May 9, 1950 R. K. HERTEL ET AL 2,506,593

SPRING HOOK

Filed April 28, 1945 4 Sheets-Sheet 1

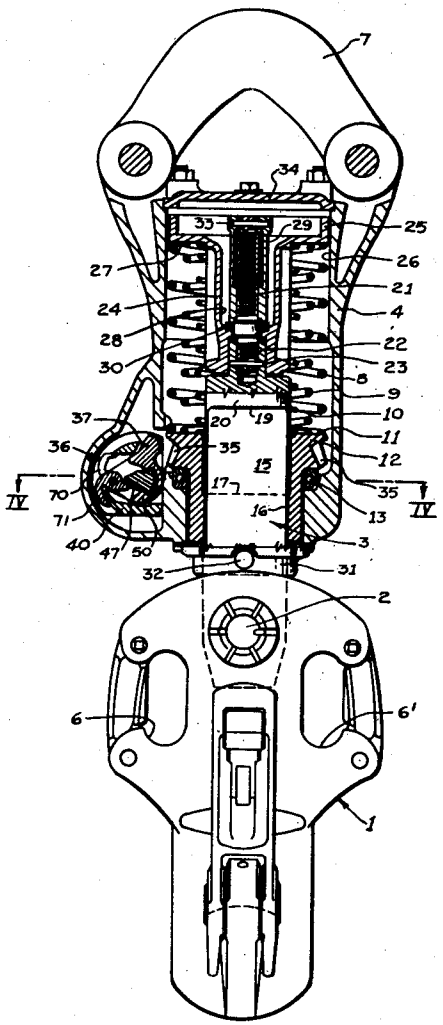


Fig. 1

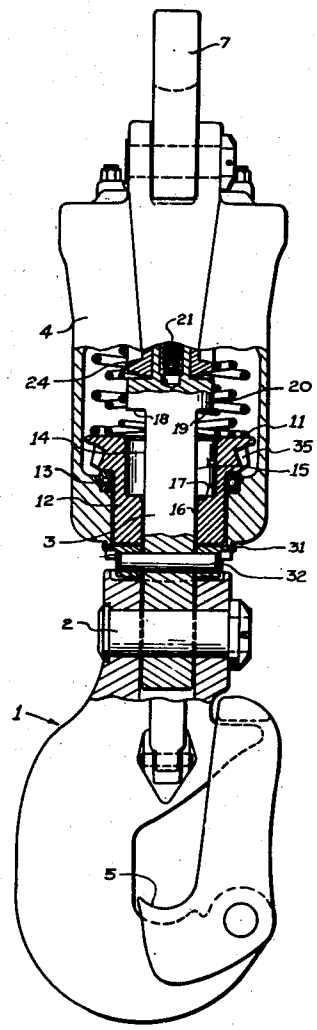


Fig. 2

Inventors
Richard K. Hertel
Garth F. Nicolson

By Lyon & Lyon Attorneys

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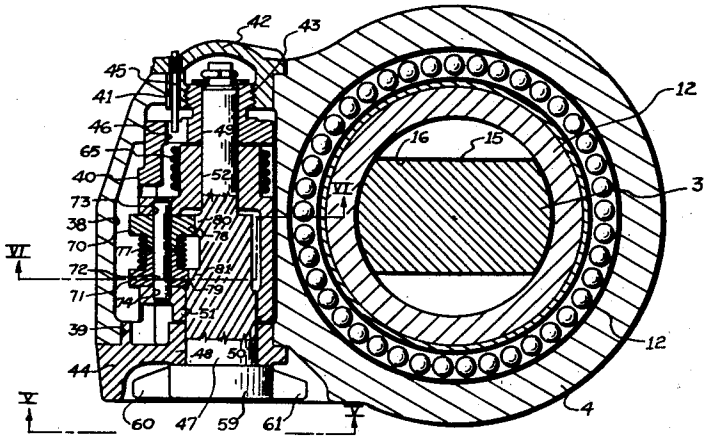


