

Dec. 1, 1942.

G. D. JOHNSON ET AL

2,303,556

LINER HANGER

Filed July 2, 1940

3 Sheets-Sheet 1

Fig. 1.

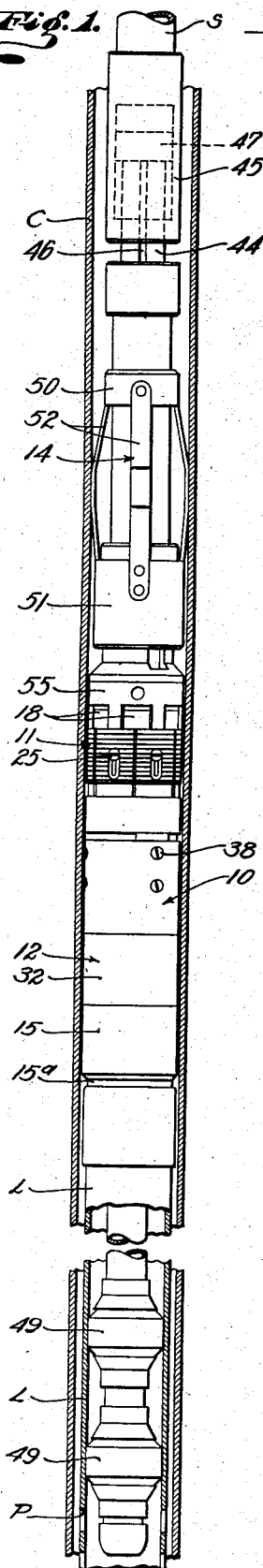


Fig. 2.

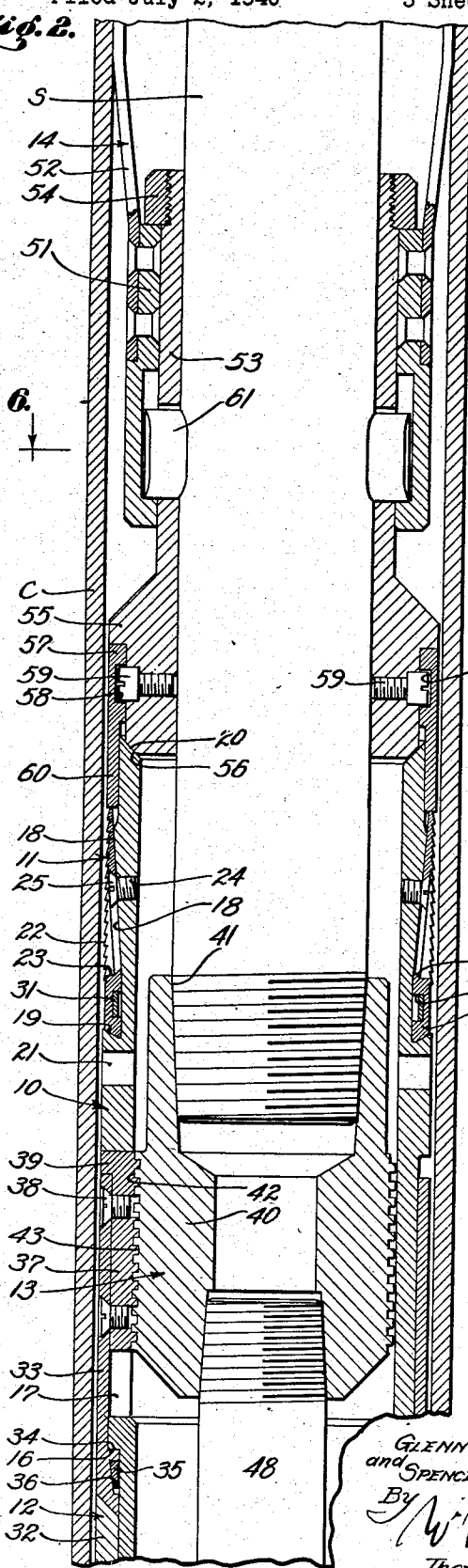
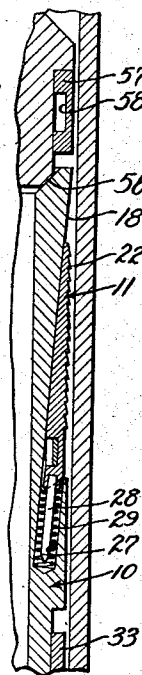


Fig. 3.



