April 21, 1942. J. S. BECK 2,280,054

ADJUSTABLE LINER FOR WELL CASINGS

Filed Feb. 14, 1939 3 Sheets-Sheet 1

Fig. 1.

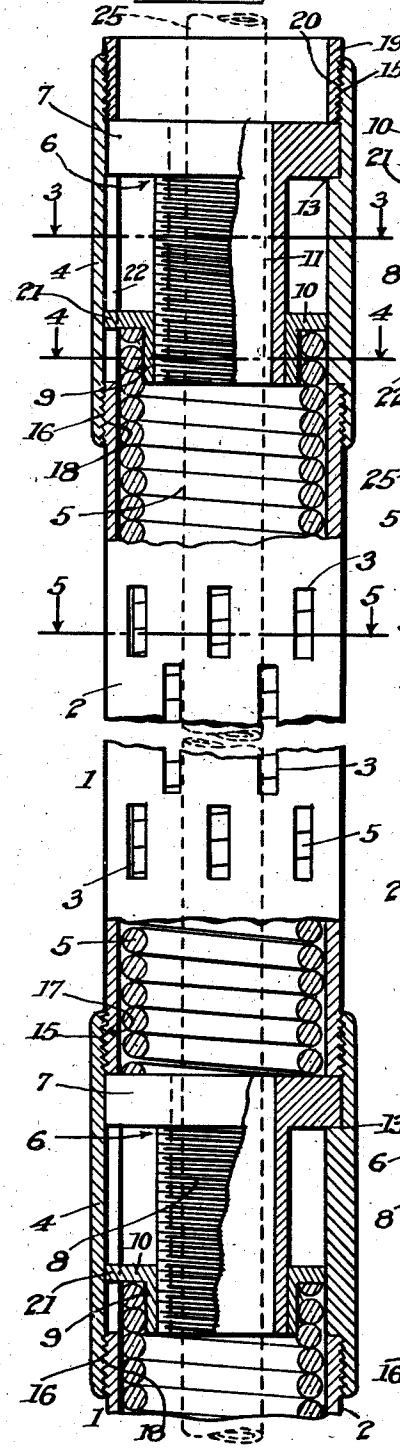


Fig. 2.

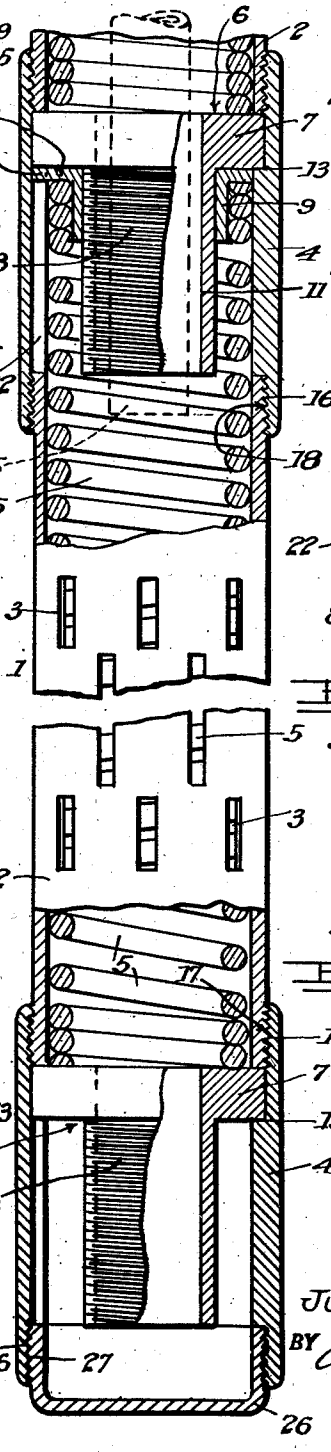


Fig. 3.

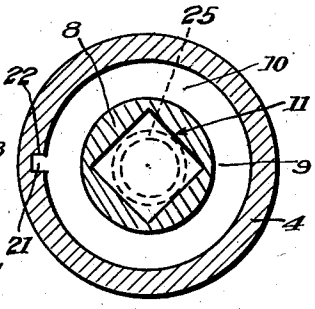


Fig. 4.