Fig. 4

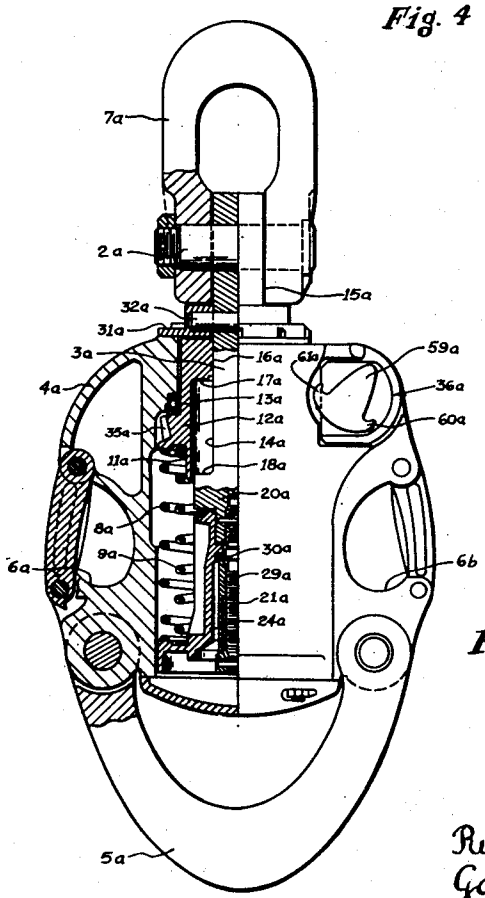


Fig. 3

Inventors
Richard K. Hertel
Garth F. Nicolson

By Lyon & Lyon Attorneys

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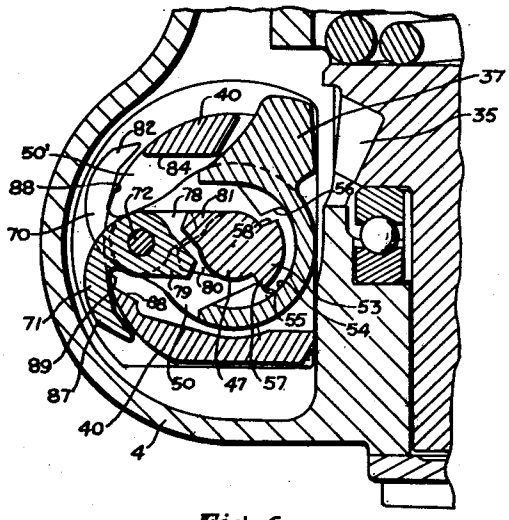


Fig. 6

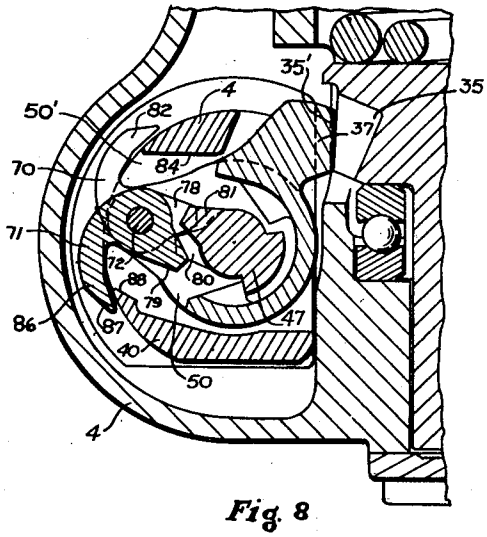


Fig. 8

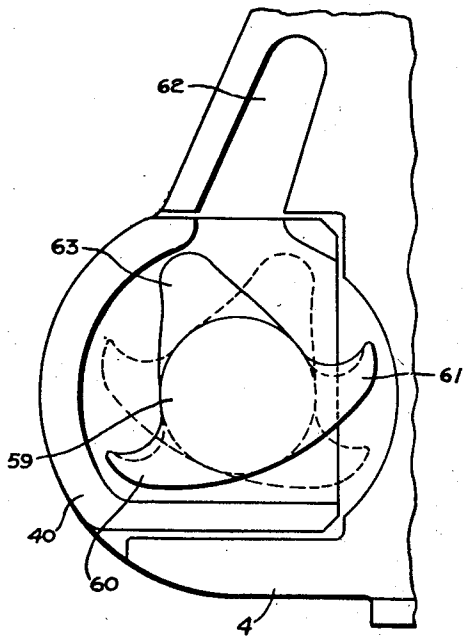


Fig. 5

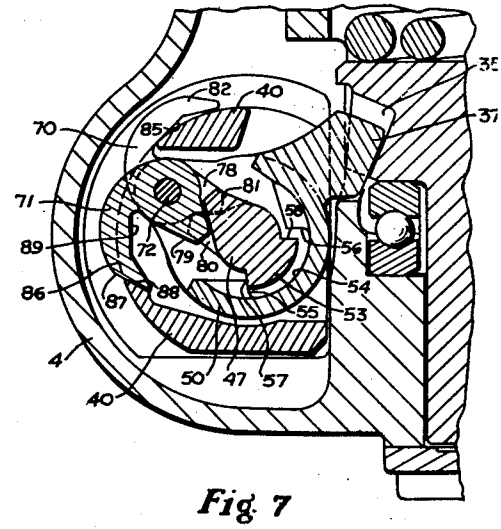


Fig. 7

Inventors
Richard K. Hertel
Garth F. Nicolson

By Lyon & Lyon Attorneys

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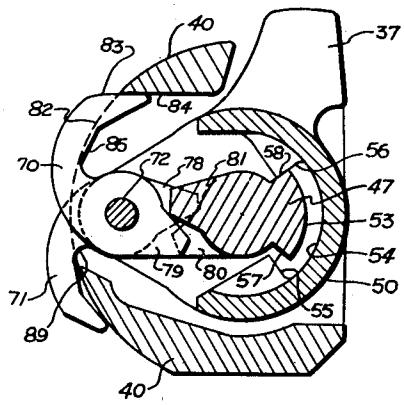


