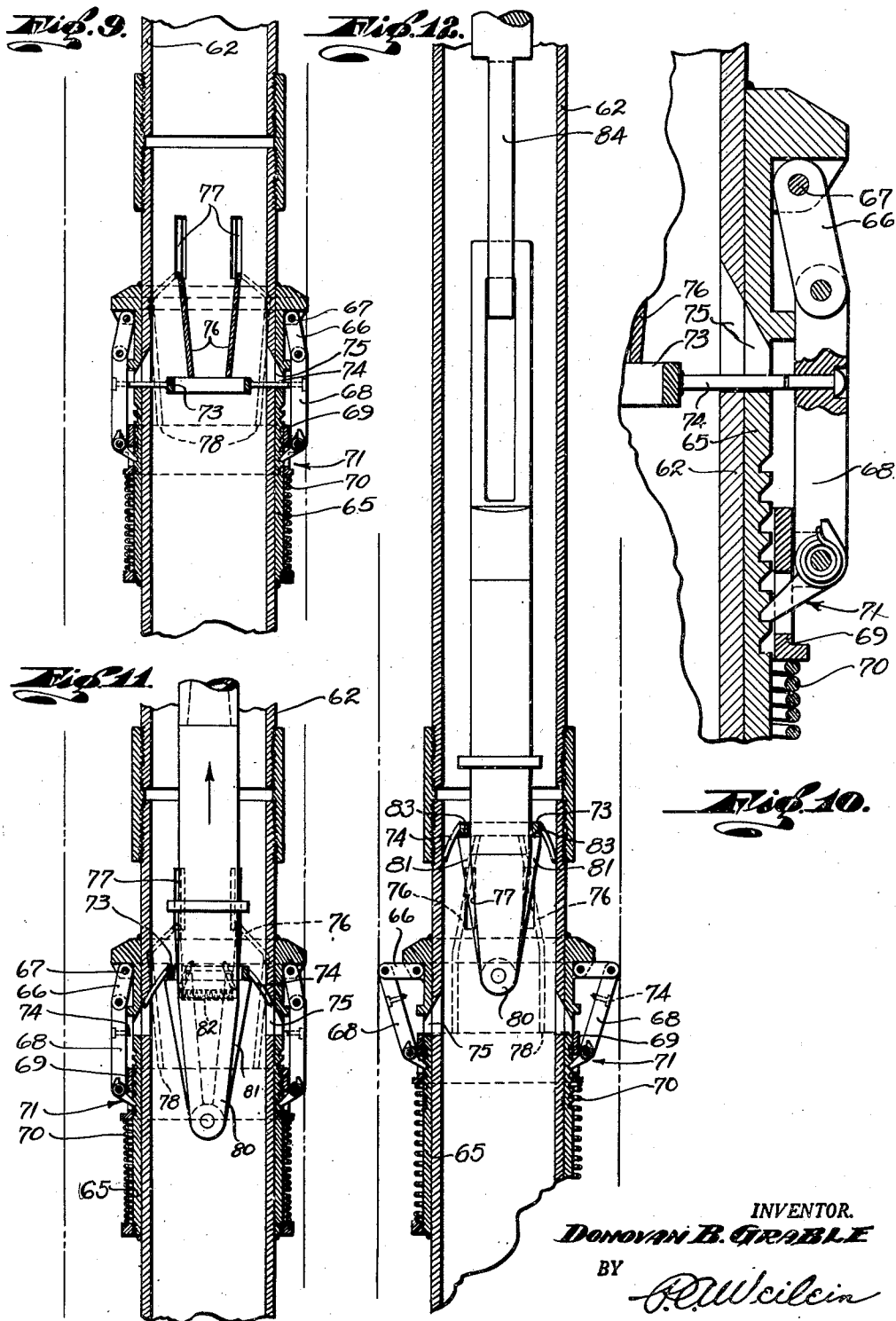
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3 Sheets-Sheet 3



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2,490,350

MEANS FOR CENTRALIZING CASING AND
THE LIKE IN A WELL

Donovan B. Grable, Long Beach, Calif., assignor,
by direct and mesne assignments, of forty-five
two hundredths to Claude C. Taylor, Long
Beach, forty-five two hundredths to Edgar W.
McGaffey, Bakersfield, and ten two hundredths
to D. W. Ward, Huntington Park, Calif.