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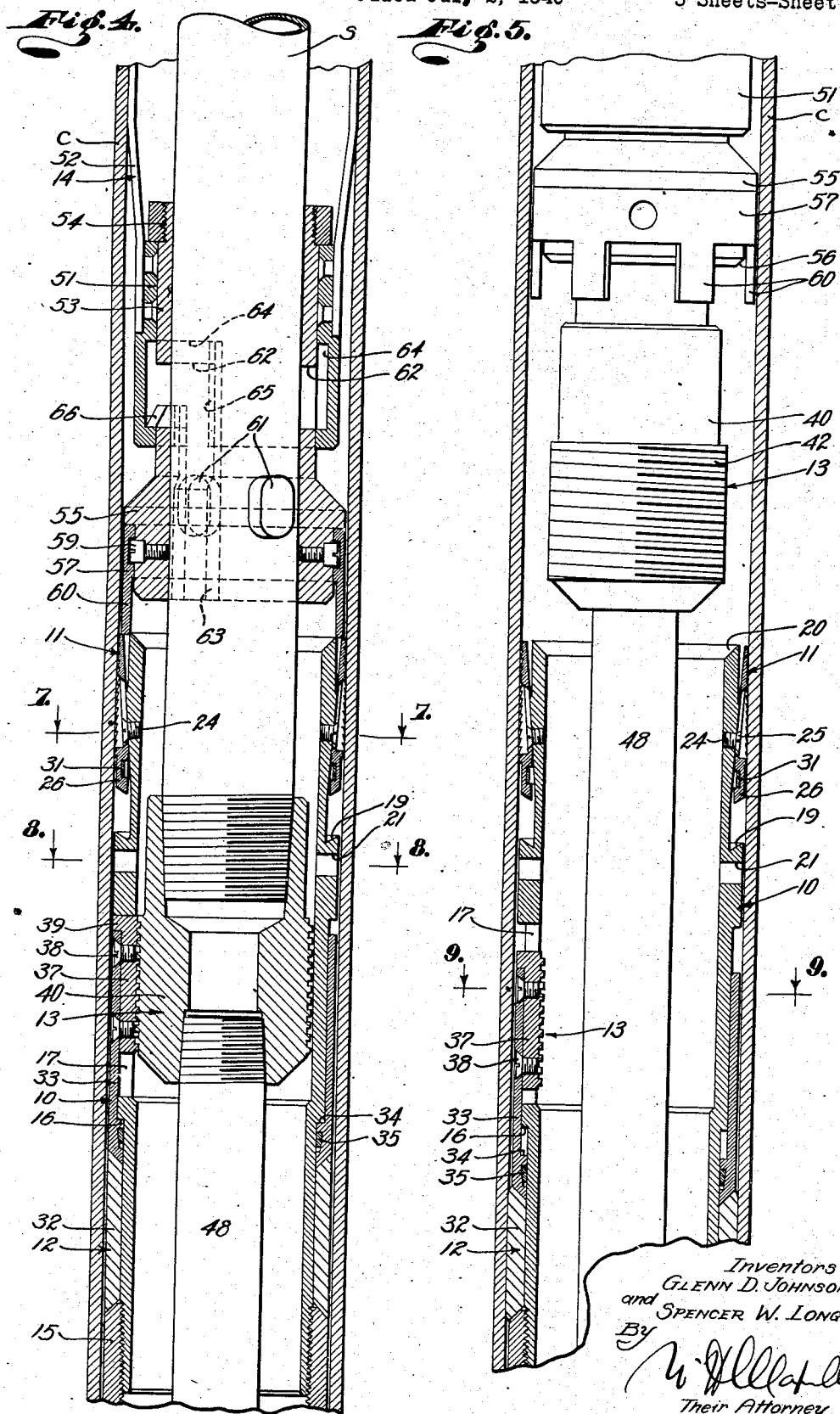
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Fig. 6.

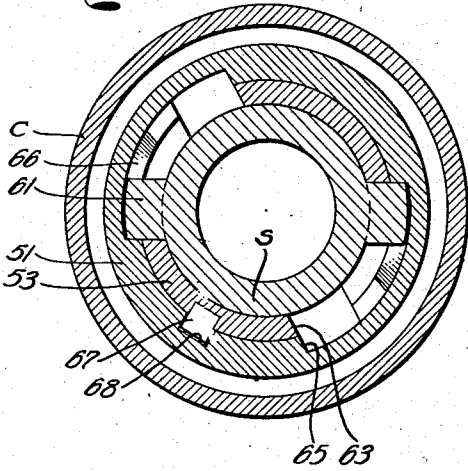


Fig. 7.

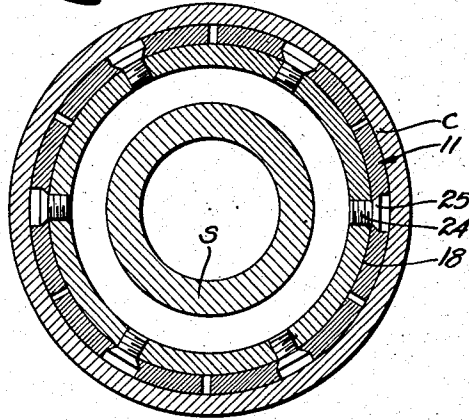


Fig. 8.

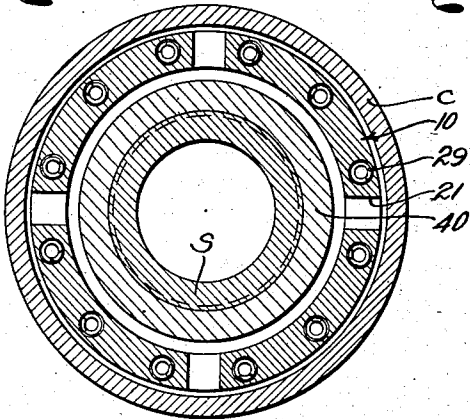


Fig. 11.