Fig. 11

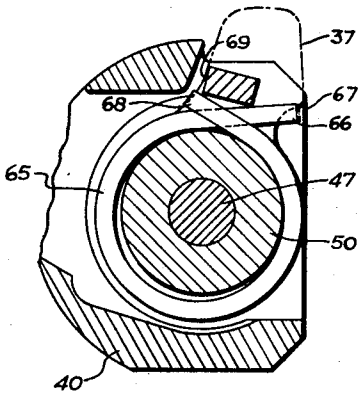


Fig. 10

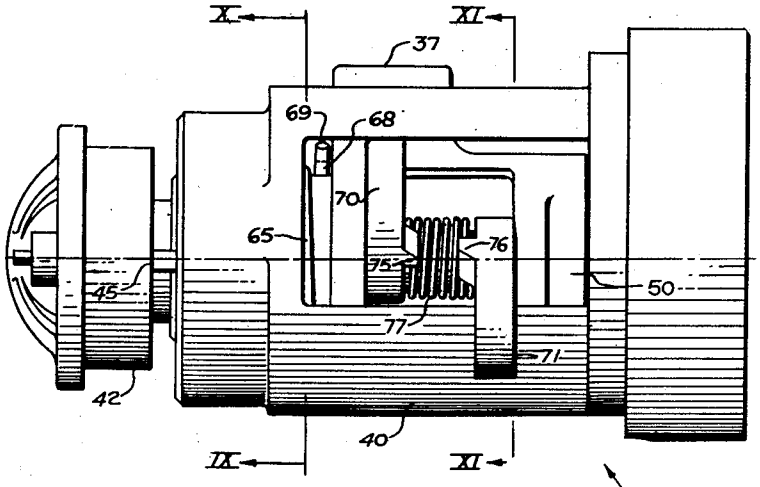


Fig. 9

Inventors
Richard K. Hertel
Garth F. Nicolson

By Lyon & Lyon Attorneys

Patented May 9, 1950

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UNITED STATES PATENT OFFICE

2,506,593

SPRING HOOK

Richard K. Hertel, Los Angeles, and Garth F. Nicolson, South Gate, Calif., assignors to Byron Jackson Co., Vernon, Calif., a corporation of Delaware

Application April 28, 1945, Serial No. 590,940

14 Claims. (Cl. 294—82)

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This invention relates to spring hooks of the type employed in oil well drilling operations.

A hook of the foregoing type is used to suspend a string of drill pipe or casing in the well, and is equipped with a compression spring which serves to raise a stand of drill pipe as it is disconnected from the string and thus avoid damaging the threads of the tool joints or couplings. In order to enable the spring to support the weight of a stand of drill pipe without undue sagging, it is customary to precompress the spring during assembly of the hook. Heretofore it has been the general practice to obtain this precompression of the spring by means of a nut threadedly engaging the upper end of the hook shank and engaging the spring to compress it between the nut and a shoulder in the housing of the hook. In addition to its function of applying precompression to the spring, according to usual practice the nut is also provided with a shoulder which is adapted to engage a shoulder in the housing upon predetermined further compression of the spring under load, thus to limit the compression of the spring and to transfer the major portion of the load from the shank directly to the housing.

The foregoing arrangement has the inherent disadvantage of subjecting the threads of the shank and nut to the full load imposed on the hook, a condition which is objectionable from several standpoints. In the first place, the root diameter of the threads is necessarily quite large in order to provide a shank of sufficient section (as much as six inches in diameter in heavy duty hooks), thus requiring the application of considerable force when screwing the nut onto the shank, in order to overcome friction between the large surface area of the threads and at the same time compress the spring to a precompression force of the order of 2000 pounds. Furthermore, a threaded connection under full hook load introduces a potential weakness because of the possibility of the nut working loose and backing off as the result of vibration, unless adequate locking means are provided. Also, in view of the difficulty in providing adequate lubrication of the threads, they are likely to become galled, or corroded from the humid atmosphere prevailing in many oil fields. This may necessitate replacement of an entire shank, in case the threads are damaged beyond safe limits of reworking, or, as occasionally happens, it is impossible to unscrew the nut and resort must be had to cutting it off with a torch. These and several other less serious objections make it highly desirable to eliminate the threaded connection subjected to the full load imposed on the shank.

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It is a principal object of this invention to provide a spring hook wherein all threaded connections are eliminated from the path of full load transfer, from the load-sustaining element of the hook to the hook-supporting member.

It is a further object of this invention to provide a spring hook wherein the precompression of the spring is effected by means which are not subjected to the full load imposed on the hook.

It is a still further object of this invention to provide a spring hook embodying a shank having an integral shoulder thereon for transferring the load between the shank and the housing member.

It is a more specific object of this invention to provide a spring hook embodying a load-carrying shank having an integral load-transferring shoulder, and a threaded extension on the shank cooperating with means for applying precompression to the spring, the threaded extension being subjected only to the maximum load imposed on the spring.

It is a still further object of this invention to provide a spring hook embodying a novel arrangement of parts providing an unusually compact construction of short overall length.

It is a still further object of this invention to provide improved means for releasably locking the shank and housing member against relative rotation.

A spring hook constructed in accordance with the principles of this invention possesses other advantages and attains other objects which will be apparent from the foregoing detailed description of a preferred embodiment, reference being had to the accompanying drawings wherein:

Fig. 1 is a longitudinal sectional view of a hook embodying the invention;

Fig. 2 is a side elevational view taken at right angles to Fig. 1, with parts broken away to illustrate certain novel features of the invention;

Fig. 3 is a view, partly in elevation and partly in longitudinal section, of a modified form of hook embodying the invention;

Fig. 4 is a transverse sectional view taken in line IV—IV of Fig. 1, illustrating the novel swivel locking mechanism;

Fig. 5 is an end elevation of the swivel lock, as viewed from the plane of line V—V of Fig. 4;

Fig. 6 is a vertical sectional view taken on the broken section line VI—VI of Fig. 4;

Fig. 7 is a view similar to Fig. 6, showing the swivel lock in locking position;

Fig. 8 is a view similar to Figs. 6 and 7 but showing the position assumed by the parts when the locking element is moved toward locking position but is out of registry with a cooperating locking recess;

Fig. 9 is a side elevation of the swivel lock subassembly;

Fig. 10 is a sectional view taken on line X—X of Fig. 9; and

Fig. 11 is a sectional view taken on line XI—XI of Fig. 9, showing on an enlarged scale the swivel lock in the position illustrated in Fig. 1.