Application December 15, 1943, Serial No. 514,368

16 Claims. (Cl. 166—4)

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This invention relates to apparatus for centralizing and laterally supporting a string of casing in a well bore, such as an oil well. In this connection casing is to be understood in the broad sense, as covering any string of tubing, piping or the like extending downwardly in a well bore and which it may be desired to centralize therein.

It is an object of the present invention to provide a method and means for centralizing and supporting a string of casing centrally in a well bore.

It is another object of this invention to provide such means which does not interfere with removing the casing from the hole if desired, which has no tendency to collect mud cake or foreign matter during the operation of running-in the casing and which allows free manipulation of the casing in either direction, at least until the centralizer has been tripped.

It is another object of this invention to provide a casing centralizer which is positively maintained free of the wall of the well bore until tripped or activated by the operator at the mouth of the well.

It is still another object of this invention to provide a casing centralizer wherein, after the initial tripping or activation of the centralizer, manipulation of the casing string serves to cause the centralizer to apply a centering force to the casing.

It is another object of this invention to provide a casing centralizer wherein a positive indication is given to the operator when the centralizer is tripped or activated.

It is still another object of this invention to provide casing centralizing means adapted to be placed at spaced points along a pipe string.

It is still another object of this invention to provide a series of centralizers or supports along a casing string arranged to be operated in sequence at desired time intervals, or selectively as desired by means controllable by the operator.

It is still another object of this invention to provide a casing centralizer which requires no openings through the wall of the casing establishing communication between the space within the casing and the space outside the casing, and hence is adapted for use on a string of solid tubing or casing.

It is a further object of this invention to provide in one modification a casing centralizer adapted for operation by hydraulic pressure, such as is readily obtainable from the circulation pump

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usually provided in connection with the hydraulic drilling of a well.

It is a further object of this invention to provide, in another modification, a casing centralizer arranged to be tripped by mechanical means operable from the mouth of the well.

It is a further object of this invention to provide in still another modification, a casing centralizer adapted for operation by cable tools, a wire line, or the like.

In its broad aspects the invention comprises means for positioning a plurality of members carried by the casing and spaced about the periphery thereof between the exterior of the casing string and the wall of the well bore, causing said members to engage the wall, and then causing said members to exert a lateral force on the casing urging it toward the center of the bore.

This invention possesses many other advantages and has other objects which may be made more easily apparent from a consideration of several embodiments of the invention. For this purpose there are shown a number of forms in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

In the drawings:

Figure 1 is an axial section through a well bore having a string of casing therein equipped with several centralizers such as are contemplated by the present invention;

Figure 2 is an axial section of one form of centralizer;

Figure 2—a is a cross section taken on line 2a—2a of Figure 2;

Figure 3 is a fragmentary detail section of the tripping means used in the form of the invention shown in Figure 2;

Figure 4 is a fragmentary vertical section on an enlarged scale showing the device of Figure 2 in operative position;

Figure 5 is a view similar to Figure 3, showing the tripping means after it has operated;

Figure 6 is an axial section of a modified form of centralizer;

Figure 7 shows the device of Figure 6 after tripping;

Figure 8 is a fragmentary vertical section on an enlarged scale showing the device of Figure 6 in operative position;

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Figure 9 is an axial section of a further modified form of centralizer;

Figure 10 is a fragmentary detail section showing the means for retaining the centralizer of Figure 9 out of operative position; and,

Figures 11 and 12 show successive operating positions of the device of Figure 9.