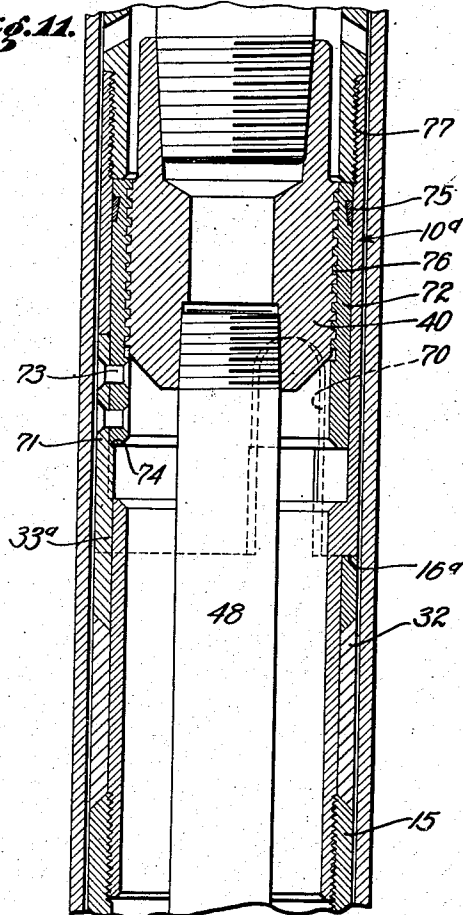


Fig. 9.

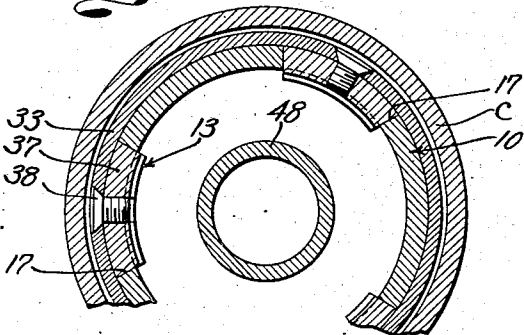
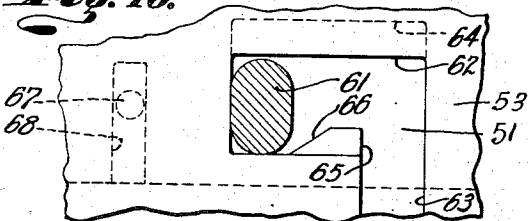


Fig. 10.



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UNITED STATES PATENT OFFICE

2,303,556

LINER HANGER

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Application July 2, 1940, Serial No. 343,614

12 Claims. (Cl. 166—12)

This invention relates to a well tool and relates more particularly to a liner hanger. A general object of this invention is to provide a practical and effective liner hanger that may be readily operated or set under practically any conditions.

Another object of this invention is to provide a liner hanger that may be positively operated to securely and dependably suspend a liner, or the like, under all conditions of operation. The improved liner hanger of the present invention may be successfully and easily operated to dependably suspend the liner in situations where the liner is caught in the well, where the liner cannot be turned in the well, where the liner is free in the well, and where it is undesirable to engage the liner with the bottom of the well.

Another object of this invention is to provide a releasable packing type liner hanger in which the liner may be washed out or flushed with suitable circulation fluid following the setting of the slips and prior to the actuation or expansion of the packing.

Another object of this invention is to provide a liner hanger that is compact and capable of embodiment in sizes for use in casings of small diameters. The liner hanger of the present invention requires only two telescoping elements at any one horizontal plane and these elements may be constructed with sufficient wall thickness to have adequate strength without unduly increasing the external diameter or the internal diameter of the tool.

Another object of this invention is to provide a liner hanger embodying a novel control means or latch means that is positive and cannot become unintentionally released when the setting string is made up and run into the well, and yet may be readily controlled to set the slips and actuate the packing.

Another object of this invention is to provide a liner hanger in which the friction means, the latch means, the slip restraining fingers and the related parts are all recovered and withdrawn from the well following setting of the tool, leaving only the essential hanger body, slips and packing associated with the liner.

Another object of this invention is to provide a liner hanger of the character mentioned in which the setting unit may be readily conditioned for use with slip and packing units intended for installation in casings of different diameters.

Another object of this invention is to provide a liner hanger of the character referred to embodying a novel screw threaded releasable con-

nection and operating connection between the hanger body and the setting unit that dependably transmits the forces required for the release and actuation of the slips and yet requires a minimum wall thickness at the hanger body.

A further object of this invention is to provide a releasable packing type liner hanger that may be readily released and withdrawn from the well when it is desired to repair or replace the liner or hanger.

The various objects and features of our invention will be fully understood from the following detailed description of a typical preferred form and application of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a side elevation of the liner hanger provided by this invention suspended from a setting string and in condition for operation in a well casing. Fig. 2 is an enlarged fragmentary vertical detailed sectional view of the principal parts of the liner hanger in the initial or unactuated positions. Fig. 3 is a fragmentary detailed sectional view taken in a plane spaced from the plane of Fig. 2 illustrating one of the spring actuating means of a slip. Fig. 4 is a fragmentary longitudinal detailed sectional view of the tool showing the slips actuated and the control or latch means released. Fig. 5 is a view similar to Fig. 4 showing the packing actuated and the setting unit being withdrawn from the well, the setting unit appearing in side elevation. Fig. 6 is a transverse detailed sectional view taken as indicated by line 6—6 on Fig. 2. Figs. 7 and 8 are enlarged transverse detailed sectional views taken as indicated by lines 7—7 and 8—8, respectively, on Fig. 4. Fig. 9 is an enlarged transverse detailed sectional view taken as indicated by line 9—9 on Fig. 5. Fig. 10 is an enlarged fragmentary stretchout view of the pin and slot means and Fig. 11 is a fragmentary longitudinal detailed sectional view of a modified form of construction.

The improved liner hanger of the present invention may be said to comprise, generally, a hanger body 10 to be secured to the upper end of a liner L, slips 11 carried by the body 10 for gripping the interior of a casing C to suspend the liner L, packing means 12 on the body 10 for sealing with the interior of the casing C, a releasable operating connection 13 between a setting string S and the body 10, and a restraining means or control 14 for the slips 11.

