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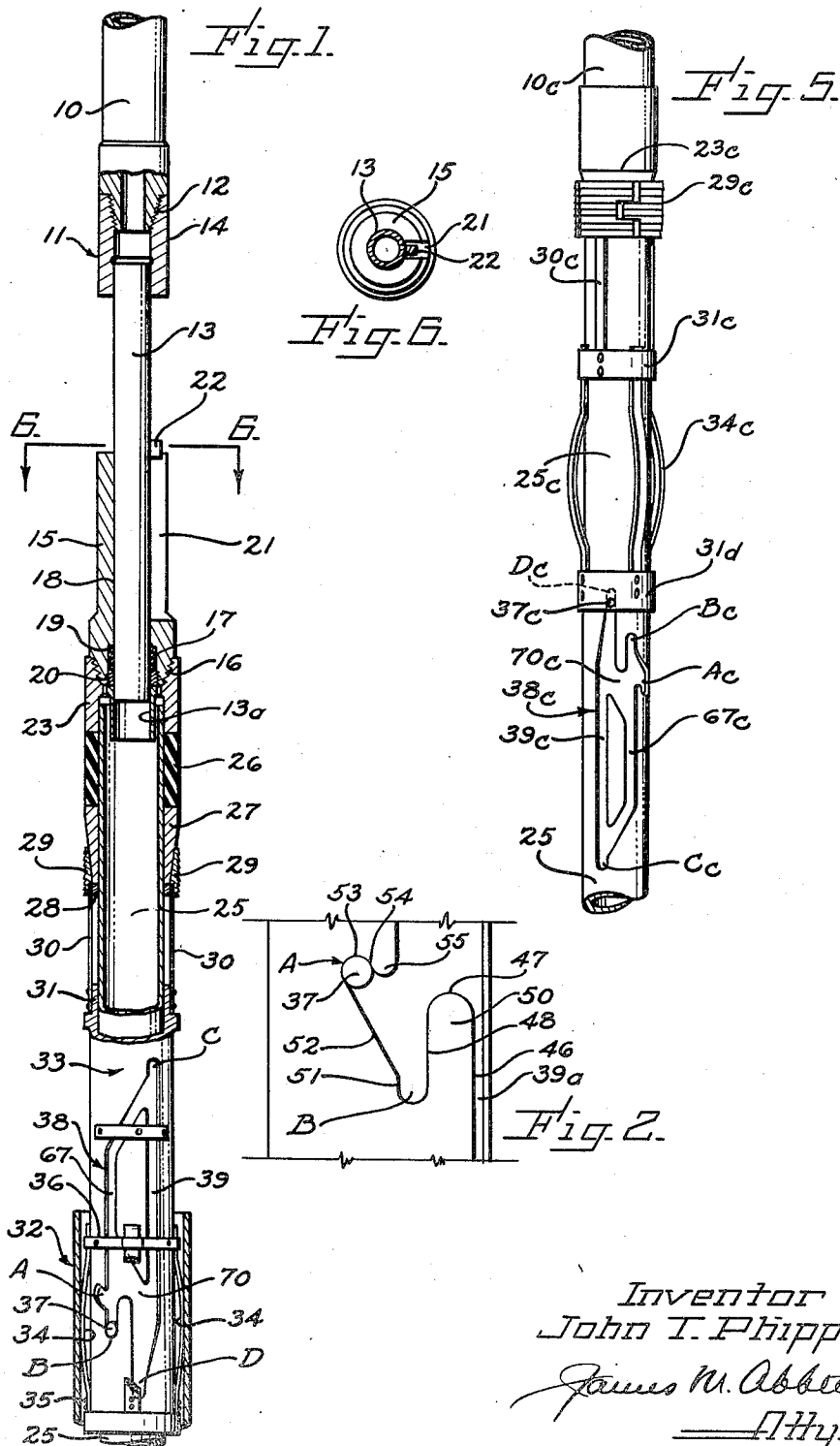
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LOCKING AND SETTING DEVICE

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LOCKING AND SETTING DEVICE

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This invention relates to oil well tools, and more particularly to locking and setting devices. This application is a continuation in part of my previously filed application, Ser. No. 480,121, filed March 22, 1943.