Referring to Figure 1 of the drawings, a well bore is indicated by 1 and has a string of casing or tubing 2 suspended therein in a manner well understood, with centralizers 3 mounted thereon at axially spaced positions. The lower portion of the well bore 1 is shown as deviating from a truly vertical direction, the centralizers 3 on the casing 2 in this portion of the bore serving to maintain the casing central in the bore or hole in spite of such slant. However, it is to be understood that the centralizers are not restricted to use in a slanting hole, since even in a hole which is considered truly vertical, the casing will not in general be central of the hole, due to irregularities in the wall of the bore caused by the different materials of the strata through which the bore passes, and washing and caving of the wall. Furthermore, a long string of casing is not itself truly straight. Accordingly, centralizers are placed wherever it is desired to position the casing centrally in the bore, and to support it against vibration.

The centralizers 3 in general each comprise a plurality of pairs of links 10 angularly spaced about the casing and extending axially thereof, the links of each pair being connected in a toggle like manner. As clearly shown in Figures 2 and 3, these links are arranged to be normally substantially flat against the outside of the casing, and retaining means are provided for releasably maintaining them in this inactive position. Means operable from the mouth of the well are provided for releasing this retaining means and causing the toggle to "jack knife" or break, whereby the joined portions of each pair of links 10 are forced outwardly, at least some of these joined portions engaging the well wall 11. Since the pairs of links on each centralizer 3 are arranged to act simultaneously, the effective diameter of the centralizer will be increased, at the same time its center remains coincident with the center of the casing. Thus, as will be herein-
after explained, such engagement of links 10 with the wall 11 may be utilized to urge the centralizer 3 and the adjacent portion of the casing 2 toward the center of the well bore 1. It is to be understood that the link pairs 10 are so proportioned and arranged with respect to the size of the casing and the well bore, that such initial operation causes the links 10 to assume some position in contact with the wall 11 less than a fully expanded position, such as indicated by broken lines in Figure 2, means being provided to prevent return of the links toward their initial position. Since the operating links 10 are entirely outside of the casing their lengths or other critical dimensions and the throw or expanded diameter of the centralizer is not restricted by the size of the casing with which the centralizer is used. Thus, a slight upward movement of the casing, referring to Figure 2, will cause the drag of the links on the wall 11 to urge them toward a more expanded position, the resultant wedging action between the casing 2 and the wall 11 exerting a force centering the casing in the hole as well as supporting the casing against vibration.

Referring more in detail to that form of the

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invention shown in Figures 2 to 5, a sleeve 15 is fixed on the exterior of the casing 2 in any convenient manner as by welding. Each pair of toggle links 10 comprises a centering link 16 pivoted on the sleeve 15 at 17 and an expander link 18 pivotally joining a collar 19 slidable on the sleeve 15 with the free end of the link 16. Axial movement of the collar 19 on the sleeve 15 serves to swing the links 16 about their pivots between the inactive position shown in solid lines in Figure 2 and the fully expanded position of Figure 4. It is to be understood that the links 10 do not necessarily assume the fully expanded position of Figure 4 to effect centering of the casing, the amount of expansion of links 10 depending on the diameter of the well bore and on the character of the wall of the well. As a means of retaining the links 10 in inactive position, a circumferential boss 20 is provided on the sleeve 15, links 18 being secured thereto by a frangible connection such as a bolt 21. The bolt 21 may have a portion 22 of reduced diameter; by providing bolts 21 of different materials or having reduced portions 22 of different diameters, the force required to release the links 10 may be adjusted.

For providing such force, one or more plungers such as indicated by 25 (see Figures 3, 4 and 5) are arranged to be forced outwardly against the links 18 by hydraulic pressure within the casing 2. The plunger 25 is slidably mounted in a suitable cylinder 26 extending through the casing 2 and the sleeve 15, and has a packed head 27 and a stem 28. It will be obvious that pressure within the casing will force the plunger outwardly, stem 28 engaging the link 18. When such pressure reaches a sufficient amount, the bolt 21 will be broken at its reduced portion 22, allowing the link 16 to be swung outwardly in response to downward movement of the collar 19. Such movement is caused by a compression spring 30 confined between the collar 19 and a suitable stop 31 on the sleeve 15. For preventing return of the links 10 to their inactive position after their initial expanding movement, ratchet teeth 32 are provided on the sleeve 15 for cooperation with the spring pressed dogs 33 pivoted on the collar 19.