The body 10 of the liner hanger is an elongate tubular member proportioned to be received in

the casing C with suitable clearance. The lower portion of the body 10 is externally threaded to receive a collar or coupling 15. The coupling 15 may directly thread on the liner L or, as illustrated, may be threaded to a nipple 15^a on the upper end of the liner. The external diameter of the body 10 is increased some distance above the coupling 15 to provide a downwardly facing external annular shoulder 16. A plurality of spaced longitudinal slots 17 are provided in the wall of the body 10 above the shoulder 16. In the preferred construction illustrated there are three equally spaced slots 17 of like size and shape. The side walls of the slots 17 are radial with respect to the longitudinal axis of the tool and the upper and lower walls of the slots are flat and horizontal. The external diameter of the body 10 is again increased at the upper ends of the slots 17.

The upper portion of the body 10 is shaped to constitute a cone or wedge part for expanding the slips 11. In the preferred construction a series of downwardly and inwardly sloping faces 18 are formed on the exterior of the body 10 some distance above the slots 17. The faces 18 are preferably, though not necessarily, transversely cylindrically curved. An upwardly facing annular shoulder 19 is provided on the exterior of the body 10 some distance below the faces 18. The shoulder 19 slopes upwardly and outwardly. The upper extremity of the tubular body 10 is provided with a downwardly and inwardly sloping seat 20. Spaced lateral ports 21 are provided in the wall of the body 10 below the shoulder 19 and above the slots 17 to facilitate the handling of the fluid employed to flush the liner L. It is to be observed that the body 10 just described is a simple, one-piece member.

The slips 11 are arranged on the body 10 to grip the interior of the casing C for the purpose of suspending the liner L. A slip 11 is provided to engage or ride on each face 18. The slips 11 are wedge-like segments having pitched inner sides that conform to the pitched body faces 18 and having cylindrically curved convex outer faces for conforming generally to the interior of the casing C. Downwardly and outwardly directed wickers or teeth 22 are provided on the outer sides of the slips 11 to bite into or grip the interior of the casing C. Novel means are provided for guiding the slips 11 and for holding the slips against displacement and loss. A vertical slot 23 is provided in each slip 11. Where a single slot 23 is formed in each slip it is equally spaced between the vertical edges of the slip. The side and end walls of the slots 23 flare outwardly. Screws 24 are threaded into openings in the body 10 and have heads 25 received in the slots 23. The heads 25 have tapered or conical under sides cooperating with the flared walls of the slots 23. It will be seen that the screw heads 25 cooperating with the slots 23 hold the slips 11 against displacement and loss yet allow free longitudinal movement and expansion of the slips.

In accordance with the invention the slips 11 are spring actuated to automatically expand into gripping engagement with the casing C when released for upward movement relative to the body 10. The slips 11 are provided with plain or un-toothed tails 26 below the wedge faces 18. The lower ends of the tails 26 are pitched downwardly and inwardly to cooperate with the pitched shoulder 19. The engagement of the tails 26 with the shoulder 19 assists in holding the slips retracted. Sloping bores 27 are provided in the

body 10 and extend downwardly from the shoulder 19, see Fig. 3. Pins 28 are secured to the slip tails 26 and project downwardly into the bores 27. Coiled springs 29 surround the pins 28 and are arranged under compression to bear against the bottom walls of the bores 27 and the lower ends of the slip tails 26. The springs 29 urge the slips 11 upwardly to be expanded through cooperation with the wedge faces 18. In practice there may be two springs 29 for actuating each slip 11 and the springs are preferably spaced equidistant from the longitudinal axes of the slips.

Means is preferably provided to connect the several slips 11 for simultaneous and uniform actuation. An annular internal groove 30 is formed in the inner sides of the slip tails 26. A split spring ring 31 is engaged in the groove 30. The ring 31 engaging in the groove 30 connects the several slips 11 for simultaneous movement and uniform expansion. The slips 11 are initially held in the retracted positions shown in Fig. 2 by the control means 14.

The packing means 12 is operated following setting of the slips 11 to seal between the body 10 and the interior of the casing C. The packing means 12 includes an annular or tubular body of packing 32 surrounding the body 10 above the coupling 14. The packing 32 may be formed of lead or similar material that is capable of lateral distortion or expansion when subjected to longitudinal compression. The means 12 further includes a follower ring or gland ring 33 surrounding the body 10 above the packing 32. The ring 33 is longitudinally shiftable on the body 10 and partially covers the slots 17. With the parts in the unactuated positions the upper end of the ring 33 is spaced a short distance below the plane occupied by the upper ends of the slots 17. The ring 33 is preferably provided with an internal upwardly facing shoulder 34 initially engaging the shoulder 16. The lower end of the ring 33 engages the upper end of the body of packing 32. This end of the ring 33 slopes downwardly and inwardly and the upper end of the packing 32 is correspondingly sloped. The upper end of the coupling 15 is pitched downwardly and outwardly and the lower end of the packing 32 is correspondingly pitched. It will be seen that downward movement of the ring 33 relative to the body 10 compresses the packing 32 to expand it into sealing engagement with the casing C.