In the operation of various oil well tools, it is common practice to mount the tools on a string of pipe threaded together at joints. Various tools have been designed to be manipulated by the movement of the drill string but in many instances the operation of these tools and the release or locking of the tools is brought about by rotation of the drill string. If the drill string is rotated in one direction the threaded joints will be tightened, but if rotated in the opposite direction one or more of the threaded joints in the length of the string of pipe may be loosened. This may result in separation of the pipe string so that a portion of the length of pipe and the tool carried thereby will be lost in the well bore, requiring a fishing operation. This result may take place when manipulating tools of various kinds such as packers, formation testers, well jars, and liner hangers.

Other types of devices have been designed to be operated, for locking and setting in a well, by longitudinal movement of the pipe string. Devices of this type can be lowered to any desired point in the well and then, by appropriate longitudinal movement of the pipe string can be set or locked in position in the well pipe. They can also be released by a longitudinal movement; but after such a release, unless twist is applied through the pipe, they can only be moved in the casing in the direction in which the pipe string has been moved to release them. They cannot, after release, be moved in the opposite direction, either for removal from the well or for resetting in a position in that last mentioned direction without applying twists through the pipe. Thus, to take a specific illustration, it may be supposed that a liner hanger has been set by one of these devices in a certain position in the casing. When set to support the liner hanger, the devices may be released by pulling upwardly on the pipe string, and thereafter the device may either be moved upwardly out of the well or may be moved upwardly to a new position where it may be reset. But, after having once been set and released, it cannot be moved downwardly to a new setting position without pipe twist in one direction. And then, having reached the new lower setting position, the pipe must be twisted in the opposite direction in order to effect the re-setting. The direction of one or the other of those twists is

dangerous. And, to take another illustration, if such a device is used, in a relatively vertically reversed position, to set and lock a plug in a well to resist upward pressure, that device can then be released by downward movement of the drill string, but it can then only be moved downwardly in the casing to a new setting position; and it cannot then be moved up to be re-set or to be removed from the well without applying twists through the pipe.

It is among the objects of the present invention to provide a lock and release device for holding a tool in any selected position, which device permits of operation for both locking and releasing solely by longitudinal movement of the pipe string without requiring any rotational movement; and which device further provides for release operation and subsequent movement of the device in either direction in the well casing, for resetting in any new position, or for removal from the well.

The present invention contemplates a lock and release structure which may be associated with any desired type of oil well tool or any similar mechanism, in which one tool element is held relatively stationary while another tool element moves in relation thereto as manipulated by the string of pipe, and between which tool elements locking means are provided which act for locking and releasing solely by the relative direct longitudinal movement of the movable tool element with relation to the temporarily fixed element.

One typical use to which the present invention may be directed is that of setting a liner hanger; and in the following description and accompanying drawings the tool will be illustrated and described in its form as adapted for that use, but without any limitation thereto.

The invention is thus illustrated by way of example in the accompanying drawings in which:

Fig. 1 is a longitudinal vertical section, with parts in elevation, showing my lock and release device, in an illustrative form as used for the setting of a liner; this figure showing the parts of the device in the relative positions which they assume when being lowered through the casing;

Fig. 2 is a fragmentary enlarged view in elevation illustrating the relative position taken by certain parts of the tool preliminary to being lowered into the casing;

Fig. 3 is an enlarged view in side elevation showing the lock and release device of the present invention, with the parts in the positions assumed when the tool is being lowered in the casing, which is shown in section;

Fig. 4 is a view similar to Fig. 3 showing the

lock and release device with its parts in the relative positions assumed when the device is set and locked;

Fig. 5 is a fragmentary elevation showing a modified form of the lock and release device; and Fig. 6 is a cross section on line 6-6 of Fig. 1.

Referring more particularly to the drawings, 10 indicates the lower joint of the string of pipe which is used to lower the devices into the well and to manipulate them therein. As illustratively shown here, a setting sub 11 is attached to the pipe at the threaded joint 12. As here shown the sub 11 has, for instance, a depending wash pipe 13 fixedly attached to its joint member 14. The wash pipe extends through a tubular section 15, which is a part of the setting sub. The lower end of this tubular section 15 is externally threaded with a left-handed thread at 16 and has a counterbore 17 at the lower end of its central bore 18 through which wash pipe 13 passes. Packing 19, held in place in counterbore 17 by a threaded nut 20, makes a fluid-tight joint between member 15 and wash pipe 13. The lower end of wash pipe 13 is equipped with an upwardly shouldered collar 13a which limits the upward movement of 13 in 15, and to which certain parts (not shown) of a liner and washer combination are attached. Tubular member 15 is formed with a longitudinal slot 21 open at its upper end. This slot accommodates a lug 22 projecting from wash pipe 13. The arrangement permits the wash pipe to have a limited longitudinal movement with relation to sub-member 15 and with relation to the parts carried by that sub-member, but at the same time provides that wash pipe 13 and sub-member 15 will rotate together.