It is believed that the operation of the centralizer will be understood from what has been set forth. Pressure within the casing 2 is increased to a sufficient amount to cause the plunger 25 to force the link 18 outwardly and free it from the retaining means by fracturing the bolt 21. The links 10 are then swung outwardly by the spring 30, at least some of the links engaging the wall 11 as shown by the broken lines of Figure 2. Upward movement of the casing 2 then causes a centering force by urging the links 16 outwardly toward the full line position of Figure 4.

It is essential that a free passage be provided down the casing for circulation to wash the hole clean before starting the cementing job, and further that the casing be free for raising and lowering to assist such washing. It is apparent that the casing is entirely free for such up and down movement as long as the centralizer is in its unexpanded position. To maintain such free passage as well as to provide means to make possible the necessary increase in pressure to trip the centralizer, valve means are provided in the casing just below the plunger 25. This valve means comprises a ported plate 34 of some material of limited strength and quite readily destructible, for example, cast iron, natural or ar-

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tificial rubber, or a phenolic condensate secured at its edge in a metallic ring 36 arranged to be confined between the ends of adjacent sections of the casing 2 a short distance below the plunger cylinder 26. The port 37 in the plate 34 is of sufficient size to permit free circulation of fluid in the casing 2.

When it is desired to trip the centralizer a ball 38 of suitable material such as cast iron, and of sufficient size to close the port 37, is placed in the casing 2 and gravitates downwardly with the circulating fluid. When the ball 38 reaches the plate 34, it closes the port 37, permitting pressure within the casing to be increased sufficiently to actuate the plunger 25. Further increase of pressure serves to break the plate 34 and release the ball 38 for further movement down the well. This arrangement permits the successive operation of a series of centralizers 3, as shown in Figure 1. Thus, a ported plate or diaphragm 34 is provided below each centralizer. As these plates are successively fractured, the ball 38 drops to the plate 34 next below, allowing pressure to be built up to operate the associated centralizer. It is intended that the diaphragms 34 be so arranged as to split into several segments upon fracturing, these sections hanging from the ring 36 in a manner as indicated by the broken lines of Figure 2, and as shown in Figure 4, so as not to obstruct circulation through the casing or the passage of conventional cementing plugs. For this purpose a plate with a plurality of radial grooves or portions of reduced thickness is provided, indicated by 35 in Figure 2—*a*.

For example, the frangible pin 21 can be proportioned to break at a pressure within the casing of 250# per sq. in. above the normal circulation pressure, which pressure can be readily ascertained, as being a function of the depth and other known conditions of the well. On the other hand, the plate 34 can be arranged to fracture under a pressure of say 500# in excess of the normal circulation pressure. By appropriate gauges at the mouth of the well, the operator can readily determine when each of these operations, viz., the breaking of pin 21, tripping of the centralizer, and the fracture of diaphragm 34 have been accomplished. This is of great advantage.

It is possible to provide for selective operation of the centralizers by providing diaphragms 34 having different sizes of ports 37, and utilizing balls 38 of appropriate sizes to respectively cooperate with such ports. Further, by omitting these diaphragms 34 and providing a solid diaphragm below the last centralizer, the centralizers can be tripped substantially simultaneously, since this arrangement makes possible the operation of all plungers 25 at the same time. It is to be understood that such a diaphragm is of readily destructible material as before, so that after tripping the centralizers, the well pressure is built up to fracture the diaphragm and establish a free passage through the casing for circulation or the passage of cementing plugs.

To prevent leakage of fluid between the inside of the casing 2 and the surrounding space, the plunger 25 is provided with a conical back 40 adapted to engage a conical seat 41 in the cylinder 26 when the plunger 25 is in its outermost position (see Figure 5). However, it is not essential that the plunger 25 be in contact with the seat 41 to prevent leakage, since the packing carried by the plunger head 27 is adequate to prevent leakage between the head 27 and the wall of the cylinder 26 in any case. A cap 42 having

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spring fingers 43 is suitably secured on the outer end of the plunger stem 28, and when the conical surfaces 40 and 41 come into contact, the fingers 43 spread and engage the outer end surface 44 of the cylinder 26, maintaining the plunger in seated position. To prevent the plunger 25 being blown out of the cylinder 26 into the casing 2, a snap ring 26—*a* is provided in a suitable groove near the inner end of the cylinder 26. By engaging the head 27, this serves to limit inward movement of the plunger.