Means may be provided for holding the ring 33 in its down position or actuated position. Grippers or slips 35 may be set in circumferentially spaced slots 36 in the interior of the ring 33 to grip the body 10 and prevent return movement or upward movement of the ring 33 following its actuation. The cooperating rear faces of the slips 35 and inner walls of the slots 36 slope downwardly and inwardly so that the slips are automatically expanded or actuated in the event the ring 33 tends to return or move upwardly with respect to the body 10.

The releasable operating connection 13 serves to connect the hanger body 10 and the associated parts with the setting string S to provide for the operation of the slips 11 and the actuation of the packing 12 by simple manipulation of the string. It is an important feature of the invention that the connection 13 provides for the full dependable actuation of both the slips 11 and the packing means 12 without the necessity of engaging the liner L against the bottom of the well and in situations where the liner L is immovably stuck in the well. The operating connection 13 in-

cludes blocks 37 arranged in the body slots 17. The blocks 37 are adapted to move vertically in the slots 17, being shorter than the slots and fitted for free vertical movement. The vertical edges of the blocks 37 are flat and radial with respect to the longitudinal axis of the tool to ride on the side walls of the slots 17. The blocks 37 are secured to the actuating ring 33 of the packing means 12. The outer sides of the blocks 37 are shaped to engage against the interior of the ring 33 and spaced screws 38 secure the blocks 37 to the ring 33. Means is preferably provided to directly transmit downward forces from the blocks 37 to the ring 33 to relieve the screws 38 of such forces. Lips or flanges 39 are provided on the upper ends of the blocks 37 and engage downwardly against the upper end of the ring 33. The flanges 39 serve to directly transmit vertical loads and forces from the blocks 37 to the ring 33 for the actuation or expansion of the packing 32.

The releasable operating connection further includes a member 40 secured to the setting string S and having threaded engagement with the blocks 37. The setting string S may be made up of lengths or stands of pipe or tubing connected by couplings preferably provided with righthand threads, and the connecting member 40 is suitably secured to the lower end of the string. As illustrated the member 40 may be a tubular part provided in its upper end with a tapered socket 41 for receiving the threaded lower end of the setting string S. An external square thread or other free running thread 42 is provided on the member 40 to mate with thread portions 43 formed on the inner sides of the blocks 37. The thread 42 and the thread portions 43 are preferably pitched in the lefthand direction and are heavy or coarse to adequately transmit the packing-actuating forces. Under certain conditions of operation the thread 42 and the thread portions 43 operate upon rotation of the string S to produce upward movement of the string relative to the body 10 and the thread 42 is of course readily disengaged or unthreaded from the thread portions 43 when the setting string is to be withdrawn from the well.

It is preferred to provide a slack connection in the string S to relieve the thread 42 and thread portions 43 of vertical forces when the thread means are operated. This slack connection may be a bumper sub comprising a mandrel 44 shiftably received in a barrel 45 and connected against turning relative to the barrel by a sliding spline connection 46. A head 47 is provided on the mandrel 44 to prevent longitudinal disconnection or separation of the mandrel and barrel 45. The slack connection or bumper sub just described is preferably connected in the string S immediately above the liner hanger and, of course, is formed to conduct the flushing fluid. With the mandrel 44 and barrel 45 in an intermediate position, where the head 47 is between the ends of the barrel 45, the thread 42 and thread portions 43 are relieved of the weight of the string S.

Means is preferably associated with the setting string S and the connecting means 13 to deliver washing fluid or circulation fluid to the liner L. This means may comprise a wash pipe 48 threaded in the lower end of the member 40 to project downwardly through the body 10. The pipe 48 may be of any selected or required length and carries one or more packers 49 for sealing with the interior of the liner L. Fluid is adapted to

discharge from the lower end of the pipe 48 to enter the liner L and pass out through the perforations P of the liner to wash the same. The wash-fluid discharging from the perforations P passes upwardly around the liner L to the ports 21 to return through the casing C as will be later described.

The control 14 is operable to initially hold the slips 11 retracted and is released or manipulated by the string S to free the slips 11 for actuation by their respective springs 29. The control 14 includes a friction drag means or friction spring assembly for engaging in the casing C. The spring assembly includes an upper sleeve 50 freely slidable on the string S and a lower sleeve 51 engaging around another element of the control. Spaced outwardly bowed leaf springs 52 extend between and connect the sleeves 50 and 51. The springs 52 serve to frictionally engage in the casing C to resist vertical movement of the sleeves 51 and 52 and the parts connected therewith.

The control 14 further includes a tube or sleeve 53 shiftably surrounding the setting string S and extending through the lower spring sleeve 51. A collar or nut 54 is provided on the upper end of the sleeve 53 and is engageable with the upper end of the sleeve 51 so that the spring assembly may resist downward movement of the sleeve 53. An enlargement or head 55 is provided on the lower end of the sleeve 53 and has a corner face 56 adapted to rest on the seat 20. A slip control ring 57 engages around the head 55. The ring 57 is rotatably connected with the head 55. An internal groove 58 is provided in the ring 57 and screws 59 are threaded in openings in the head 55 to have their heads received in the groove 58. The engagement of the screws 59 in the groove 58 prevents relative longitudinal movement between the sleeve 53 and the ring 57 while permitting free relative turning between these parts. Fingers 60 of reduced thickness project from the lower end of the ring 57 and engage with the upper ends of the slips 11. There may be one finger 60 for each slip 11. The fingers 60 project downwardly past the upper end of the body 10 to contact the upper ends of the slips 11.