An upper packer collar 23 is threaded at 16 left-handedly onto the lower end of sub-member 15. The upper end of a tube 25 projects into and is secured to collar 23. A suitable expansive packing ring or sleeve 26 surrounds tube 25 and lies between upper collar 23 and the upper shoulder of an annular expanding cone 27 which is free to move on sleeve 25 and which compresses and expands packer 26 by moving upwardly. Downward movement of cone 27 is limited by a shoulder or ring 28 fixed on tube 25. The outer surface of cone 27 is tapered downwardly and forms the expansive surface for a set of vertically movable casing slips 29. These slips are carried at the upper ends of spring arms 30, the lower ends of which are secured to a ring 31 which, in this form of the device, is formed as an upper portion of a cam sleeve 33.

Cam sleeve 33 is freely mounted upon tube 25, being free to slide and rotate with reference thereto under control of the camming mechanism which will be described. The sleeve carries a set of bow springs 34 which frictionally engage well casing 32. These springs are secured at their lower ends on sleeve 33 by rivets or screws 35, their upper free ends extending through a strap 36 on sleeve 33. The springs are so designed that they will frictionally engage the well casing and tend to hold sleeve 33 stationary whenever the device is raised or lowered in the casing. In other words, they constitute a frictional drag which, during certain operations hold sleeve 33 relatively stationary.

The lock and release means which is now about to be described is a means which, in this particular form of the device, acts between tube 25 and sleeve 33, to enable packer 26 and slips 29 to be set and locked, to be unlocked and released, and to be reset in any position which may subse-

quently be desired or to be removed from the hole. The operation of this lock and release device is effected exclusively from relative longitudinal movement between cam sleeve 33, and tube 25 or any equivalent member which is connected to the pipe string 10. In the particular illustrative organization here shown, tube 25 extends on downwardly below the lower end of cam sleeve 33 to carry the various parts which make up a liner. Patent 2,318,167, issued May 4, 1943, to L. R. Knowlton, shows the whole organization of a liner setting and washing device such as is contemplated in Fig. 1 of the present drawings. In such an organization wash tube 13 is extended on down through tube 25 by wash tube extensions which depend from collar 13a; and the purpose of the limited longitudinal motion which is allowed between wash tube 13 and sub-member 15 is to allow of the vertical manipulation of certain parts carried by the extended wash tube, after tube 25 has been set in position by operation of slips 29 and expansion of packer 26. And in such a complete organization, after the liner has been set and the washing operations completed, then by right-handed rotation of pipe string 10, the left-handed thread joint at 16 may be broken and disconnected and the whole sub, including the part 15, and all of the parts attached to wash tube 13, may then be removed from the well, leaving the liner in its set position.

However, the particulars of the foregoing operations are not pertinent to the present invention; and the operation of my lock and release device may be considered as if a pipe string 10 were directly, and either releasably or non-releasably, connected to collar 23 and thus to tube 25 or its equivalent. In the organization as here shown, the weight of the several parts which depend from wash tube 13 is sufficient to keep sub-member 15 in its illustrated relative lowermost position on wash tube 13 throughout the operations hereinafter described. In other words, although the drag of springs 34 is sufficient to hold cam sleeve 33 from downward movement while tube 25 is moved downwardly through it, the drag of those springs is not sufficient to cause wash tube 13 to move downwardly in sub-member 15. Thus, in the following described locking and releasing operations which involve relative longitudinal movement between tube 25 and cam sleeve 33, tube 25 and drill pipe 10 may be looked upon as moving longitudinally as a unit. Or, in any case, the locking and releasing operations which are to be described are operations which are caused by relative longitudinal movement between tube 25 and sleeve 33; and whether or not there may be some longitudinal lost motion between pipe string 10 and tube 25 is of no consequence in the operation of the locking and releasing device.