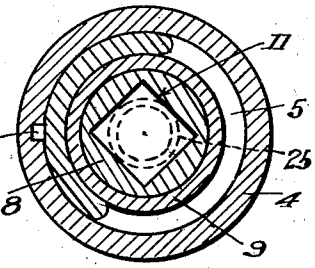


Fig. 5.

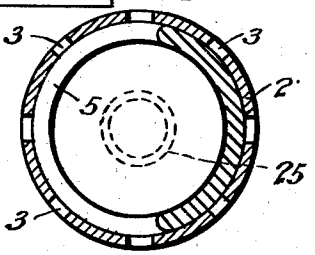
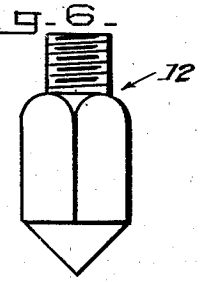


Fig. 6.



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April 21, 1942. J. S. BECK 2,280,054

ADJUSTABLE LINER FOR WELL CASINGS

Filed Feb. 14, 1939 3 Sheets-Sheet 2

Fig. 7.

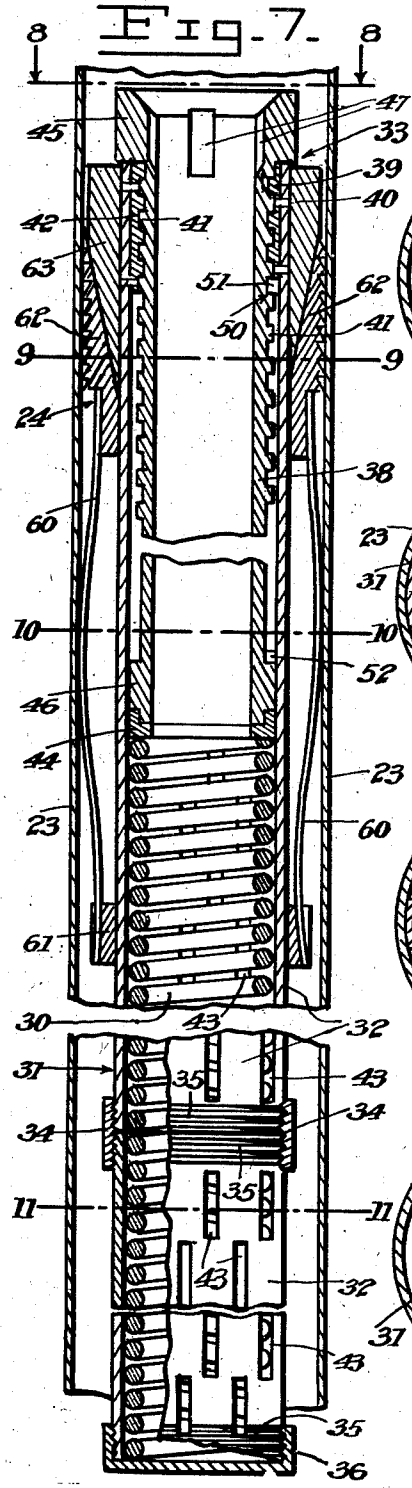


Fig. 8.

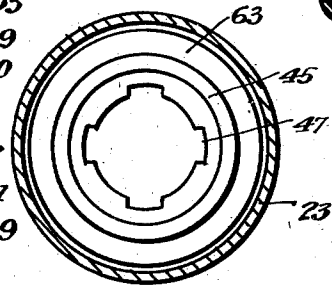


Fig. 9.

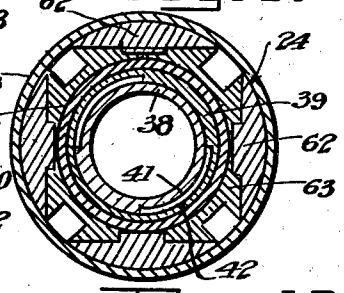


Fig. 10.

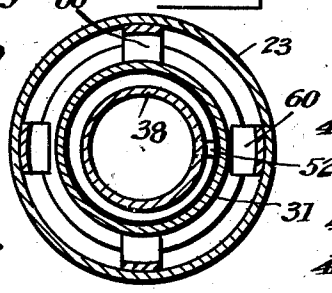


Fig. 11.