It will be obvious that the centralizing mechanism disclosed in Figures 2 to 5 may be inverted if desired, that is, with links 16 pivoted to the casing 2 at the upper end of the sleeve 15 and above the collar 19, the latter being arranged to move upwardly in response to release by the plungers 25 to swing the links 16 outwardly. With a centralizer arranged in this manner, the casing 2 is lowered to increase the centering force exerted by the links 16 instead of raised. This may be advantageous under some operating conditions.

Figures 6, 7 and 8 show a centralizer similar to that just described but with another form of tripping mechanism to permit its use on perforated casing, parts corresponding to those in the previously described form being indicated by the same numerals with the addition of the letter "a." Frangible pins or rods 50 are provided as before for retaining the wall engaging links in collapsed or inactive position, but in this form of the invention the pins 50 extend through suitable openings 51, 52 in the casing 2—*a* and the sleeve 15—*a*, downwardly and inwardly of the casing, and are connected to and support a ring 53 axially of the casing. The ring 53 is also connected with the collar 19—*a* by several flexible elements 54, such as light steel cables, extending through openings 55 in the casing 2—*a* and the sleeve 15—*a*. As shown in Figure 6, before tripping the device, a small amount of slack indicated at 56 is provided in each cable, whereby a lost motion connection is formed between the ring 53 and the collar 19—*a*. Thus, sufficient downward movement of the ring 53 to break the rods 50 before moving the collar 19—*a* is provided.

Downward force for moving the ring 53 is provided by a string of tubing or drill pipe 57, operable from the mouth of the well. This tubing carries a spear 58 at its lower end, having a pair of spring urged pivoted fingers 59 arranged to swing inwardly against the force of the spring to permit passage through the ring 53. A stop collar 60 on the spear 58 serves to transmit downward movement of the spear to the ring 53.

The operation of this form of the invention is as follows. Spear 58 is inserted downwardly through the ring 53, fingers 59 swinging inwardly to permit such insertion, until the ring 53 is engaged by the stop collar 60. Downward force on the tubing 57 and the spear 58 will now be supported by the rods 50, and upon such force reaching a sufficient amount, these rods will be pulled in two, allowing the ring 53 to move downwardly until the slack is taken out of the cables 54, whereupon downward force will be transmitted to the collar 19—*a*, causing the links 16—*a* to swing outwardly to engage the wall 11—*a* of the well. With this arrangement force may be applied by the operating means 57 to expand the centralizer to the limit of its movement. Or, upward movement may be imparted to the casing 2—*a* serving to wedge the links 16—*a* between the casing 2—*a* and the wall 11—*a* as before.

After the links 16—*a* have engaged the wall

11—*a*, additional downward force is applied to the spear 58 serving to break the cables 54, after which the spear 58 together with the ring 53 and the pieces of the rods 50 and of the cables 54 attached thereto may be removed from the well, the fingers 59 serving to retain the ring 53 on the spear. Or if a series of centralizers are used, as in Figure 1, the spear 58 may be lowered until the ring 53 of the next centralizer is engaged, when the tripping operation is repeated, this ring being on the spear below the first ring 53. Continued downward travel of the spear serves to successively trip the centralizers. After they have all been tripped, the tubing 57 and the spear 58 together with all the rings 53 and attached pieces of rods 50 and of cables 54 may be removed from the well.

The casing centralizer may be further modified so as to be tripped and opened to wall engaging position by a member moving upwardly of the casing, making possible the use of the device with cable tools, or its operation by a cable. Such a modification is shown in Figures 9 to 12.

