This invention relates to locking devices for well tools and more particularly to locking devices for removably locking well tools, such as plugs or chokes, in the well tubing or casing, or the like.

One object of this invention is to provide a new and improved locking device for locking well tools in selected positions in well tubing or casing, or the like.

Another object is to provide a new and improved locking device, of the type described, having locking means which are positively double locked to prevent either upward or downward movement of the locking device in the well conductors.

Still another object of the invention is to provide a new and improved locking device, of the type described, which may be selectively locked in and to any desired landing nipple of a plurality of landing nipples connected in and forming a part of the well tubing, casing, or the like.

A further object of the invention is to provide a new and improved locking device, of the type described, which may be releasably double locked in position in a selected landing nipple of a plurality of landing nipples forming a part of the well conductors.

A still further object of the invention is to provide a new and improved locking device, of the type described, which may be lowered into the well conductor, double locked in place in a landing nipple thereof, and removed therefrom by means of appropriate running and pulling tools which are moved and operated in the well conductor by means of a flexible line.

Additional objects and advantages of the invention will be readily apparent from the reading of the following description of devices constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

Figure 1 is a view, partly in elevation and partly in section, of the locking device and of a running tool by means of which the locking device is lowered through and locked in a well conductor, showing the operative components of the locking device and the running tool as they appear while the locking device is being lowered through the well conductor;

Figure 2 is a continuation of the view of Figure 1 showing the lower end of the locking device;

Figure 3 is a view, partly in elevation and partly in section, of the upper portions of the locking device and of the running tool, showing the locking device positioned in a selected landing nipple with the operative components of the running tool in appropriate positions to lock the locking device in the selected nipple upon further operation of the running tool;

Figure 4 is a continuation of the view of Figure 3 showing the lower portions of the locking device and of the running tool;

Figure 5 is a view, partly in elevation and partly in section, of the upper portion of the locking device and of the running tool, showing the operative components of the locking device and the running tool as they appear immediately after the locking device has been double locked in position in the selected landing nipple of the well conductor and the running tool has been freed from the locking device for upward removal from the well;

Figure 6 is a continuation of the view of Figure 5 showing the lower portion of the locking device;

Figure 7 is a perspective view of the locking device, with a component thereof removed, showing the landing nipple engaging or locking keys thereof double locked in expanded locking positions;

Figure 8 is a perspective view of the locking device, with a component thereof removed, showing the landing nipple engaging or locking keys thereof double locked in expanded locking positions;

Figures 9, 10 and 11 are horizontal cross-sectional views taken on the lines 9—9, 10—10 and 11—11, respectively, of Figure 1;

Figure 12 is a side view of the locking device, partly in elevation and partly in section, taken at substantially ninety degrees from the view of Figure 7;

Figure 13 is a sectional view of a modified form of the locking device showing it double locked to prevent both upward and downward movement in a landing nipple of a well tubing; and

Figures 14 and 15 are horizontal cross-sectional views taken on the lines 14—14 and 15—15, respectively, of Figure 13.

In the drawings, the numeral 20 designates generally a locking device, which includes a central tubular lock mandrel 21 having a threaded lower end to which a packing mandrel 22 is adapted to be secured. The packing mandrel carries a packing assembly 23 which is retained in place on said mandrel by a packing nut 24 threaded on the lower end thereof. A suitable flow controlling or restrictive device, or other well tool may be connected to the threaded lower end 25 of the packer mandrel. If desired, any other suitable well device may be connected to the lower end of the lock mandrel in place of the packing mandrel and packing assembly.

The lock mandrel 21 is provided intermediate its ends with a pair of lateral opposed bosses 26 between which the lower ends of locking keys 27 are adapted to slide. Each boss 26 has its upper corners cut away to provide longitudinally disposed pairs of opposed lock shoulders or surfaces 28 on each boss. The lock shoulder having an upwardly facing stop shoulder 29 at its lower end. The inner surfaces of the locking keys may be engaged by the lock shoulders 28 of the bosses when the keys are expanded, which thus lock the keys in expanded positions, when the lock mandrel is in the raised position shown in Figures 5 and 6, and the stop shoulders 29 of the bosses may engage downwardly facing stop shoulders 30 of the keys to limit upward movement of the lock mandrel 21 relative to the locking keys.

The locking keys 27 are held in proper position on the lock mandrel by a tubular key retainer or cage 31 slidable mounted on the lock mandrel, the cage being provided with windows 32 through which the bosses 33a and 33b of each key protrude. An upper retaining flange 33c and a lower retaining flange 33d at the upper and lower ends, respectively, of each locking key engage the inner wall of the cage 31 at the upper and lower ends of the windows 32 to limit outward movement of the locking keys on the lock mandrel. A bushing 34 is threaded into the lower end of the cage 31 and limits downward movement of the lock mandrel with respect to the cage since the lower ends of the bosses 26 are engageable with the upper end of the bushing.