Referring to Figs. 1 and 2 of the drawings, a hook body 1 is connected by a pivot pin 2 to the lower extremity of a shank 3 which is supported in a housing 4 for rotation and axial movement relative to the housing. The hook body 1 may be either a single hook or may be of the so-called "Triplex" design, as shown, with a main central load-receiving recess 5 (Fig. 2) to receive a swivel bail or other single load member, and a pair of laterally offset recesses 6 and 6' (Fig. 1) to receive the usual elevator links. The hook body may, if preferred, be of "Duplex" design, incorporating only the link recesses 6 and 6' and omitting the main recess 5. A bail 7 is suitably attached to the upper end of the housing 4 for connecting the hook to the usual travelling block.

The shank 3 is yieldably supported by the housing for limited axial movement relative thereto by one or more helical compression springs, herein three in number, designated 8, 9 and 10. The springs are supported at their lower ends on the upper surface 11 of a swivel ring 12 rotatably supported on a thrust bearing 13 in the lower portion of the housing. As shown most clearly in Figs. 2 and 4, the major portion of the shank 3 is flattened on diametrically opposite sides at 14 and 15, and the swivel ring 12 is provided with an opening 16 through its lower portion, conforming in shape to the flattened portion of the shank, whereby the shank is free to move axially through the ring but is confined against rotation relative thereto. The opening 16 terminates at its upper end in a transverse shoulder 17 adapted to cooperate with downwardly facing shoulders 18 and 19 formed on the shank at the upper extremities of the flattened sides 14 and 15, to limit the downward movement of the shank. Above the shoulder 17, the opening in the swivel ring 12 is cylindrical in cross-section to accommodate the cylindrical upper portion 20 of the shank.

It has been customary heretofore to threadedly secure a nut to the upper extremity of the hook shank, and to limit the downward movement of the shank by engagement of the under surface of the nut with an upwardly facing stop shoulder formed on the housing. The objections to this practice have been set forth hereinabove. In the present instance, precompression of the springs 8, 9 and 10 is effected by means of an element threadedly connected to the upper extremity of the shank, but contrary to usual practice, this element is wholly independent of the means for limiting downward movement of the shank and hence it is not subjected to the full load supported by the hook. This latter function is performed by the downwardly facing shoulders 18 and 19 forming an integral part of the shank.

Referring to Fig. 1, a threaded stem 21, of considerably smaller size than the shank 3, extends upwardly from the upper extremity of the

shank 3. For convenience, the stem is formed as a separate element threadedly secured at 22 to the shank and locked against inadvertent unscrewing by a locking pin 23. It will be appreciated, however, that it could equally well be formed as an integral extension of the shank 3, or, if separate, it could be attached thereto by other means than that shown. A sleeve-like member 24 is telescoped over the stem 21, the major portion of the member 24 being of substantially the same overall diameter as the shank 3, and the upper portion thereof being enlarged at 25 to loosely fit the bore 26 of the housing 4. A downwardly facing shoulder 27 is thus formed on the member 24 for engagement with the upper ends of the springs 8, 9 and 10.

It will be noted that the member 24 is provided with a deep cup-shaped recess 28 for the reception of an elongated nut 29 threadedly secured to the stem 21 and bearing against the bottom wall of the recess 28 to rigidly secure the member 24 to the shank 3. If desired, a bearing 30 may be interposed between the lower surface of the nut and the base of the recess to avoid undue friction between these surfaces while the nut is being made up on the stem to apply precompression to the springs.

As shown most clearly in Fig. 2, a ring 31 is secured by a transverse pin 32 to the portion of the shank 3 projecting below the housing 4. The purpose of this ring is to provide an abutment on the shank engageable with the bottom wall of the housing to limit the upward movement of the shank as it is urged upwardly by the springs.

The mode of assembly of the hook is as follows: The bearing 13 is first placed on its seat in the housing, and the swivel ring 12 is then inserted into position on the bearing. The shank 3, with the threaded stem 21 attached thereto, is then inserted through the upper end of the housing, with its lower portion projecting through the opening 16 in the swivel ring. The shank ring 31 is then applied to the shank from the lower end thereof and secured in place by the pin 32. The springs 8, 9 and 10 are then seated on the swivel ring 12 in nested relation, whereupon the member 24 is applied to the upper end of the shank. It will be understood that the free length of the springs is considerably greater than the precompressed length shown in Fig. 1, and the threaded portion of the stem 21 is made of sufficient length to permit the nut 29 to be started on the stem when the springs are fully expanded. As the nut is threaded downwardly on the stem, the springs are compressed between the shoulder 27 on the member 24 and the upper surface 11 of the swivel ring, the engagement of the shank ring 31 with the lower surface of the housing 4 restraining the shank against upward movement. During this operation the shank is held against rotation in any desired manner, such as by inserting a bar through the pivot pin hole in the lower end of the shank. The shank, swivel ring 12, springs, sleeve member 24 and stem 21 constitute a unit between the elements of which no relative rotation takes place, the thrust of the nut being applied to the member 24 through the bearing 30. After the springs are compressed the desired amount, the nut 29 is locked to the stem 21 by a locking pin 33. A cover plate 34 is then secured to the upper end of the housing 4, and the bail 7 is then attached to the housing.

It will be apparent from the foregoing description that the threaded connection between the nut 29 and the stem 21 is subjected only to the

force exerted by the springs when the latter is under maximum compression. This force is a predetermined amount, limited by engagement of the shoulders 18 and 19 on the shank with the shoulders 17 on the swivel ring 12. This force seldom exceeds 5000 pounds, which is relatively small in comparison with the total load imposed on the hook, which may be several hundred tons. Hence the stem 21 may be of relatively small diameter, thus greatly reducing the torque required to overcome friction between the threads as the nut is made up. Of greater importance is the fact that even if the nut 29 should back off when the hook is under full load, no serious consequence would ensue, such as dropping the load, which would occur if the nut were subjected to the full load.