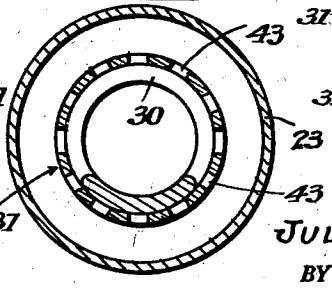
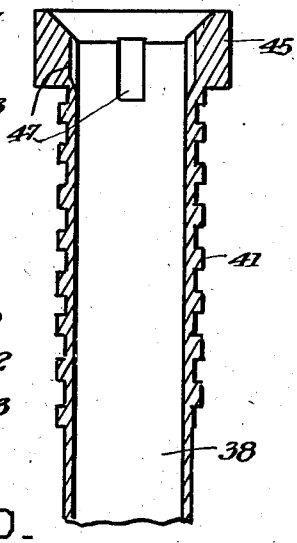
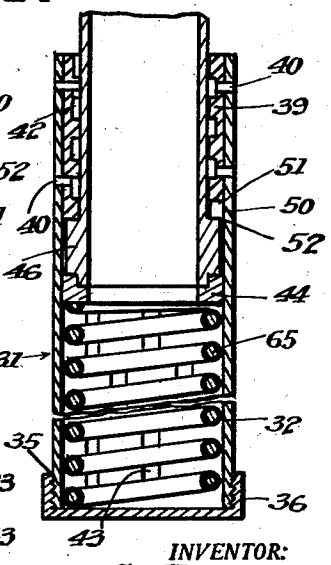


Fig. 13.

Fig. 12.





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ADJUSTABLE LINER FOR WELL CASINGS