As shown in Figure 9, the centralizer, except for the tripping mechanism, is practically the same as that of the previously described forms but is inverted. Thus, a sleeve 65 is fixed on the casing as before, the centering links 66 being pivoted thereto at 67. Expander links 68 serve to operatively connect the links 66 with a collar 69 axially slidable on the sleeve 65. In this case, upward movement of the collar 69 serves to swing the links 66 into operative position. A spring 70 is provided to urge the collar 69 upwardly; a ratchet mechanism 71 similar to that of the first form being arranged to permit free upward movement of the collar 69 to expand the centralizer but to prevent reverse movement of the collar and reduction in diameter of the centralizer.

The tripping mechanism comprises a ring 73 within the casing 62 and connected to the expander links 68 by frangible or shear pins 74 which pass through suitable openings 75 through the casing 62 and sleeve 65. The ring 73 is also joined to the collar 69 by a number of light cables 76 which pass upwardly from the ring 73 through openings 77 in the wall of the casing and downwardly to the point of connection 78 on the collar 69.

It will be apparent that upward movement of the ring 73 from its initial position (Figures 9 and 10) will first bend the pins or rods 74 and then break them, releasing the links 66, 68 and slackening the cables 76, as shown in Figure 11. The collar 69 may or may not be moved upwardly by the spring 70 to expand the centralizer, depending on various conditions. In any case, continued upward movement of the ring 73 will first pull the cables 76 tight and then pull the collar 69 upward causing the links to swing outwardly, the parts assuming the relative positions of Figure 12.

A spear 80 having pivoted fingers 81 urged apart by a compression spring 82 provides upwardly directed shoulders 83 for engaging the ring 73. Spear 80 is shown as connected to a conventional set of jars 84 which in turn is connected to a sinker bar and cable, not shown. In operation, the spear 80 is lowered until it contacts the ring 73, the weight of the jars and sinker bar cooperating with the ring 73 to cause the fingers to be pressed together to allow them to pass through the ring. The fingers then move apart to provide the shoulders 83 under the ring 73

as shown in Figures 11 and 12. Upward movement of the spear 80 by the attached cable will then move the ring 73 upwardly with the results just explained. However, continued upward movement of the cable and spear 80 after the links 66, 68 have swung outwardly to the limit of their movement will part the cables 76, allowing the ring 73 together with the remnants of the pins 74 and cables 76 attached thereto to be removed from the casing with the spear.

This form of centralizer can also be used at spaced positions and tripped successively by the spear 80. In such a case the spear must be lowered to trip the uppermost centralizer first, and then be pulled upwardly in the casing to remove the ring 73 as just explained. The spear 80 is then lowered to engage the ring 73 of each successively lower centralizer, severing the pins 74 and cables 76 connected therewith and removing the ring, as just pointed out. When the centralizers have all been tripped and the operation completed, the rings 73 of all the centralizers with the pieces of pins 74 and the cables 76 connected thereto will have been removed from the well, leaving the inside of the casing clear for further operations.

The pull on the cable can be used to force the centering links 66 against the well wall to center the casing, or this force can be supplemented by movement of the casing 62, as before. However, in this case, the casing must be lowered for this purpose. In the event that the centralizer is used on a liner, a pull on the cable must be relied on to force the links 66 against the well wall to center the liner if the liner has been hung and cannot be moved upwardly or downwardly, this being the routine method of landing perforated liners. If, however, the liner is free or has not been hung, it may be moved axially downward to provide this force or to increase it. By appropriate use of a weight indicator in connection with the cable, the operator can determine when the frangible pins 74 are broken, when the cables 76 are pulled apart, and other important operating data.

It is not essential that the spear 58 or 80 be run in the hole on tubing or cable especially for the purpose of tripping the centralizers. They could be placed on drill pipe tubing, or a string of cable tools, with various types of delayed action setting tools, washing tools or the like and removed from the holes as the other tools are removed.