The control 14 further includes a releasable lock or latch mechanism connecting the sleeves 51 and 53 with the string S in positions where the slips 11 are held retracted by the fingers 60. This lock or latch mechanism includes two diametrically opposite pins or lugs 61 on the setting string S. Sets of slots are provided in the sleeves 51 and 53 to receive or cooperate with the lugs 61, see Fig. 10. The slots in the inner sleeve 53 are substantially L-shaped having horizontal upper arms 62 and vertical legs 63 extending downwardly from the arms 62. The legs 63 continue downwardly through the sleeve 53 to the lower end of the head 55 being in the nature of grooves where they pass through the head. The arms 62 of the slots are shaped and proportioned to normally receive the lugs 61 with only working clearance between the upper and lower ends of the lugs and the upper and lower walls of the slot arms. As illustrated the lugs 61 may have substantially flat vertical sides and rounded upper and lower ends. The slot legs 63 are proportioned to receive and freely pass the lugs 61.

The outer sleeve 51 has a pair of diametrically opposite slots of inverted J-shape for receiving or cooperating with the lugs 61. The slots in the sleeve 51 have horizontally extending arms 64

and legs 65 extending downwardly from the arms. The arms 64 are considerably wider than the slot arms 62 in the sleeve 53 so that the lugs 61 have considerable vertical movement or play in them. A sloping lug-retaining face 66 is provided on the lower wall of each slot arm 64. The faces 66 slope upwardly and toward the vertical legs 65 so that the horizontal arms 64 of the slots are restricted in width where they join the legs 65. The telescopically related sleeves 51 and legs 65 are keyed against relative turning. A peg or key 67 is fixed to the sleeve 53 and cooperates with a vertical internal key-way 68 in the sleeve 51 to prevent relative turning between the sleeves.

With the parts in the initial positions the lugs 61 occupy the inner portions of the slot arms 62 and 64. The sloping faces 66 on the sleeve 51 of the spring assembly prevent the lugs 61 from unintentionally reaching the vertical legs 63 and 65 of the slots when the string S is made up and run into the well with the liner hanger on its lower end. Thus the latch means dependably retains the parts in the positions where the slips 11 are retracted and vertical movement and turning movement of the string S accompanying the lowering of the tool through the well cannot cause premature release of the slips.

Fig. 11 of the drawings illustrates a modified form of the liner hanger construction. In this arrangement the slots 17 are replaced by vertical slots or notches 70 which extend upwardly in the body 10^a from its shoulder 16^a. The packing gland ring 33^a shiftably surrounds the body 10^a and has its upper end at the body shoulder 16^a. Fingers 71 are provided on the upper end of the gland ring 33^a and are received in the notches 70. The blocks 37 employed in the previously described form of the invention are replaced by a tube 72 arranged within the body 10^a. The tube 72 enters the series of fingers 71 and rivets 73 or similar securing members rigidly connect the fingers 71 with the tube 72. The lower end of the tube 72 rests on upwardly facing shoulders 74 on the inner sides of the fingers 71 for the direct transmission of downward forces from the tube to the fingers. Slips or grippers 75 are arranged in slots in the tube 72 and are adapted to grip the interior of the body 10^a to prevent return movement or upward movement of the ring 33^a following expansion of the packing. The tube 72 has a continuous thread 76 for mating with the thread 42 of the member 40. In this construction the body 10^a may be sectional and may have a threaded connection 77 immediately above the tube 72.

In operation the liner hanger is assembled and secured to the lower end of the setting string S, the liner L being secured to the hanger body 10, as above described. In the following description of operation it will be assumed that the structure of Figs. 1 to 10, inclusive, is employed. The string S is made up and lowered into the well in the usual manner to bring the liner L to the desired position. With the liner L in the selected position the setting string S is raised a short distance and turned to the right. The raising of the string S moves the lugs 61 upwardly in the slot arms 64 of sleeve 51. The springs 52 frictionally engage in the casing C to hold the sleeve 51 against movement when the lugs 61 move upwardly in the slot arms 64. The turning of the string S to the right moves the lugs 61 through the slot arms 62 and 64 to bring them into alignment with the slot legs 63 and 65. The string S is then moved downwardly or al-

lowed to lower. During this downward movement of the string S the body 10 and the parts carried thereby of course move downwardly with the string but the springs 52 frictionally engaging in the casing C hold the sleeve 51 against downward movement. The nut 54 contacting the upper end of the sleeve 51 holds the sleeve 53 against downward movement and the lugs 61 on the downwardly moving string S pass downwardly in the slot legs 63 and 65. The downward movement of the body 10 with the string S is accompanied by actuation of the slips 11. The sleeve 53 carrying the ring 57 and its fingers 60 is held against downward movement by the spring assembly as above described, and when the body 10 moves downwardly with the string S the springs 29 move the slips 11 upwardly on the wedge faces 18 so that they are expanded by the wedge faces. Any continued downward movement of the body 10 following expansion of the slips 11 by the springs 29 merely further expands or sets the slips so that they obtain a tighter engagement with the casing C. It will be observed that the slips 11 are fully and dependably actuated by simple manipulations of the string S without the necessity of engaging the liner L with the bottom of the well and without dragging the freed or expanded slips through the casing.

Following the setting or actuation of the slips 11 the liner L may be washed or flushed out. To perform this operation a suitable flushing fluid is pumped down through the string S to discharge from the lower end of the wash pipe 48. The fluid thus discharged into the liner L passes out through the perforations P to wash the same and then flows up in the annular passage between the liner L and the interior of the casing C. Upon reaching the ports 21 the fluid flows into the body 10 and continues upwardly through the body to discharge into the casing C above the body. The fluid is free to discharge through the lower ends of the slot legs 63 and through the space that occurs between the seat 20 and the corner surface 56 of the spring supported sleeve 53. The improved liner hanger of the present invention makes full provision for the washing of the liner L and is constructed so that the solid matter may readily pass up through the liner hanger construction without sanding up any of the parts.