Referring now to the novel means for releasably locking the shank against rotation relative to the housing, it will be observed that a series of locking recesses 35 are provided in the outer periphery of the swivel ring 12. Only two of these recesses are shown in the drawings, but it will be understood that as many as are desired may be provided, preferably at 45° angular intervals. A locking mechanism, generally designated 36, is mounted in a suitable recess in the housing, and includes as an element thereof a locking element 37 selectively engageable with any one of the recesses 35.

The locking mechanism is constructed as a unitary sub-assembly which may be assembled separately from the remaining parts of the hook, and then inserted as a unit into the housing 4. This sub-assembly is best illustrated in its entirety in Fig. 9, and in Fig. 4 it is shown mounted in the housing. As shown in the latter figure and in Fig. 1, the housing 4 is enlarged to provide a recess 38 to receive the sub-assembly. At one end of the recess the housing is bored at 39 to form a centering surface which is engaged by a corresponding surface on a unitary frame 40 in which the elements of the locking mechanism are mounted. At the opposite end of the recess the housing 4 is bored at 41 to form a centering surface for a cap 42 which is threadedly connected at 43 to the adjacent end of the frame 40. The locking mechanism is completely assembled except for the cap 42, and is then inserted into the recess 38 from the end adjacent the large bore 39, until the flanged portion 44 of the frame 40 engages the housing. The cap 42 is then threaded onto the opposite end of the frame to secure the frame rigidly to the housing. The cap may be locked by a locking pin 45 extending through the cap and loosely engaging a socket 46 in the frame.

An operating member or crank 47 is journaled at its opposite ends at 48 and 49 in the frame 40, for oscillation about its axis through an arc of approximately 45°. As shown in Figs. 4, 6 and 7, the locking element is formed integral with a sub-frame 50 which is journaled on the crank 47 at 51 and 52. A segmental projection 53 is formed on the mid-portion of the crank 47, and a similarly shaped recess 54 is provided in the internal surface of the sub-frame 50. However, the end walls 55 and 56 of the recess 54 embrace an arc which is slightly greater than the arcuate extent of the projection 53 as defined by the end walls 57 and 58 thereof, whereby there is a slight lost motion between the crank and the sub-frame.

As shown in Figs. 4 and 5, an enlarged head 59 is formed on one end of the crank 47 exteriorly of the frame 40 where it is accessible for manual manipulation. A pair of oppositely projecting wings 60 and 61 are provided on the head, the upper surfaces of the wings being concave to facilitate engagement thereof by the hooked end of a releasing rod, whereby a downward pull on the rod will serve to oscillate the crank about its axis in either direction. The head 59 is positioned within a recess in the housing 4, and to facilitate engagement of the releasing rod with either of the wings 60 and 61, a narrow, elongated slot or groove 62 is formed in the outer wall of the housing for reception of the hooked end of the rod. An upwardly extending projection 63 on the head 59 serves to guide the rod from the groove 62 into engagement with the proper wing, depending on which position the crank occupies.

When the head 59 is in the solid-line position of Fig. 5, the locking element 37 is in released position and the segmental projection 53 on the crank 47 occupies the position shown in Figs. 1 and 11, with its upper end surface 58 abutting the end wall 56 of the recess 54. Upon oscillation of the crank 47 in a clockwise direction, it first moves through a small arc of approximately 10° to 15° of lost motion without effecting movement of the sub-frame 50. Upon engagement of the end surface 57 with the end wall 55, as shown in Fig. 6, subsequent rotation of the crank is accompanied by corresponding movement of the sub-frame 50 to move the locking element 37 into engagement with one of the locking recesses 35 in the swivel ring 12, as shown in Fig. 7. The purpose of the lost angular motion between the crank 47 and the sub-frame 50 is to effect the release of latch means normally latching the sub-frame in either of its positions, as will be presently described. The above-described locking mechanism is claimed per se in a copending divisional application Serial No. 69,454 filed January 6, 1949 by applicants and entitled "Hook locking mechanism."

It will be observed with reference to Figs. 4, 8 and 10 that a helical torsion spring 65 surrounds a portion of the sub-frame 50 adjacent the locking element 37, one end 66 of the spring abutting a surface 67 on the locking mechanism frame 40, and the other end 68 of the spring engaging a lug 69 on the sub-frame 50. The sub-frame 50 is thus at all times urged by the spring 65 toward its locking position wherein the locking element 37 engages one of the recesses 35 in the swivel ring 12.

The latch means for positively latching the sub-frame in either of its two extreme positions comprises a pair of latch members 70 and 71 both pivotally mounted on a common pivot pin 72, the opposite ends of which are supported in aligned bores 73 and 74 in the sub-frame 50. Thus the latch members are mounted for oscillation relative to the sub-frame about the axis of the pin 72, and they also move bodily with the sub-frame when the latter is oscillated about the axis of the crank 47. It will be noted by reference to Figs. 6, 7, 8, 9 and 11 that the latch members 70 and 71 are of identical construction, but the member 71 is mounted on the pin 72 in inverted relation to the member 70. Lugs 75 and 76 are formed on the adjacent sides of the latch members (Fig. 9) to provide abutments for the opposite ends of a torsion spring 77 which thus urges the member 70 in a clockwise direction and urges the member 71 in a counter-clockwise direction, as viewed in Figs. 6, 7, 8 and 11. Referring to the latter figures, it will be noted that a cam 78 is formed on the member 70 and a similar cam 79 is formed on the member 71. Co-

operating cams 80 and 81 are formed on the crank 47 in the planes of the cams 78 and 79, it being noted that the cam 80 engages the under surface of the cam 78, and that the cam 81 engages the upper surface of the cam 79. The torsion spring 77, urging the latch members in opposite directions, maintains the cooperating cam surfaces in constant engagement.