I claim:

1. A casing centralizer comprising an expansible spider, including a collar slidable with respect to the casing and a plurality of members mounted on said casing and operatively connected with said collar so as to move outwardly from the casing in response to movement of said collar in one direction, means urging said collar to move in said direction to cause said members to move outwardly, frangible means maintaining said members in retracted position, and means extending through the walls of the casing and operable from within the casing for fracturing said frangible means and releasing said members to move outwardly from the casing in response to movement of said collar.
2. A casing centralizer comprising an expansible spider adapted for mounting on the casing, said spider including a sleeve adapted to be secured to the casing, a collar slidable with respect to the casing, and a plurality of axially extending toggle linkages, each of which is pivotally secured

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at one end to said sleeve, the other ends of said linkages being attached to said collar, means urging said collar to move in a direction to swing said linkages outwardly from the sleeve, frangible means maintaining the links of each of said linkages substantially aligned, and means operable from within the casing for fracturing the frangible means, whereupon said linkages are swung outwardly from the casing.

3. A casing centralizer comprising an expandible spider adapted for mounting on the casing, said spider including a sleeve adapted to be secured to the casing, a collar slidable with respect to the casing, and a plurality of axially extending toggle linkages, each of which is pivotally secured at one end to said sleeve, the other ends of said linkages being attached to said collar, means urging said collar to move in a direction to swing said linkages outwardly from the sleeve, frangible means maintaining the links of each of said linkages substantially aligned, means operable from within the casing for fracturing the frangible means whereupon said linkages are swung outwardly from the casing, and means operating to prevent movement of the collar in a direction to swing said linkages inwardly toward the casing but permitting movement of the collar in a direction to swing the linkages outwardly from the casing.

4. A casing centralizer comprising an expandible spider adapted for mounting on the casing, said spider including a sleeve adapted to be secured to the casing, a collar slidable with respect to the casing, and a plurality of axially extending toggle linkages, each of which is pivotally secured at one end to said sleeve, the other ends of said linkages being attached to said collar, means resiliently urging said collar to move in a direction to swing said linkages outwardly from the sleeve, frangible means maintaining the links of each of said linkages substantially aligned, means operable from within the casing for fracturing the frangible means, and means forming a lost motion connection between said means operable from within the casing and said collar, whereby said lost motion means after fracture of the frangible means, acts to move said collar to urge said linkages to swing outwardly.

5. A casing centralizer adapted for use on a fluidtight string of casing, comprising a member mounted exteriorly on the casing for movement outwardly with respect thereto to engage the wall of the well bore, and means extending through the wall of said casing in a fluidtight manner, responsive to fluid pressure in the casing for causing outward movement of said member.

6. A casing centralizer adapted for use on an imperforate string of casing comprising a member mounted with respect to the casing to move outwardly from the casing and engage the wall of the well bore, and a plunger mounted in the wall of the casing and movable transversely of the casing in response to fluid pressure therein to engage the member and cause outward movement thereof.

7. A casing centralizer adapted for use on an imperforate string of casing comprising a member mounted with respect to the casing to move outwardly from the casing and engage the wall of the well bore, frangible means retaining said member out of wall engaging position, and a plunger mounted on the wall of the casing and movable transversely of the casing in response to fluid pressure therein to engage said member

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and fracture said frangible means, causing outward movement of said member.

8. Casing centralizing means comprising a plurality of sets of members mounted at axially spaced points along the casing, said members being arranged to move outwardly from the casing and engage the wall of the well bore in response to fluid pressure within the casing, and valve means associated with each set of members for controlling the application of pressure thereto, said means comprising a ported diaphragm extending across the casing adjacent each of said sets, and means for closing the port.

9. Casing centralizing means comprising a plurality of sets of members mounted at axially spaced points along the casing, said members being arranged to move outwardly from the casing and engage the wall of the well bore in response to fluid pressure within the casing, and valve means associated with each set of members for controlling the application of pressure thereto, each of said valve means comprising a yieldable structure adapted to close the casing, said structure being adapted to yield responsive to a rise of pressure to a predetermined amount for applying pressure to a succeeding set of members.

10. A casing centralizer comprising a member mounted with respect to the casing to move outwardly from the casing and engage the wall of the well bore in response to fluid pressure within the casing, and valve means in said casing for causing said pressure to be effective on the member, said valve means including a diaphragm member and a closure member adapted to cooperate to close the casing space below the member, one of said members being adapted to yield responsive to a rise in pressure to permit fluid to pass freely through the casing.