Filed Feb. 14, 1939 3 Sheets-Sheet 3

Fig. 14

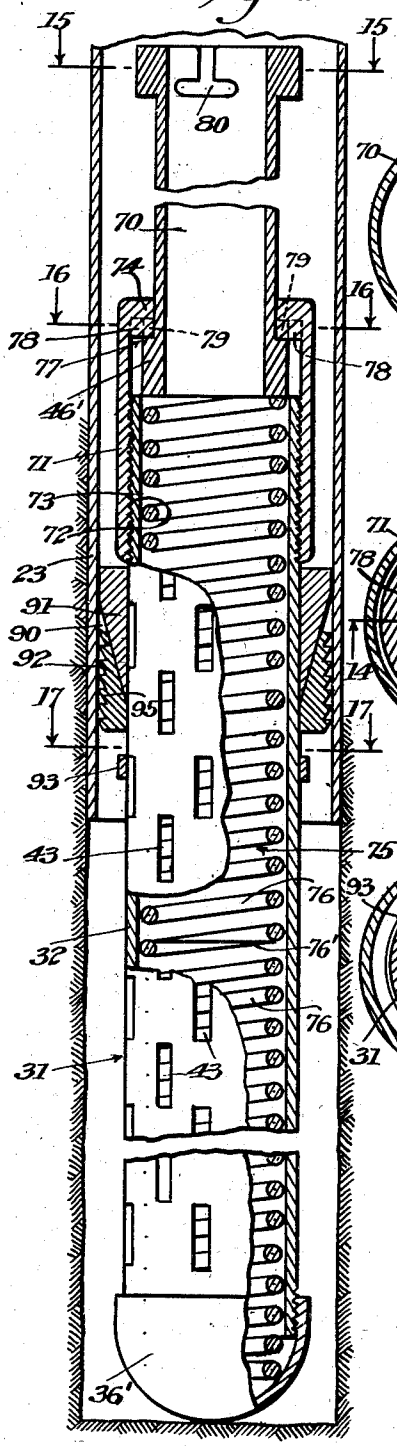


Fig. 15

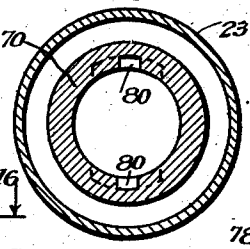


Fig. 16

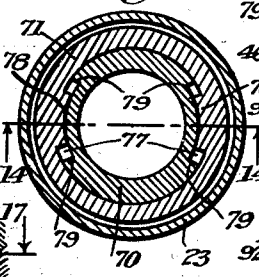


Fig. 17

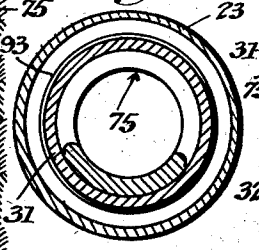


Fig. 18

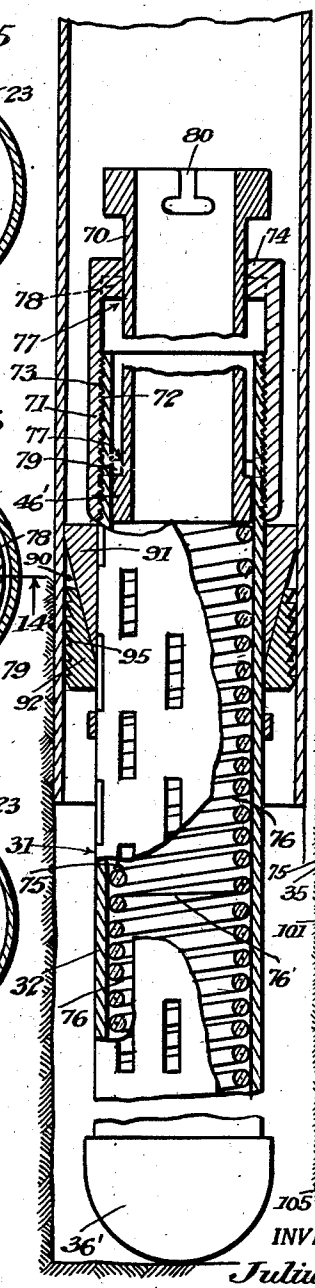
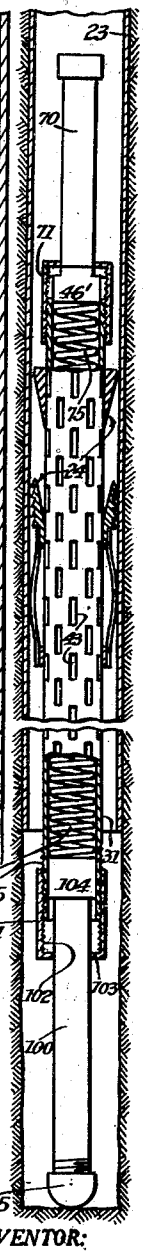


Fig. 19



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Patented Apr. 21, 1942 2,280,054

UNITED STATES PATENT OFFICE

2,280,054

ADJUSTABLE LINER FOR WELL CASINGS

Julius S. Beck, Los Angeles, Calif.

Application February 14, 1939, Serial No. 256,299

1 Claim. (Cl. 166—8)

This invention relates to liners which are connected to the lower end of the casing in an oil well, for screening the oil before it enters the casing, and this invention is an improvement upon my Liner for well casing disclosed in my application, Serial No. 221,135, filed July 25, 1938.

The general object of this invention is to provide a liner for oil well casing which may be adjusted to vary the size of its screening openings, whereby the liner may be adjusted for coarser or finer screening of the oil pumped through the casing as conditions require.

Other objects and advantages will appear hereinafter.

The invention consists in the lovel features of construction, combination of elements and arrangements of parts hereinafter described and claimed.

The invention is illustrated in the annexed drawings, which form a part of this specification and in which,

Fig. 1 is a fragmentary view partly in elevation and partly in longitudinal section of the upper portion of my liner, showing the spring of the uppermost unit of my liner compressed and closing the screen openings.

Fig. 2 is a view like Fig. 1, of the lower portion of my liner, but showing the spring of the lowermost liner unit expanded and partly uncovering the screen openings for screening the oil.

Fig. 3 is a cross section of my liner taken on line 3—3 of Fig. 1.

Fig. 4 is a cross section of my liner taken on line 4—4 of Fig. 1.

Fig. 5 is a cross section of my liner taken on line 5—5 of Fig. 1.

Fig. 6 is a side elevation of the wrench for operating the spring adjusting means for varying the size of the screen openings.

Fig. 7 is a longitudinal section of a modification of my invention shown supported in an oil well casing and with the spring compressed and reducing the screen openings to their minimum size for the fine screening.

Fig. 8 is a cross section taken on line 8—8 of Fig. 7.

Fig. 9 is a cross section taken on line 9—9 of Fig. 7.

Fig. 10 is a cross section taken on line 10—10 of Fig. 7.

Fig. 11 is a cross section taken on line 11—11 of Fig. 7.