Following the setting of the slips 11, when it is not desired to flush the liner L, or following the above described liner flushing operation, the packing 32 is actuated by simple manipulation of the string S. To actuate the packing 32 under normal conditions the string S is lowered or allowed to settle so that a substantial weight or down pressure is applied to the blocks 37 threaded with the member 40 on the string. As the body 10 is held against downward movement by the slips 11 gripping the casing C, the downward pressure applied to the blocks 37 serves to actuate or compress the packing 32. The downward force is transmitted to the ring 33 by the flanges 39 bearing on the upper ends of the ring and the ring 33 bearing on the upper end of the packing compresses the packing. Sufficient force or pressure may be applied to the packing 32 to assure its full actuation. It is to be observed that the blocks 37 are free to move down in the slots 17 during actuation of the packing 32.

With the slips 11 set and the packing 32 actuated the string S and the setting parts are released and withdrawn from the well. To accomplish this the string S is manipulated to bring

the barrel 45 to an intermediate position so that little or no weight is applied to the member 40. The string is then rotated to the right to unthread the member 40 from the blocks 37. The thread 42 is readily unthreaded from the thread portions 43 of the blocks 37. When the member 40 has been unthreaded from the blocks 37 the string is raised and withdrawn from the well. The member 40 and the wash pipe 48 are secured to the lower end of the string S to be withdrawn thereby. The lugs 61 engaged in the slots of the sleeves 51 and 53 connect the latch means parts and the friction spring assembly with the string S so that these elements are withdrawn on the string.

In the event it is found that the liner L is caught or stuck in the well upon being brought to the desired position the hanger may be fully actuated to set the slips 11 and to compress the packing 32. When it is found that the liner L is caught or stuck in the well the string S is manipulated to bring the barrel 45 to an intermediate position relative to the mandrel head 47 and the string S is rotated to the right. Rotation of the string S to the right causes the thread 42 to thread upwardly in the thread portions 43. Thus the lower portion of the string S carrying the sleeve 53 is moved upwardly with respect to the body 10. During this threading operation the pins or lugs 61 may cam up the sloping faces 66 and if this occurs the lugs merely push the spring assembly through the casing C for a short distance. The upward movement of the sleeve 53, resulting from threading of the thread 42 through the thread portions 43, moves the fingers 60 upwardly so that the springs 29 may actuate the slips 11. The slips 11 forced upwardly along the wedge faces 18 by the springs 27 expand into full gripping engagement with the casing C. In actual practice about five full revolutions of the string S is sufficient to release the slips 11 for gripping the casing. Following the setting or actuation of the slips 11 fluid may be circulated through the string S to flush out the liner L as described above. If it is not desired to circulate or wash the liner L the packing 32 may be actuated immediately following the setting of the slips 11. In either case when it is desired to actuate the packing 32 the weight or a portion of the weight of the string S is applied to the blocks 37 which still have threaded engagement with the member 40. The downward pressure is applied to the ring 33 and the ring compresses and expands the packing 32. The slips 11 engaged with the casing C of course hold the body 10 against downward movement during the expansion of the packing. With the packing 32 expanded the upper portion of the string S may be raised to bring the barrel 45 to an intermediate position with respect to the mandrel 44 so that there is a minimum of weight on the member 40. The string S is then rotated to unthread the member 40 from the blocks 37. With the member 40 unthreaded from the blocks 37 the string S is withdrawn from the well carrying with it the member 40, pipe 48, sleeve 53 and the spring assembly of the means 14.

Having described only a typical preferred form and application of our invention, we do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to ourselves any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims.

Having described our invention, we claim:

1. In a well tool of the character described for use on a well string, a tubular body having longitudinal slots, packing means on the body operable under compression to seal between the body and the well wall, members shiftable in the slots to transmit compression forces to the packing means, a mandrel on the string, and co-engaging threaded parts on the members and mandrel for transmitting forces from the mandrel to the members for the actuation of the packing means and releasable upon rotation of the string.

2. In a well tool of the character described, a body having a wedge part, a series of slips around the body expandible through cooperation with the wedge part, the slips having slots, pins projecting from the body and extending through the slots, heads on the pins preventing displacement of the slips, and a spring ring engaging within the series of slips to assure uniform expansion of the slips.

3. In a well tool to be operated on a well string, a body movable with the string, gripping means carried by the body for gripping the well wall, means tending to cause operation of the gripping means, and a control for the gripping means comprising a shiftable sleeve on the string for holding the gripping means retracted, the sleeve being adapted to have relative movement with respect to the string and body, friction means having movement-retarding cooperation with the well wall and shiftable carrying the sleeve, and a pin and slot connection between the string and the sleeve initially holding the sleeve in the position where the gripping means is retracted and releasable by manipulation of the string so that the body may be moved with respect to the sleeve to cause actuation of the gripping means.

4. A well tool for use on a well string comprising a body, a releasable connection between the string and body, gripping means carried by the body operable to grip the wall of a well to support the body therein, spring means tending to actuate the slips, friction means arranged to have relative movement with respect to the string and body and having movement-resisting engagement with the wall of the well, means on the friction means for normally holding the gripping means inactive, and pin and slot means for holding the friction means against longitudinal movement relative to the string in a position where the griping means is held inactive and releasable by turning of the string relative to the friction means whereby the gripping means may operate, the pin and slot means connecting the friction means with the string for removal from the well therewith.