A lock sleeve 35 is slidable mounted on the lock mandrel and its lower portion extends between the lock man-
drel and the cage and is provided with a pair of slots 36 into which the upper ends of the locking keys extend. The lower portions of the lock sleeve on each side of the slots are cut away to provide longitudinally disposed slots 37, which are adapted to abut the inner surfaces of the upper portion of the keys 27 to lock the keys in expanded positions when the lock sleeve is in the lower or locking position shown in Figures 5 and 8. Downwardly facing stop shoulders 38 are formed on the lock sleeve at the upper end of each lock shoulder 27, and these stop shoulders are adapted to engage the upwardly facing stop shoulders 39 of the locking keys to limit downward movement of the lock sleeve on the lock mandrel.

The lock sleeve is provided near its lower end with an upwardly facing stop shoulder 40 which is adapted to engage an internal annular downwardly facing stop shoulder 41 within the upper portion of the bore of the cage 31 to limit upward movement of the lock sleeve with respect to the cage. The upper end of the lock sleeve is provided with an annular external flange 42 which may be engaged by a suitable pulling tool.

The locking keys 27 are yieldably biased outwardly toward expanded positions by a pair of springs 44. Each of the springs has a central coiled portion 45 which is disposed between the lower end of the lock sleeve and the upper end of the adjacent lock mandrel boss 26 and has curved outer ends 46 which are received in side recesses 47 of the keys.

It will be seen that when the lock mandrel 21 is moved upwardly relative to the key cage 31 and the locking keys 27 while the keys are in their expanded positions, the lock shoulders 28 of the lock mandrel bosses 26 engage the rear or inner surfaces of the lower portions of the keys to lock the keys against inward movement toward retracted position. The lock sleeve 35 may then be moved downwardly between the lock mandrel and the cage until the lock shoulders 27 of the lock sleeve engage the rear or inner surfaces of the upper portions of the locking keys to prevent inward movement of said keys toward retracted position. Thus, the keys are positively double locked in their expanded positions, and any fluid pressures or other forces acting on the locking device in either upward or a downward direction cannot dislodge the bosses 33b of the locking keys from their expanded positions wherein they are engaged in the internal locking groove 52 formed in the bore of a selected landings 50 connected in the well tubing or conductor 51, as will hereinafter more fully be explained.

The locking device is lowered into the well conductor or tubing 51, which may include a plurality of vertically spaced landing nipples 50, by means of a running tool 53 (Figure 1) on the lower end of a flexible line running and pulling mechanism (not shown) until a selected landing nipple located at the proper depth is reached. The running tool is then operated by jars imparted thereto through the flexible line mechanism to lock the locking device in the selected landing nipple.

The running tool 53 includes a top sub 54 having a threaded pin at its upper end by means of which it may be secured to the flexible line mechanism in the usual manner. An elongate core 55 connected at its upper end to the top sub has an enlarged lower portion 56 provided with a central bore 57 and a pair of opposed lateral windows 58 (Figure 3). A wedge member 59 and a catch lug 60 having wedge or beveled surfaces 61 and 62, respectively, are disposed in each window 58 of the core. A tubular body 64 is movably mounted on the core and has an internal annular flange 64a at its upper end slidable on the core above the enlarged lower portion thereof, and a helical spring 63 surrounding the core between the flange 64a and the upper ends of the wedge members 59, whereby the spring biases the wedge members downwardly and the sleeve upwardly relative to the core. The action of the spring on the wedge members biasing the same downwardly tends to urge the lugs 60 outwardly of the windows 58 in the core, from the positions shown in Figure 1 to that shown in Figure 3, because of the action of the wedge surfaces 61 and 62.

A tubular sleeve 65 movably mounted within the tubular body 64 has the lugs 60 in retracted positions in its bore when said tubular sleeve is held in the raised position shown in Figure 1 by the engagement of its lower end with the upper end of the lock sleeve 35 of the locking device. Upward movement of the tubular sleeve within the tubular body is limited by an internal downwardly facing stop shoulder 66 formed in the bore of the tubular body and which engages the upper end of the tubular sleeve. Downward movement of the sleeve 65 is limited by the upper end of a skirt 67 which is threaded in the lower end of the tubular body and is adapted to engage a downwardly facing external annular stop shoulder 68 formed intermediate the ends of the tubular sleeve.