Fig. 12 is a longitudinal section of the modification of my invention as shown in Fig. 7, but showing the spring expanded and uncovering the screen openings to the greatest extent for coarse screening.

Fig. 13 is a cross section of a modification of screen adjusting spring, as shown in Fig. 12.

Fig. 14 is a longitudinal section of another modification of my liner with a single spring compression plunger mounted in the upper end of the liner tube, showing the spring expanded, and showing means for preventing gas under pressure from blowing the liner out of the well.

Fig. 15 is a horizontal section of Fig. 14 taken on line 15—15 of Fig. 14.

Fig. 16 is a horizontal section of Fig. 14 taken on line 16—16 of Fig. 14.

Fig. 17 is a horizontal section of Fig. 14 taken on line 17—17 of Fig. 14.

Fig. 18 is a view like Fig. 14 except that the spring is shown compressed by the plunger in the upper end of the liner tubing.

Fig. 19 is a longitudinal section, partly in elevation, of another modification of my invention, with a spring compression plunger mounted in the lower end as well as in the upper end of the liner tube, and showing the spring partly compressed by the plunger in the lower end of the liner tube.

Referring more particularly to Figs. 1 to 6 inclusive of the drawings my liner is formed in a plurality of superimposed units I, each of which includes a casing section 2 provided with a plurality of inlets 3, screw couplings 4 connected to the ends respectively of said sections, a coil spring 5 within said section fitted to the inner surface of said section and extending across said inlets 3, and spring-positioning members 6 secured in said couplings respectively, each of which spring positioning members including a circular base 7 formed with a depending externally threaded shank 8, and a nut 9 threaded on said shank, which nut is formed at its upper end with an external flange 10, and there being a square opening 11 extending axially through said base 7 and shank 8 to receive a wrench 12 for the purpose hereinafter described. The base 7 of each spring-positioning member 6 rests upon an internal shoulder 13 in the upper end portion of a coupling 4. The sections 2 of adjoining units I are connected by couplings 4, which have internal threads 15 and 16 in their upper ends and lower ends respectively for engaging external threads 17 and 18 on the lower ends and upper ends respectively of the tubes 2 of adjoining units I. The lower end of each tube 2 engages the upper side of the base 7 of the spring-posi-

tioning member 6, in the coupling 4 to which said tube is connected at its lower end, and holds said base upon the shoulder 13 in the upper end portion of said coupling. The spring-positioning members 6 in the coupling 4, which is connected to the upper end of the tube 2 of the uppermost unit I, is detachably held in said coupling by means of a lock ring or adapter 19, formed with an external thread 20, which engages the internal thread 15 in the upper end of said coupling, whereby the lower edge of said lock ring is drawn down against the upper side of said base and said base is held upon the shoulder 13 in said coupling. The flange 10 of the unit 9 is formed with a spline 21 which is slidably fitted in a longitudinal groove 22 in the inner side of the coupling 4 to prevent turning of the nut 9 when the spring-positioning member 6 is rotated by the wrench 12, while inserted in the square opening 11 of said member, whereby said nut is moved up or down on the threaded shank 8 of said member to adjust the length of the spring 5 and the width of the spaces between the coils of said spring.

My liner, as above described, is detachably secured in the lower portion of a well casing 23 by means of a conventional liner hanger 24, as shown in Figs. 7 and 9 of the drawings, so that the liner will be completely or partly submerged in the oil in the bottom of the well. A pump tubing 25 may be extended downwardly into my liner a suitable distance through the openings 11 in the spring-positioning members 6 and the springs 5, as shown in dotted lines in Figs. 1 and 2, so that the pump (not shown) may pump oil from the well through one or more of the liner units I. As shown in Figs. 2 the pump tubing 25 is extended down into the lowermost unit for pumping oil from said unit.

The lower end of my liner as above described is closed at its lower end by a screw plug 26 which is formed with an external thread 27 for engaging the thread 16 in the lower end of the coupling 4 which is threaded on the lower end of the tube 2 of the lowermost liner unit, for securing the spring-positioning member 6 against the lower end of said tube for supporting the spring 5 in said tube.