In the particular form shown in Figs. 1, 2, 3, and 4, the lock and release mechanism includes a lock pin 37 mounted on and extending radially from the outer surface of tube 25. This pin extends outwardly into a cam slot, generally designated by the numeral 38, which slot is in this case cut through the wall of sleeve 33. A modification will be described later in which the locking pin is carried by sleeve 33 or its equivalent and the cam slot is formed in tube 25 or its equivalent.

The cam slot structure is designed to cooperate with pin 37 to permit sleeve 33 to be locked against movement, to be thereafter released if desired, and to be again locked if desired, so that the device may be moved and set in any number of different locations. Referring more particu-

larly to Figs. 3 and 4 where the cam slot is shown at larger scale than in Fig. 1, it will be seen in the particular cam formation here illustrated that the slot has a vertically extending longitudinal lane 39, here shown as straight and bounded on one side by a straight face 40 and on the other side by a straight face 41. The upper end of face 40 terminates in a shoulder 42 which forms, with a wall 58, a pocket C which lies directly above the upper end of lane 39 of the cam slot.

The lower end of lane 39 is formed with a pocket D to which an inclined cam face 44 leads; so that pocket 43 is displaced from a position directly under the vertical lane 39; in the particular illustration herein this displacement is shown toward the left. A straight longitudinal face 46 forms the wall of pocket D opposite the inclined face 44 and extends upwardly a substantial distance from pocket D. At its upper end face 46 merges into a curved face 47 which in turn merges into a downwardly extending face 48, which latter face together with faces 46 and 47 define an upwardly projecting finger 50 which lies between the lower portion 39a of lane 39 and the lower portion 67a of another vertical lane 67 which will be described. At the lower end of 67a a pocket B is formed preferably lying directly under the lower end of cam slot lane 67. Pocket B lies at a definitely higher elevation than pocket D; in fact, as will appear pocket D need have no definite closed end. The lower lane 67a is formed between face 48 and relatively short face 51 which is here shown as lying in line with and, in effect, as a downward continuation of face 56 which forms the outer wall of the slot lane 67. Preferably, however, instead of faces 56 and 51 being continuous, an offset pocket A is formed as illustrated by an inclined face 52, an upper curved face 53, and an upper inclined face 54. A tongue 55 overhangs pocket A as illustrated.

The relatively long longitudinal face 56, which forms the outer wall of slot lane 67, extends upwardly and merges with an inclined face 57 which leads to the upper pocket C.

The internal defining faces of some of the cam slot lanes, including the face 41 which has been previously referred to, are formed by the edges of an internal cam element 59. This element has a face 60 which lies opposite face 56, and a face 61 lying opposite face 57. Face 61 merges through curved end face 62 into face 41. Faces 57 and 61 form between them an upper inclined portion 67b of the slot lane 67 leading to the upper pocket C. The lower end of face 60 merges into an inclined face 63 which terminates, preferably through a curved shoulder portion 64 at the lower end of longitudinal face 41. The cam element 59 is supported in position by the strap 36 and another strap 65.

Attention is directed to the fact that pocket C, to which slot lane 67, 67b leads, is in such a position above the upper end of slot lane 39, that when pin 37 moves relatively downwardly from pocket C it will enter the upper end of lane 39. Attention is also directed to the fact that the lower pocket D is out of vertical alinement with the lower end of slot lane 39, so that the shoulder 64 overhangs pocket D. Or, in other words, the lower end 39a of slot 39 is inclined in such a manner that pocket D underlies shoulder 64. With this arrangement, when pin 37 moves upwardly from pocket D it will move up into contact with shoulder 64 and inclined face 63 and be deflected through the cross passage 70 into the longitudinal slot lane 67 and thus to a position above

pocket B which lies directly below the lower end of 67. And then, pocket B is so related to the lower end of slot run 67 that, upon relative downward movement of the pin from 67 it will pass into pocket B, or upon relative upward movement from pocket B it will pass into 67.