The latch member 70 includes a latch finger 82 which projects outwardly through a window 50' in the sub-frame 50 and has a latching surface 83 engageable with a cooperating surface 84 on the frame 40 to latch the sub-frame in released position, as shown in Fig. 11. The finger 82 is so shaped as to provide a recess 85 to receive the adjacent portion of the frame 40 when the sub-frame and latch members are moved to the locked position shown in Fig. 7. The latch member 71 is similarly provided with a finger 86 having a latching surface 87 engageable with a cooperating surface 88 on the frame 40 to latch the sub-frame 50 in locked position (Fig. 7), and is so shaped as to provide a recess 89 to receive the adjacent portion of the frame 40 when the sub-frame 50 and latch members are moved to released position (Fig. 11).

The operation of the locking mechanism and its latch members is as follows: Assuming that the parts are in the released position shown in Fig. 11 and it is desired to lock the shank 3 and hook body 1 against rotation relative to the housing 4, the operator engages the releasing hook with the wing 61 (Fig. 5) and pulls downwardly to move the crank 47 in a clockwise direction. The initial movement of the crank does not effect movement of the sub-frame 40 until the surface 57 engages the surface 55, but during this initial clockwise movement of the crank the cam 80, acting on the cam 78, moves the latch member 70 from its latching position to the unlatched position shown in Fig. 6. Inasmuch as the torsion spring 65 constantly urges the sub-frame 40 in a clockwise direction, as soon as the latch member 70 has been moved completely out of the window 50' the sub-frame is rotated by the spring 65 into the locked position shown in Fig. 7. Upon reaching this position, the finger 86 of the latch member 71 clears the lower wall of the window 50' and is urged by the torsion spring 77 into latching engagement with the surface 88. The sub-frame 50 and its locking element 37 are thus positively held in locked position until the latch member 71 is released by manual manipulation of the crank in a counter-clockwise direction.

It frequently occurs that when locking the hook against swivelling, the locking element 37 is not in registry with one of the locking recesses 35 when it is moved toward locking position. In that event, the locking element moves inwardly until it engages the outer wall 35' (Fig. 8) of the swivel ring. With the sub-frame in this position, the finger 82 of the latching member 70 is disposed in non-latching position outside the frame 40, and hence the locking element 37 is free to snap into a recess 35 under the influence of the spring 65 upon rotation of the shank 3 and swivel ring 12. When this occurs, the finger 86 on the latch member 71 clears the lower wall of the window 50' and snaps into latching engagement with the surface 88 under the influence of the torsion spring 77. The parts thus assume the positions illustrated in Fig. 7.

When it is desired to release the locking mechanism to permit free swivelling of the shank 3 and hook body 1 relative to the housing 4, the

operator engages the releasing hook with the wing 60 (Fig. 5) and pulls downwardly to move the crank 47 in a counter-clockwise direction. Initial movement of the crank causes the cam 81 thereon to act on the cam 79 on the finger 71 and swing the latter in a clockwise direction to release the latching surface 87 from the surface 88. Full release of the latch member 71 occurs concurrently with engagement of the upper end surface 58 of the projection 53 with the upper end wall 56 of the recess 54. Thereupon continued movement of the crank rotates the sub-frame 40 and its locking element 37 into released position, and when this position is reached the finger 82 on the latch member 70 clears the upper wall of the window 50' and snaps into the window into latching engagement with the surface 84 under the influence of the torsion spring 77. The locking element is thus securely latched against inadvertent return to its locking position.

It will be apparent from the foregoing description of the locking mechanism and its mode of operation, that there is no danger of the locking element being either locked or released accidentally as the result of a sudden jar or vibration, because of the positive latch in both positions. Positive latching in locked position is especially desirable inasmuch as it has been found that a lock which is merely spring-pressed into locked position is occasionally released by the whipping and the vibration to which the hook is subjected during drilling. The swivel lock in the hook is relied on to hold the rotary swivel body against rotation, which tends to occur due to the frictional drag of the swivel stem in its stuffing box. If the swivel lock should accidentally become released, the rotary swivel may rotate several times before this condition is noticed, thus wrapping the rotary hose about the kelly and possibly severing the hose.

The construction of the locking mechanism as a complete, operative sub-assembly is a distinct advantage inasmuch as it permits its assembly as a separate unit, and enables its operation to be checked before it is inserted into its recess in the housing 4. It is also feasible to equip a complete line of hooks of varying capacities with identical locking mechanisms, and, by providing a complete, unitized sub-assembly, a few sub-assemblies at a distribution point are sufficient to care for the replacement needs of a large number of hooks of different capacities. The replacement in the field of a worn or damaged locking mechanism is also greatly facilitated by this construction.

In Fig. 3 there is illustrated a different type of hook embodying the features of this invention. This hook is of the so-called "connector" type, and in most respects constitutes an inverted arrangement of the construction shown in Figs. 1 and 2. Thus it will be observed that the shank 3*a* projects from the upper end of the housing 4*a*, instead of from the lower end thereof as in Figs. 1 and 2, and the projecting end of the shank is connected by a pivot pin 2*a* to a bail or clevis 7*a* by which the hook may be suspended from the usual travelling block. Since in this construction the housing 4*a* corresponds functionally to the hook body 1 of Figs. 1 and 2, it is provided with a pair of diametrically opposite link receiving recesses 6*a* and 6*b*. A bail 5*a* may be suitably connected to the lower end of the housing to support a single-bail elevator or other load.