The operation of my invention as as follows:

My liner being secured in a well casing by a liner hanger, and a pump tubing 25 being extended down in the liner through the openings 11 in the spring-positioning members 6 and through the springs 5, into the lowermost unit I, as illustrated in dotted lines in Figs. 1 and 2 of the drawings, oil is pumped by the pump from the bottom of the well through the inlets 3 in the tube 2 and the spaces between the coils of the spring 5 of the lowermost unit I, through said pump tubing 25 and out of the well through the pump and its discharge tubing, and the oil, passing from the well into the liner through said inlets 3 and spaces between said spring coils, is finely or coarsely screened according to the width of the spaces between the coils of said spring, which spaces may be adjusted by the wrench 12, which being secured on the lower end of the pump tubing or drill pipe, may be inserted in the square opening 11, in any one of the spring-positioning members 6, and turned either to the right or to the left to turn said spring-positioning member, so that the unit nut 9 will move down or up on the threaded shank 8 of said member and compress said spring or allow said spring to expand, whereby the spaces between the spring coils are narrowed or widened.

The modification of my invention shown in Figs. 7 to 11 inclusive comprises only a single spring 30 of any suitable length fitted within a perforated liner casing 31 of one or more sections 32, and a single spring-positioning and adjusting means 33 mounted in the upper end of said tubing. When the liner tubing 31 includes two or more sections 32 said sections are coupled together at their adjoining ends by the conventional screw couplings 34 which engage threads 35 on the ends of said sections. On the thread 35 on the lower end of the liner tubing 31 is screw seated a bull nose 36, upon which rests the lower end of the spring 30. The spring-positioning and adjusting means 33 comprises a screw sleeve 38, extending into the upper end of the liner casing 31, and a screw bushing 39, secured in the upper end of said tubing by pins 40, through which bushing said sleeve extends, with its lower end engaging the upper end of the spring 30, said sleeve being formed with an external square thread 41 which engages an internal square thread 42 formed in said bushing, whereby said sleeve, upon being rotated in one direction or the other will move down or up in the liner casing and compress the spring 30 or allow said spring to expand, for adjusting the width of the space between the coils of said spring for finer or coarser screening of the oil admitted from the well through the perforations 43 in the liner tubing 31 and through the adjusted spaces between the coils of said spring. On the lower end of the screw sleeve 38 is turnably fitted a thrust bearing 44 which bears against the upper end of the spring 30 and slidably remains with said spring against rotation, as said screw sleeve is rotated to compress said spring or to allow said spring to expand to adjust the width of the spaces between the coils of said spring. The screw sleeve 38 is formed at its upper end with an external head 45 for engaging the upper ends of the liner tubing 31 and bushing 39 for limiting the downward movement of said screw sleeve and the compression of the spring 30. The screw sleeve 38 is formed at its lower end portion with an external bearing 46 which bears against the inner side of the liner casing 31 to guide the lower end of said sleeve in said tubing, and engages the lower end of the bushing 39 to limit the upward movement of said screw sleeve 38, with relation to the liner tubing 31, and the expansion of the spring 30, when the sleeve 38 is turned and its thread 41 disengaged from the screw bushing 39. A clutch 50, comprising a clutch member 51 on the lower end of the bushing 39 and a clutch member 52 on the upper end of the sleeve bearing 46, is provided for engagement to prevent rotation of the screw sleeve 38 when in its uppermost position, in order to trip the liner hanger to remove or set the liner. The screw sleeve 38 is formed in its upper end with a plurality of longitudinal grooves 47 to receive a wrench for rotating said screw sleeve.

The liner hanger 24 for holding my liner in a well casing 23, as illustrated in Fig. 7 of the drawings is of conventional form, including a plurality of outwardly bowed springs 60, a collar 61 secured to the lower end of said springs, slips 62 secured to the upper ends of said springs, and a wedge sleeve 63. The collar 61 of the wedge sleeve 63 are fitted over the liner casing 31 and said wedge sleeve is wedged behind the slips 62,

so that said slips will engage the inner side of the casing 23 and hold my liner in any suitable position in the well casing.

In the form of my invention shown in Figs 12 and 13 the spring 65 is covered by a rubber covering 66, so that when said spring is compressed the said rubber covering on the adjacent coils of said spring may be brought into liquid-tight contact to prevent entrance of oil between the coils of the spring into the liner.