In operation of the present invention the structure is assembled as shown, with slips 29 drawn down to their retracted positions by lowering sleeve 33 on tube 25. Preparatory to insertion in the casing the sleeve is hung on pin 37 by engaging pocket A on the pin (see Fig. 2). In this position the weight of the sleeve and slips hangs on the pin while the device is being lowered into the upper end of the casing. Then when the drag springs 34 engage in the casing as the device is lowered, the sleeve and slips will be relatively dragged upwardly to the position shown in Figs. 1 and 3, pin 37 passing down into pocket B along the inclined face 52. In this position of the parts the bottoming of pin 37 in pocket B holds the slips down in their non-expanded positions. To reach that position sleeve 33 and the slips have rotated slightly on tube 25, but that rotation has put no appreciable rotary torque on the drill string.

When the structure has been lowered to the desired setting position in the casing, the pipe string is then lifted, sleeve 33 being held relatively stationary. Pin 37 will move upwardly from pocket B, into and through slot lane 67, and then through lane 67b, and finally into pocket C. In this operation sleeve 33 again rotates slightly relative to tube 25, but no appreciable rotative torque is put on the pipe string as the sleeve is free to rotate relative to 25, and relative to the casing except for the small drag exerted by springs 34. In pocket C the pin is in alinement with the upper end of slot lane 39, and upon subsequent downward movement of the pipe string and tube 25 the pin moves down directly into lane 39. On continued lowering, the pin moves down lane 39 and 39a, guided by inclined face 44 into pocket D. As the pin moves down in D below the level of B, sleeve 33 and the slips move relatively upwardly. The slips up and out on cone 28 to expand and grip the casing and to force the cone relatively upwardly to expand packer 26. In this position of the parts pin 37 has preferably not reached a bottom position in pocket D; and it is immaterial how far below that pin position the pocket D extends.

If it is desired to release the slips to pull the whole device from the well, or to move it up to a new setting position, it is only necessary to pull up the pipe string. Pin 37 will then move up through lane 39a and through the cross connecting lane 70, guided by faces 64 and 63, into lane 67, and thence up lanes 67 and 67b into pocket C. When the pin moves above the level of B the slips are released. If, after measured movement upward, it is desired to re-set the slips, it is only necessary to move the pin string down, when pin 37 will again move down lanes 39 and 39a into pocket D.

If it is desired to release and re-set the slips in a relatively lower position, the pipe string is first moved up just far enough to carry pin 37 up into lane 67 or 67b—not far enough to allow the pin to reach position C directly over lane 39. Then, upon subsequent lowering, pin 37 travels down lane 67 and down into pocket B; and the whole device then moves down the casing in the same condition as it did initially. Repetition of the initial setting operations will then re-set the

slips in the desired new location at a level below the first setting. Removal from the well to re-set the parts in their initial lowering position (pin 37 in pocket B) is not at all necessary. Straight longitudinal movements of the pipe string, without any rotation or torque strain on the pipe joints, perform the operations of setting, releasing and resetting.

It is to be particularly noted that, by proper manipulation of the pipe string, the device may be released and then moved in either direction, up or down, to a re-setting, or out of the well. Consequently, to use the device as an anchor to take upward pressure instead of downward force it is only necessary to arrange the whole device on the pipe string in a position upside down, as related to the position of Fig. 1, and then to operate it by movements which are relatively the opposite of those described above. And in such use it will be noted that the device can be released and moved in either direction to be re-set or to be pulled out of the casing.

The specific form of device so far described has the cam slot formed in or on the anchor sleeve 33 and has its pin 37 on tube 25 or other equivalent part which is attached to the pipe string. That arrangement may be reversed, as shown in Fig. 5. There a pipe string 10c is shown directly attached to expanding cone 23c, and tube 25c is shown as depending from pipe 10c. Slips 29c, riding the cone upwardly to expand, are mounted on spring arms 30c attached to an upper ring 31c. Drag springs 34c are mounted between spaced rings 31c and 31d which are free to move on tube 25c except as controlled by the cam device. The two rings and their interconnecting drag springs form, in effect, a movable sleeve like 33 of Fig. 1. Pin 37c is mounted on ring 31d to project inwardly into a cam groove 38c which is sunk in the outer face of tube 25—not necessarily cut through its wall. Cam groove 38c is exactly like cam slot 38 except that it is relatively reversed in a vertical direction. For use as a weight supporting anchor the operational movements of this form are the same as first described for Figs. 1-4. The major parts of groove 38c are indicated by references corresponding to those of Figs. 1-4 with the suffix c subjoined.