11. A casing centralizer for use in a well, comprising a pair of links connected to form a toggle linkage, movement of the free ends of said linkage toward each other serving to swing the links outwardly from the casing to engage the wall of the well bore, means pivotally securing one free end of said linkage to the casing, and a collar slidably mounted on the casing to which the other free end of said linkage is pivoted, and means for moving said collar axially of the casing toward said pivotal securing means, comprising a member within the casing, means securing said member to said collar, and means operable from the mouth of the well for shifting said member to move said collar toward said pivotal securing means.

12. In a casing centralizer for use in a well, comprising a pair of links connected to form a toggle linkage, movement of the ends of said linkage toward each other serving to swing the links outwardly from the casing to engage the wall of the well bore, means pivotally securing one end of said linkage to the casing, a collar slidably mounted on the casing to which the other end of said linkage is pivoted, a member within the casing, a frangible connection between said member and one of said links to maintain said links in retracted position, means forming a lost motion connection between said member and said collar, and means operable from the mouth of the well for moving said member, movement of said member in one direction serving first to break the frangible connection and to then move said collar to swing the links outwardly.

13. In a casing centralizer for use in a well, comprising a pair of links connected to form a toggle linkage, movement of the ends of said link-

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age toward each other serving to swing the links outwardly from the casing to engage the wall of the well bore, means pivotally securing one end of said linkage to the casing, a collar slidably mounted on the casing to which the other end of said linkage is pivoted, a member within the casing, a frangible connection between said member and one of said links to maintain said links in retracted position, means forming a lost motion connection between said member and said collar arranged to fracture in response to a predetermined force, and means operable from the mouth of the well and having opposed shoulders for confining said member, movement of said means in one direction causing said member to move to first break the frangible connection and then cause the collar to swing the links outwardly, continued movement of said means serving to fracture said lost motion forming means and thereby disconnect said collar and said member, movement of said means in the opposite direction thereafter removing the member from the casing.

14. In apparatus for centralizing a casing in a well bore, a plurality of casing centralizers mounted at axially spaced points along the casing, each centralizer including: a pair of links connected together to form a toggle linkage, movement of the ends of said linkage toward each other serving to swing the links outwardly from the casing to engage the wall of the well bore, means pivotally securing one end of said linkage to the casing, and a collar slidably mounted on the casing to which the other end of said linkage is pivoted, a plurality of members respectively secured to each of said collars, and means operable from the mouth of the well for successively engaging and moving said members in response to movement of said last mentioned means in one direction, whereby said collars are moved to cause the links of successive centralizers to swing outwardly from the casing.

15. In apparatus for centralizing a casing in a well bore, a plurality of casing centralizers mounted at axially spaced points along the casing, each centralizer including: a pair of links connected together to form a toggle linkage, movement of the ends of said linkage toward each other serving to swing the links outwardly from the casing to engage the wall of the well bore, means pivotally securing the lower end of said linkage to the casing, and a collar slidably mounted on the casing to which the other end of said linkage is pivoted, a plurality of members respectively secured to each of said collars, and

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means operable from the mouth of the well for successively engaging and moving said members in response to movement of said last mentioned means downwardly, whereby said collars are moved to cause the links of successive centralizers to swing outwardly from the casing.

16. In apparatus for centralizing a casing in a well bore, a plurality of casing centralizers mounted at axially spaced points along the casing, each centralizer including: a pair of links connected together to form a toggle linkage, movement of the ends of said linkage toward each other serving to swing the links outwardly from the casing to engage the wall of the well bore, means pivotally securing the upper end of said linkage to the casing, and a collar slidably mounted on the casing to which the other end of said linkage is pivoted, a plurality of members respectively secured to each of said collars, and means operable from the mouth of the well for successively engaging and moving said members in response to movement of said last mentioned means upwardly, whereby said collars are moved to cause the links of successive centralizers to swing outwardly from the casing.

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