It will be understood by those familiar with

oil field operations that in the use of this type of hook the rotary swivel is supported by the drill pipe elevator which is attached to the elevator links supported in the recesses 6a and 6b, instead of having the swivel bail supported in the main hook recess 5 of Fig. 2.

It will be observed from a comparison of Figs. 1 and 3 that the internal construction of Fig. 3 is substantially identical with but inverted with respect to that of Fig. 1. Thus the housing 4a is resiliently and rotatably supported by the shank 3a through the intermediacy of nested compression springs 8a and 9a interposed between a sleeve member 24a attached to the shank and a swivel ring 12a journaled in the housing. A thrust bearing 13a is interposed between the swivel ring and the housing to permit free rotation of the housing when under full load. The shank 3a is flattened on opposite sides at 14a and 15a and passes through a similarly shaped opening 16a in the swivel ring, to provide a slidable and non-rotatable connection between the shank and the swivel ring. The lower extremity of the shank is of full circular cross-section at 20a, and thus provides a pair of upwardly facing shoulders at the lower end of the flattened section, one of these shoulders being shown at 18a. These shoulders are adapted to engage a downwardly facing shoulder 17a on the swivel ring, formed at the juncture of the opening 16a and the cylindrical recess therebelow which telescopically receives the cylindrical portion of the shank when the springs are compressed under load.

In this embodiment of the invention, a downwardly depending skirt 11a as provided on the swivel ring 12a, extending downwardly past the shoulder 18a in the lowermost position of the latter, to substantially close the cylindrical recess in the swivel ring and exclude any foreign matter, such as scale from the surfaces of the springs, which might deposit on the shoulder 18a and interfere with proper full-surface engagement between the shoulders 17a and 18a when the springs are fully compressed. A similar skirt may be provided on the swivel ring 12 of Fig. 1, extending upwardly between the inner spring 10 and the shank. This skirt may in either case be integral with the swivel ring, as shown, or it may be formed as a separate member with a radially extending flange interposed between the swivel ring and the adjacent ends of the springs to retain the skirt in place.

In Fig. 3 the same method of pre-compressing the springs is employed as is shown in Fig. 1. A threaded stem 21a, constituting a reduced extension of the shank 3a, is suitably secured to or formed integral with the lower end of the shank. A nut 29a is threaded on the stem and exerts thrust against the sleeve 24a through a bearing 30a to apply initial pre-compression to the springs and to maintain this pre-compression when the hook is not loaded. An abutment ring 31a is secured to the upwardly projecting end of the shank by a pin 32a, and engages the end wall of the housing 4a to limit the extent to which the shank may move inwardly into the housing under the influence of the springs.

The manner in which the hook of Fig. 3 is assembled is identical with that previously described in connection with the hook of Fig. 1, and hence it is not deemed necessary to repeat it at this point.

A swivel locking mechanism 36a similar to the mechanism 36 of Fig. 1 is provided for locking the housing 4a against rotation with respect to the swivel ring 12a and the shank 3a. It will be apparent that by inverting all parts of the mechanism 36 of Figs. 1 and 6 to 11 except the crank 47, this same mechanism can be used in the hook of Fig. 3. Hence a detailed description thereof is not deemed necessary.

Although there have been described herein two specific embodiments of the invention, it will be understood that the invention is not limited to the detailed construction shown, but is susceptible of various embodiments within the scope of the appended claims.

We claim:

1. In a hook structure, the combination of an integral housing member and a shank member mounted therein for longitudinal movement relative thereto, shoulder means on said respective members adapted to cooperate to limit said longitudinal movement in one direction and to transmit a load directly between said members, resilient means between said members for resisting said longitudinal movement in said direction, means adjustably connected to one of said members for applying initial stress to said resilient means, the shoulder means on said shank member being fixed thereto independently of said stress-applying means whereby said last-named means is not subjected to the load transmitted through said shoulder means.

2. In a hook structure, the combination of an integral housing member and a shank member mounted therein for longitudinal movement relative thereto, shoulder means on said respective members adapted to cooperate to limit said longitudinal movement in one direction, resilient means between said members for resisting said longitudinal movement in said direction, and means adjustably connected to one of said members and independent of said shoulder means for applying initial stress to said resilient means.

3. In a hook structure, the combination of an integral supporting member and a load-carrying member mounted for relative longitudinal movement, resilient means between said members for resisting said movement, means adjustably connected to one of said members for pre-loading said resilient means, and shoulder means fixed on said respective members independently of said pre-loading means for limiting said relative longitudinal movement in one direction and for transmitting a load from the load carrying member to the supporting member independently of said pre-loading means.

4. In a hook structure, the combination of an integral supporting member and a load-carrying member mounted for relative longitudinal movement, resilient means supported by said supporting member and resiliently supporting said load-carrying member, said resilient means being adapted to yield under load and permit said relative longitudinal movement, shoulder means on the respective members adapted to cooperate to limit said longitudinal movement in one direction and to transmit a load directly from said load-carrying member to said supporting member independently of said resilient means, and means for pre-loading said resilient means, said pre-loading means being independent of said shoulder means and being subjected only to the load transmitted from said load-carrying member to said supporting member through said resilient means.