An elongate prong 71 having a head 71a at its upper end is slidable in the bore 69 of the tubular sleeve 65, and a prong screw or extended shoulder 80 extends upwardly from the upper end of the prong and projects upwardly into the bore 57 of the core 55. A spring 73 surrounds the prong extension and is confined between a flange 72 at the upper end of said extension and the upper ends of the wedge members 59, whereby the prong extension and prong upwardly toward the position shown in Figure 1. The prong extends downwardly into the tubular lock mandrel 21 of the locking device and has enlargement at its lower end which is secured to the lock mandrel by a shear pin 74. The cage bushing 34 is provided with a hole 75 through which the shear pin 74 may be inserted into aligned holes in the lock mandrel and the lower end of the prong.

The lock sleeve 35 of the locking device is secured at its upper end to the skirt 67 by means of shear pins 76 disposed in aligned openings in the skirt and the flange 42 of the lock sleeve. A rotatable ring 77 mounted exteriorly of the upper portion of the skirt 67 is provided with a plurality of apertures (not shown) through which these shear pins may be inserted to connect the lock sleeve to the skirt and, thus, to the tubular body 64 of the running tool.

When it is desired to lock a well tool in a landing nipple 50, or in a selected one of a plurality of landing nipples 50 connected in a well flow conductor or tubing string, the well tool is connected to the lower end of the lock mandrel 21 of the locking device is then secured to the running tool by means of the shear pins 74 and 76, so that the lock sleeve and the lock mandrel are held in their longitudinally separated positions shown in Figure 1, whereby the locking keys 27 of the locking device are free to move between retracted and expanded positions.

The running tool, locking device and well tool are then lowered into the well tubing. The locking keys 27 are yieldably biased outwardly by the springs 44 whereby their downwardly facing beveled shoulders 79 will contact the upwardly facing beveled shoulders of downwardly facing nipples in passing therethrough. Since these shoulders are beveled, downward jars imparted to the running tool will cam the keys inwardly against the resistance of the springs 44 to permit the locking device to pass through all landing nipples until the selected landing nipple at the proper depth is reached and the bosses 33b of the keys are located in the annular groove 52 of the landing nipple at the selected depth.

An upward pull is then exerted on the running tool, causing the upwardly facing beveled shoulders 81 of the keys to contact the downwardly facing annular shoulder 82 at the upper end of the landings 50 in the landing nipple. The relatively sharp angle of the shoulders 81 and 82 require a substantial force to move the locking keys upwardly from this position, and an upward pull on the run-
ning tool will move all other parts of the locking device upwardly with respect to the locking keys until the lock shoulders 28 of the lock mandrel 21 are lifted to a position between the upper surfaces of the locking keys, thus locking the keys expanded. A further upward pull will now cause the core 55 to move upwardly compressing the springs 63 and 73 since the lugs 60 are restrained against outward movement by the tubular sleeve 65. The strength of the springs 63 and 73 are such that a lesser force is required to compress the springs 63 and 73 than is required to move the keys 27 inwardly against the resistance of the springs 44. The locking keys, being locked in expanded position, cannot move upwardly, and the lock mandrel 21 can move upwardly only until the stop shoulders 39 engage the shoulders 30 at the lower ends of the locking keys, whereby further upward movement of the lock mandrel is prevented. Similarly, the upper end of the packing mandrel 22 will engage the lower end of the bushing 34 at the lower end of the key cage 31 and the upwardly facing stop shoulders 32 in the lower portion of the windows 32 of the key cage will also engage the downwardly facing stop shoulders 30 of the locking keys to prevent upward movement of the packing mandrel, lock mandrel and key cage. The prong 71 being connected to the lock mandrel by the shear pin 74 is held against upward movement by the spring 73 permits the core 55 to move further upwardly with respect to the prong and prong extension.

The shoulder 40 on the lock sleeve 35 engages the stop shoulder 41 in the key cage 31 to limit upward movement of the lock sleeve, since the bushing 34 at the lower end of the cage engages the lower ends of the bosses 26 on the lock mandrel to limit upward movement of the cage. Since the lock sleeve is connected to the tubular body 64 by the shear pins 76, upward movement of the tubular body is thus limited by such connection, and upward movement of the tubular sleeve 65 is likewise limited by virtue of its engagement with the shoulder 66 in the tubular body.

As the core 55 moves upwardly and compresses the springs 63 and 73, the lugs 60 are moved upwardly past the upper end of the tubular sleeve 65, which is held against upward movement by the stop shoulder 66 in the bore of the tubular body 64. When the lugs move above the upper end of the tubular sleeve, the spring 63 biases the wedge members 59 downwardly and the wedge surfaces 61 and 62 engage the lugs downwardly over the upper ends of the tubular sleeve, as shown in Figure 3.