5. A well tool for use on a well string comprising a body, a releasable screw threaded connection between the body and string operable upon rotation of the string to cause relative longitudinal movement between the body and string, gripping means carried by the body operable to grip the wall of a well to support the body and liner therein, spring means tending to operate the gripping means, friction means arranged to have relative movement with respect to the string and body and having movement-resisting engagement with the well wall and adapted to hold the gripping means retracted, and a connection between the friction means and the string initially holding the friction means in the position where the gripping means is retracted and moving the friction means longitudinally with the string to free the gripping means for operation upon said relative longitudinal movement between the body and string.

6. In a well tool of the character described, a

tubular body, packing means on the body operable under compression to seal with the well wall, a gland shiftable on the body to transmit compression forces to the packing means, a setting mandrel, gripping means on the body operable to grip the wall of the well to hold the body against downward movement so that a downward force on the gland may actuate the packing means, spring means tending to operate the gripping means, means for frictionally engaging the well wall to hold the gripping means retracted and releasable by manipulation of the mandrel to allow actuation of the gripping means, and a releasable connection between the gland and mandrel whereby the last named means may be released and the packing means actuated by manipulation of the mandrel.

7. In a well tool for use on a well string, a tubular body having longitudinal slots, packing means on the body operable under compression to seal between the body and the well wall, members shiftable in the slots to transmit compression forces to the packing means, a mandrel on the string received in the body, gripping means on the body operable to grip the wall of the well to hold the body against downward movement so that a downward force on the members may actuate the packing means, spring means tending to operate the gripping means, means for holding the gripping means retracted releasable by relative movement between the body and string, and releasable screw threads on the mandrel and members operable upon rotation of the string to produce said relative movement and operable to transmit vertical forces from the mandrel to the members for the actuation of the packing means.

8. In a well tool for use on a well string, a tubular body having longitudinal slots, packing means on the body operable when compressed to seal with the well wall, members shiftable in the slots to transmit compression forces to the packing means, a mandrel part on the string received in the body, gripping means on the body operable to grip the wall of the well to hold the body against downward movement so that a downward force on the members may actuate the packing means, means tending to operate the gripping means, holding means for normally holding the gripping means retracted, the holding means being arranged to have relative movement with respect to the string and body, a releasable threaded connection between the mandrel part and said members providing for movement of the body by the mandrel and for the application of packing actuating forces to the members, and a releasable latch connection between the string and holding means for retaining the holding means in the position where the gripping means is retracted and releasable by manipulation of the string to allow actuation of the gripping means, the latch connection coupling the holding means to the string for withdrawal from the well therewith.

9. A liner hanger for securing a liner in a well and adapted to be operated on a setting string comprising a tubular hanger body, packing on the body operable when compressed to seal between the body and the wall of the well, gripping means on the body operable to grip the wall of the well to suspend the body therein, means tending to operate the gripping means, a member having limited movement on the body for transmitting actuating forces to the packing, a releasable threaded connection between the

string and member whereby the string may be manipulated to move the body and actuate the packing, friction means arranged to have relative movement with respect to the string and body having movement-resisting engagement with the wall of the well, a part connected with the friction means normally holding the gripping means inactive, and a pin and slot connection between the string and friction means initially holding the friction means in a position where the gripping means is inactive and releasable by manipulation of the string so that the body and string may be moved with respect to the friction means to free the gripping means for operation.

10. In a well tool to be operated on a well string, a body on the string, gripping means carried by the body for gripping the well wall, means tending to cause operation of the gripping means, a sleeve shiftable on the string and cooperating with the gripping means to hold the same retracted, friction means having movement-retarding engagement with the well wall and including a part shiftable engaging around the sleeve and having limited movement with respect to the sleeve, the sleeve and part having bayonet slots, and a pin on the string normally cooperating with the slots to hold the sleeve in the position where the gripping means is held inactive and movable in the bayonet slots to allow relative movement between the body and sleeve to free the gripping means for operation.

11. In a well tool to be operated on a well string, a body movable with the string, gripping means carried by the body for gripping the well wall, means tending to cause operation of the gripping means, a sleeve shiftable on the string for holding the gripping means retracted, friction means having movement-retarding engagement with the well wall and including a part shiftable engaging around the sleeve and having limited movement with respect to the sleeve, the sleeve having a bayonet slot, the part having a bayonet slot whose lateral arm has a pitched stop shoulder, and a pin on the string normally engaged in the lateral arms of the slots to hold the sleeve in the position where the gripping means is retracted, the pin being restrained against movement into the longitudinal arms of the slots by the stop shoulder, the pin being positioned for movement over the stop shoulder by upward movement of the string relative to the friction means, upward movement of the pin through said longitudinal slot arms serving to free the gripping means for operation.

12. A well tool for use on a setting string comprising a body, packing means on the body for sealing with the well wall, slips on the body spaced longitudinally from the packing means and operable to grip the well wall, means tending to operate the slips, a control for holding the slips retracted releasable by manipulation of the setting string, and a releasable connection between the string and the packing means whereby the string may be manipulated to actuate the packing means following actuation of the slips and may then be disconnected from the body, the body having ports between the slips and packing means for admitting fluid that may be circulated up past the packing means before actuation of the latter.

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