5. In a hook structure, the combination of an integral housing member and a shank member mounted therein for longitudinal movement relative thereto, one of said members constituting a

supporting member and the other constituting a load-carrying member, resilient means between said members resisting said movement in one direction and adapted to yield under load to permit said movement, means threadedly connected to one of said members and engaging said resilient means for applying initial stress thereto, shoulder means in said housing member and cooperating shoulder means integral with said shank member and engageable with said first-named shoulder means upon predetermined relative movement between said members, for transferring a load directly between said members independently of said threaded connection.

6. A hook structure comprising an integral housing member and a shank member mounted therein for longitudinal movement relative thereto, load-carrying means on one of said members and supporting means on the other member, shoulder means in the housing member, cooperating shoulder means integral with the shank member and engageable with said first-named shoulder means to limit the relative longitudinal movement between said members in one direction, spring means seated at one end in the housing member, and abutment means engaging the other end of the spring means and adjustably connected to the shank member for pre-loading said spring means.

7. A hook structure comprising an integral housing member having a relatively large axial opening at one end thereof and a relatively small axial opening at the other end thereof, means forming a shoulder in the housing facing said large opening, a shank member insertable through said large opening and having a portion of a size to pass through the small opening and having a lateral projection forming an integral shoulder engageable with the shoulder in the housing member to limit the inward movement of the shank member in the housing member, a spring seat in the housing member, a spring abutment on the shank member, spring means interposed between said seat and said housing and urging said shank member in the direction of the large opening in the housing member, and shoulder means detachably connected to the portion of the shank member protruding through said small opening in the housing member and engageable with the outer end wall of the housing member to limit movement of said shank member in the direction of the large opening in the housing member.

8. A hook structure comprising a housing member and a shank member mounted therein for longitudinal and rotary movement relative thereto, one of said members constituting a supporting member and the other constituting a load-carrying member, a lock ring mounted in the housing member and having a non-circular opening therethrough, a portion of said shank member extending through said opening and being of non-circular contour conforming to configuration of the opening in said lock ring whereby the shank member is slidably and non-rotatably connected to said lock ring, shoulder means on said lock ring at one end of the opening therein, cooperating shoulder means on the shank member adjacent one end of the non-circular portion thereof and engageable with the shoulder means on said lock ring to limit the longitudinal movement of the shank member relative to the housing member in one direction, and means for releasably locking the lock ring against rotation relative to the housing member.

9. A hook structure comprising a housing member and a shank member mounted therein for longitudinal and rotary movement relative thereto, one of said members constituting a supporting member and the other constituting a load-carrying member, said shank member being of non-circular cross-section through a substantial portion of its length and having an integral, laterally projecting shoulder at one end of the non-circular portion, a lock ring mounted in said housing and provided with an opening of a size to slidably and non-rotatably receive the non-circular portion of the shank member, said lock ring having a shoulder adapted to cooperate with the shoulder on the shank member to limit the longitudinal movement of the shank member relative to the housing member and lock ring in one direction, means for releasably locking the lock ring against rotation relative to the housing member, abutment means adjustably connected to said shank member, and spring means interposed between said abutment means and said lock ring for yieldably resisting said relative movement between the shank member and the housing member.

10. A hook structure, comprising: a housing member defining a tubular chamber; a locking ring journaled in said housing; a shank member slidably mounted in said locking ring for rotation therewith in said housing member; spring means bearing between said locking ring and an end of said shank member within said housing to hold said shank member in a retracted position; and means carried by said housing member for engaging and locking said locking ring against rotation thereby to lock said shank against rotation.

11. A hook structure, comprising: a shank member; a locking sleeve slidable thereon; spring means interposed between said sleeve and an end of said shank member to urge said locking sleeve to one extreme position on said shank member; a housing embracing said shank member, spring means and locking sleeve; a thrust bearing means between said sleeve and housing opposing the load of said spring; and means carried by said housing member for engaging and locking said locking ring against rotation thereby to lock said shank against rotation.

12. A hook structure, comprising: a shank member; a sleeve slidable thereon and having a locking flange; spring means interposed between said sleeve and an end of said shank member urging said sleeve to the opposite end thereof; a housing embracing said shank member, spring means and sleeve; a thrust bearing between the side of said flange opposite from said springs and said housing for journaling said sleeve thereon; and means carried by said housing member for engaging and locking said locking ring against rotation thereby to lock said shank against rotation.

13. A hook structure, comprising: a housing member; a locking ring journaled in said housing; a shank member slidably mounted in said locking ring for longitudinal movement relative thereto and for rotation therewith in said housing member; spring means bearing between said locking ring and said shank member within said housing to hold said shank member in a retracted position; shoulder means on said locking ring and said shank adapted to limit said longitudinal movement in one direction; and means carried by said housing member for engaging and locking

said locking ring against rotation thereby to lock said shank against rotation.

14. In a hook structure, a combination comprising: a housing member and a shank member mounted therein for longitudinal movement relative thereto, one of said members constituting a supporting member and the other constituting a load-carrying member; a locking ring journaled in said housing in sliding relation with said shank for rotation therewith in said housing member; spring means bearing between said locking ring and said shank member to hold said shank member in a retracted position; cooperating shoulder means associated with said shank member and said locking ring adapted to limit said longitudinal movement of said shank member; and means carried by said housing member for engaging and locking said locking ring against

rotation thereby to lock said shank against rotation.

RICHARD K. HERTEL.
GARTH F. NICOLSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,605,187	Holt	Nov. 2, 1926
1,922,386	Minor	Aug. 15, 1933
2,058,186	Spalding	Oct. 20, 1936
2,058,187	Spalding	Oct. 20, 1936
2,158,232	Grau et al.	May 16, 1939
2,158,372	Long	May 16, 1939