The operation of the modification of my invention shown in Figs. 7 to 13 inclusive is as follows:

Upon lowering a wrench tool in the well until it engages the grooves 47 in the upper end of the screw sleeve 38, said sleeve as shown in Fig. 7, may be rotated by said tool, by power applied to said tool on the well derrick, until the sleeve thread 41 is disengaged from the thread 42 in the upper end of the liner tubing 31, as shown in Fig. 12. Upon removing said wrench tool from the well a sinker bar may be lowered in the well upon the head 45 on the upper end of the screw sleeve 38, so that the weight of said sinker bar will depress said sleeve 38 and compress the spring 30 or 65, and upon lifting said sinker bar the spring 30 or 65 will expand and force the sleeve 38 up after the sinker bar. Such compression and expansion of the spring 30 or 65 will cause said spring to scrape any deposits from the inner side of liner casing 31 and from any of the perforations 43 in said casing which might be closed or partly closed by such deposits, thus enabling an attendant to keep said perforations open, for the free flow of oil therethrough into the casing, without removing my liner from the well.

In the modification of my invention shown in Figs. 14 to 18 inclusive, the bushing 39 and threads 41 and 42 are eliminated from the liner tubing 31, and a tubular plunger 70 without the thread 41 is substituted for said plunger 38, while a coupling 71 is screw seated on the upper end of the liner casing 31, by means of screw threads 72 and 73 on said casing and said coupling respectively, into which coupling the plunger 70 extends, and the upward movement of said sleeve is limited by the engagement of the upper end of its bearing 46' with an internal flange 74 on the upper end of said coupling 71. The upper end of a spring 75 in the perforated liner casing 31 engages the lower end of the plunger 70, while the lower end of said spring rests upon the bull nose 36' on the lower end of said liner casing, which casing may comprise one or more sections 32. The spring 75 may be made in a plurality of sections 76 placed end to end as indicated at 76'. The sleeve 70 may be clutched to the coupling 71 by a clutch 77, under the influence of the spring 75, as illustrated in Figs. 14 and 16, which clutch comprises engaging members 78 and 79, the members 78 being formed on the under side of the flange 74 on the upper end of the coupling 71, and the members 79 being formed in the upper end of the bearing 46 on the lower end of the sleeve 70.

When the plunger 70 is clutched to the coupling 71 by the clutch 77, a tool may be lowered in the well into engagement with bayonet slots 80 in the upper end of said sleeve, and upon turning said tool in one direction or the other the screw coupling 71, through the medium of the plunger 70, clutch 77 and the screw threads 72 and 73, may be moved down on the liner casing 31, to compress the spring 30, for finer screening of the oil between its coils, or said coupling may be moved up on said liner casing to allow said spring 30 to expand for coarser screening of the oil between its coils, thus providing a means for adjusting the screening of the oil through my liner while it is down in the well.

Upon lowering a sinker bar upon the upper end of the plunger 70, said sleeve may be depressed to compress the spring 30, and upon raising said sinker bar said spring may be allowed to expand and force the plunger 70 upwardly behind the upwardly moving sinker bar, whereby said spring is caused to scrape the inner surface of the liner casing 31 and scrape away any deposits from the perforations 43 in said liner casing and open up any of said perforations that might be closed by such deposits.

As shown in Figs. 14 to 18 inclusive, means 90 may be provided for detachably securing my liner down in a well to prevent high gas pressure from blowing my liner and other apparatus out of the well. Said means 90 may comprise an inverted conical wedge sleeve 91, secured on the liner tubing 31 near the upper end thereof, a plurality of slips 92 fitted on said liner tubing below said wedge sleeve, and a collar 93 secured on said liner tubing below said wedge sleeve, upon which collar said slips rest, out of engagement with said wedge sleeve 91, when the slips are not subjected to high gas pressure in the well below the slips. The wedge sleeve 91 slidably engages the inner side of the well casing 23 and centers my liner in the well. The bull nose 36' is rounded and is preferably screw seated on the lower threaded end of the liner tubing 31, in which bull nose rests the lower end of the spring 75. Said bull nose rests upon the bottom of the well, whereby my liner is supported in operative position down in the well.

In the event of a "heave" of gas under great pressure in the bottom of the well, the slips 92 will be forced upwardly by the high pressure of the gas into engagement with the wedge sleeve 91, until the teeth 95 of said slips bind against the inner side of the well casing 23 and hold my liner in position in the well against said gas pressure, thus preventing my liner from being blown out of the well by such high gas pressure.