The following general observations will assist in an understanding of the essential features of the device and also of the scope of the invention as defined in the following claims. In the foregoing description it has been assumed that pin 37 moves substantially to the bottom of the pocket at D when slips 29 are fully expanded against the casing. In practice, the slips will preferably be fully expanded before the pin reaches the bottom of that pocket in order to insure full expansion of the slips. Or, to put the matter the other way around, the pocket or passage bottom shown at 45 may be located any suitable distance below the pin position shown at D in Fig. 4; in fact, it is immaterial whether there is any bottom or closed end to the passage below position D, as the setting of the slips determines the position to which pin 37 will move down. And it is only necessary that the whole device be so proportioned and arranged that, in the set position of the slips, pin 37 has moved down the inclined wall 44 far enough that the pin is then under deflection shoulder 64 so that on subsequent straight upward movement the pin will be deflected by 64 and 63 into slot 67.

It has been mentioned before that pin 37 may be carried by the outer sleeve 33 and the cam slot may be cut into the outer face of tube 25; in

which case the cam slot will be relatively inverted but will have the same functions as here described. Thus, the whole anchor and locking combination comprises two members, one of which (here the tube 25) is movable vertically with the well pipe (whatever that well pipe may be) and the other of which (here the outer sleeve 33) has a dragging engagement with the well casing. These two members, respectively, carry the two elements of the device to be operated (here the cone 27 and slips 29 of the anchor) which is operated to set and unset by relative vertical movement. One of the two relatively vertical movable members carries the pin which plays in the cam slot carried by the other of those two members. It is immaterial which one of the members carries the pin and which one carries the cam slot; the configuration of the cam slot being the same in any case, except to be reversed vertically. And it will also be readily understood that the whole combination device, in either form shown in the drawings, can be turned upside down to anchor a pipe or other unit against upward movement. However, for purposes of simplicity and clarity, this discussion of the whole device and particularly of the functions of the cam slot are confined, without limitation, to its operation in the form and orientation shown in the Figs. 1-4.

Starting with the pin in position B, where it is whenever the device is being lowered in dragging contact with the casing, it is only essential that when the pin moves up from position B it will travel up through lane 67 so that it can be deflected by the upper diagonal wall 57 into a position over the upper end of lane 39, or into a position from which, on subsequent downward movement, the pin will move down at the right hand side of the point 62 so as to enter lane 39 rather than to re-enter lane 67. Thus, if for the moment we disregard pocket A, the path which lane 67 takes from pocket B to pocket C is of no particular importance except that the upper end of lane 67 shall lead diagonally laterally (to the right as illustrated) to guide the pin to a position C which is laterally past the point 62. Then, with reference to the movement of the pin downwardly from the position C, it is only necessary that, the pin having passed down to the right of point 62, the walls 41 and 40 be of such shape as to guide the pin downwardly into and through lane 39.

With regard to lane 39, it is only important that it have a guiding wall 44 which inclines downwardly and laterally toward lane 67 (in the particular arrangement shown in the drawings to the left) to guide the pin laterally under the deflection shoulder 64 as the pin reaches or approaches the position D. It is only essential that lane 39 and its downward diagonal continuation be such that upon subsequent upward movement of the pin from position D it will move upwardly into engagement with deflection shoulder 64 and be guided upwardly and laterally again into lane 67, rather than move upwardly into lane 39. And, the pin having been deflected by shoulder 64, 63 into lane 67 it is then only necessary that wall 56 of that lane be of such configuration and so placed that subsequent downward movement of the pin will carry it into position B. In other words, it is only necessary that deflection shoulder 64 and 63 deflect the pin far enough to the left that, upon subsequent downward movement, it will pass to the left of tongue 50.

From what has been said, it will be readily recognized that it is not necessary for lanes 39

and 67 to be straight, or vertical or parallel, although in practice such configurations are preferable. And, as regards the pocket A which is initially hung on the pin as the device is lowered into the casing, it is only necessary that that pocket open into lane 67 at some point in one of its walls where the pin on moving down from A, will eventually move behind (to the left of) tongue 50 which defines the right-hand side of pocket B; and also that pocket A be so located with reference to slot 67 that the pin on its upward movement from B will pass up into 67 rather than into pocket A. For reasons such as these, a straight vertical run of slot 67 above pocket B is preferred, but not necessary.