The modification of my invention shown in Fig. 19 is like that shown in Figs. 14 to 18 inclusive, except that the bull nose 36' is eliminated from the lower end of the liner tubing 31 and a tubular plunger 100 is slidably mounted in the lower end of said liner tubing by means of a screw sleeve coupling 101, formed with an internal thread 102, which engages the external thread 35 on the lower end of said liner tubing 31, said coupling 101 being also formed at its lower end with an internal flange 103, which surrounds the plunger 100 and is adapted to engage a head 104 on the upper end of said plunger for limiting the downward movement of said plunger in the liner tubing 31 and preventing said plunger from dropping out of the lower end of said tubing when the liner is in such position in the well that the lower end of said plunger cannot rest upon the bottom of the well. A bull nose 105 is screw seated on the lower end of the plunger 100 for resting upon the bottom of the well when the liner is lowered far enough down the well as illustrated. The lower end of the spring 75 rests upon the head 104 on the upper end of the plunger 100 and exerts a downward pressure upon said plunger, forcing said plunger downwardly in the lower end

of the liner tubing **31** until the plunger head **104** engages the coupling flange **103**, when the liner is so positioned in the well casing **94** that the bull nose **105** on the lower end of the plunger **100** rests above the bottom of the well, while the plunger is in its said lowermost position in the liner tubing **31**. This modification of my liner is supported in the well casing **23** by a tubing hanger **24**, as shown in Fig. 7 of the drawings, with the bull nose **105** on the lower end of the plunger **100** located above the bottom of the well, while said plunger is held in its lowermost position with its head **104** engaging the coupling flange **103**.

The operation of this modification of my liner is as follows:

When the liner is held in the well casing by the tubing hanger **24**, as illustrated in Fig. 7, a conventional sinker bar may be lowered in the well upon the upper end of the plunger **70** to depress said plunger and compress the spring **75**, and the sinker bar may then be elevated to allow said spring to expand. The lowering of the sinker bar and the compression and expansion of the spring **75** several times will cause said spring to scrape away deposits on the inner side of the liner tubing **31** and open any of the perforations **43** in the liner tubing which may be closed by such deposits. However, the compression and expansion of the spring **75** at its upper end, by the upper plunger **70**, will compress and expand the upper portion of the spring to a considerably greater extent than the lower portion of the spring and consequently the inner side of the upper portion of the liner tubing **31** will be scraped more effectively by the spring than the inner side of the lower portion of the liner tubing.

A greater compression and expansion of the lower portion of the spring **75**, than is produced by the operation of the upper plunger **70**, may be produced by the operation of the lower plunger **100** in following manner:

A conventional tripping tool is lowered in the well and the liner hanger **24** is tripped by said tool, whereby the slips **62** are released from the casing **23**, and the liner is lowered by said tool until the bull nose **105** on the lower end of the plunger **100** rests upon the bottom of the well and the liner tubing **31** descends under its own weight, over plunger and causes the spring **75** to be compressed, by the head **104** on the upper end of said plunger, between said head and the bearing **46'** on the lower end of the upper plunger **70**, as illustrated in the drawings. The tripping tool is then removed from the well casing and a suitable tool, such as a combination socket, is then lowered in the well casing and the coupling **71** on the upper end of the liner tubing **31** is gripped by said socket, whereupon the liner tubing is raised and lowered several times by said tool, and the spring **75** correspondingly expands and is compressed between the plungers **70** and **100**, causing the lower portion of said spring to be expanded and contracted to a greater extent and to scrape the lower portion of the inside of the liner tubing more effectively than when the spring is contracted and expanded by means of the upper plunger **70**, as above described.

I do not limit my invention to the exact construction herein disclosed since various changes may be made therein without departing from the spirit of the invention.

I claim:

A liner for wells comprising a perforated liner tube, a coil spring mounted in said tube, a sleeve screw-seated in said liner tube so that one end of said sleeve engages one end of said spring for compressing or allowing said spring to expand, when said screw sleeve is turned in one direction or the other, means for limiting the outward movement of said sleeve with relation to said liner tube, when said sleeve is turned out of threaded engagement with said tube, and a clutch, which is brought into engagement for clutching said sleeve against rotation with relation to said tube, when said sleeve is turned out of threaded engagement with said tube and is limited in its outward movement with relation to said liner tube.

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