While I have shown the preferred form of my invention as now known to me, it will be understood that various changes may be made in combination, construction and arrangement of parts by those skilled in the art, without departing from the spirit of the invention as claimed.

I claim:

1. In lock and release mechanism for well devices of the type which embody two members one of which is longitudinally movable by control from the ground surface and the other of which is movable both longitudinally and transversely with relation to the one, the second mentioned member being provided with means for creating a frictional drag on the wall of the well tending to hold that member stationary, one of said members being provided with a cam slot and the other with a slot engaging pin; the improvement in slot formation which comprises the combination of two longitudinally extending and laterally spaced slot lanes joined together at one of their corresponding longitudinal ends, one of said lanes having a closed opposite end and that lane having a run approaching and entering the end junction in a diagonal direction longitudinally and laterally toward and into that end of the other lane, so that when the pin has passed through the first mentioned lane into the joined end of the second mentioned lane by relative movement in one longitudinal direction it will then pass through the second mentioned lane when the pin is moved longitudinally in the opposite direction with relation to the cam slot; the other end of the second mentioned lane extending longitudinally, in the direction away from the joined ends, beyond the corresponding closed end of the first mentioned lane, the second mentioned lane having near its second mentioned end a diagonal run leading longitudinally away from the joined ends and laterally toward the first mentioned lane; and a cross-connecting lane leading diagonally from an intermediate part of the second mentioned lane into an intermediate part of the first mentioned lane and longitudinally toward the joined ends of the lanes, said diagonal lane having a diagonal pin-deflecting wall which laterally overhangs the second mentioned end of the second mentioned lane so that when the pin moves longitudinally away from that end it will be engaged by said overhanging wall and deflected into the intermediate part of the first mentioned lane.

2. The improvement specified in claim 1, and also including a pin receiving pocket in the form of an extension from one side of the first mentioned slot lane extending diagonally from that side in a longitudinal direction toward the joined ends of the two lanes.

3. The improvement specified in claim 1, and in which the first and second mentioned slot lanes extend longitudinally and are mutually parallel except in their diagonal runs, and also including a pin receiving pocket in the form of an extension from that side of the first mentioned lane which is opposite to the second mentioned lane, said pocket extending diagonally from said lane in a longitudinal direction toward the joined ends of the two lanes.

4. In lock and release mechanisms for well devices of the type which embody two members one of which is longitudinally movable by control from the ground surface and the other of which is movable both longitudinally and transversely with relation to the one, the second mentioned member being provided with means for creating a frictional drag on the wall of the well tending to hold that member stationary, one of said members being provided with a cam slot engaging pin and the other with a cam slot composed of two longitudinally extending and laterally spaced lanes joined together at one of their corresponding ends, one of the lanes being longitudinally shorter than the other in its extent from the joined ends; the improvement which comprises a pin receiving pocket in the form of an extension from one side of the shorter lane extending diagonally from that side in a longitudinal direction toward the joined ends of the two lanes.

5. In lock and release devices for well mechanisms which include a supporting member longitudinally movable from the ground surface, a tubular member telescoping thereover and capable of longitudinal and rotational movement relative to said supporting member, and means carried by said tubular member for creating a frictional drag on the wall of said well tending to hold said tubular member stationary as it is moved longitudinally in the well on said supporting members; an engaging element carried by one of said members, a cam slot formed on the other of said members and receiving the engaging element, said slot comprising a releasing lane and a setting lane, said lanes converging at their one end and there terminating in a junction abutment adapted to be encountered by the engaging element, the releasing lane being formed at its opposite end with an abutment to be encountered by the engaging element, said setting lane being formed at the opposite end from the junction abutment with an extension passageway continuing longitudinally of the tubular member a distance from the junction abutment greater than the distance of the releasing lane abutment from the junction abutment and being offset laterally toward the releasing lane, a transverse lane establishing communication between the releasing lane and the setting lane intermediate their ends, said transverse lane defining a path of travel for the engaging element from the setting lane to the releasing lane in a direction toward the joined ends of said lanes, a diverting shoulder at the juncture of the setting lane and the transverse lane for guiding the engaging element from the extension end of the setting lane into the transverse lane, and a diverting shoulder at the juncture of the joined ends of the releasing and setting lanes for directing the engaging element from the junction abutment into the setting lane.

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