When the lugs 60 move past the upper end of the tubular sleeve 65 and are freed to move outwardly, they overlie and abut the upper ends of the lugs and thus hold the springs 63 and 73 in compression, resisting downward movement of the prong 71 and the tubular body 64 and the skirt 67 carried by the tubular body. The lock sleeve 35 is still secured to the tubular skirt and the prong is still secured to the lock mandrel so that the operative elements of the running tool and the locking device are now in the positions shown in Figures 3 and 4.

Downward jars or blows are then imparted by the running tool mechanism to the core 55, such blows being transmitted through the wedge members 59 and the lugs 60 to the upper end of the tubular sleeve which causes said tubular sleeve to move downwardly relative to the tubular body 64 and the skirt 67. Since the lower end of the tubular sleeve engages on the upper end of the lock sleeve, the downward force applied to the tubular sleeve shears the pins 76 and the lock sleeve is moved downwardly relative to the skirt and the locking keys until the lock sleeve is moved between the inner surfaces of the upper ends of the locking keys and thus double lock the locking keys in their expanded positions. Downward movement of the lock sleeve is limited by the engagement of the stop shoulders 39 on the lock sleeve with the shoulders 30 at the upper ends of the locking keys.

Upward jars are then imparted to the running tool causing the pin 74 to shear and thus free the running tool from the locking device. The running tool is then removed from the well tubing leaving the locking device, and the well tool it supports, double locked in position in the well tubing so that fluid pressure or other forces acting in either direction therein cannot dislodge the locking device from the landing nipple. If the well fluid pressure exerts a downward pressure on the locking device, which could tend to move the lock mandrel downwardly out of locking position, the lock sleeve holds it in locking position. Conversely, if an upward force is exerted on the locking sleeve which could tend to move the lock sleeve upwardly out of locking position, the lock mandrel holds the locking device in locking position. Furthermore, since the lock sleeve is slideable exteriors for the lock mandrel and is not exposed to upward flow of fluids, which flow upwardly through the bore of the lock mandrel, the lock sleeve will not be affected by upward fluid flow or pressure differentials, so that both lock members, the mandrel and the sleeve, hold the keys in expanded locking position against displacement by upward fluid flow and pressure differentials.

When it is desired to remove the locking device and the well tool it supports, a suitable retrieving tool is lowered into the well conductor and employed first to impart downward jars or blows to the upper end of the lock mandrel 21, which now projects above the upper end of the lock sleeve, to drive said lock mandrel downwardly so that its locking shoulders 28 no longer engage the locking keys. The retrieving tool may then engage the flange 42 of the lock sleeve and an upward pull thereon may move the lock sleeve upwardly relative to the locking keys until its lock shoulders 37 are moved out of engagement therewith. The locking device is then pulled up and out of the well tubing, the downwardly and outwardly beveled upper shoulders 88 of the locking keys camming the keys inwardly upon meeting obstructions during upward movement of the locking device through the well tubing. It will be readily apparent that the locking device cannot be freed for removal until the lock mandrel has been moved downwardly, so that if a condition of pressure differential acting upwardly on the packing mandrel and lock mandrel exists, the tool cannot be accidentally released by pulling upwardly on the lock sleeve. This prevents "blow-outs" of the locking device and fouling of the flexible line running and pulling mechanism.

It will be seen that a new and improved double locking lock device for well tools has been illustrated and described which includes central lock members with locking bosses which engage locking keys mounted on the lock mandrel to lock the keys in expanded position upon upward movement of the lock mandrel with respect to the keys. It will be apparent that the locking keys are mounted on the lock mandrel for lateral movement between retracted and expanded positions and that bias means, the springs 44, are provided to urge the locking keys toward the expanded positions. It will also be seen that a lock sleeve is provided which is slideably mounted on the lock mandrel for movement between the locking keys and the lock mandrel and that downward movement of the lock sleeve with said lock mandrel causes the lock sleeve to engage the locking keys to lock them in the expanded positions. The double lock adds security to the installation in which the locking device is used, and prevents dropping of the device should upward pressure differential be sharply decreased or removed.

Moreover, it will be seen that a running tool has been provided for the locking device which includes a central prong 71 detachably secured to the lock mandrel, a tubular member which includes the tubular body 64 and the skirt 67 and which is detachably secured to the lock sleeve, and a tubular sleeve in the tubular member which
coacts with biasing springs 63 and 73 and the wedges 59 and lugs 60 to simultaneously hold both to locking mandrel and lock sleeve in their unlocked positions; and that upward force or jars imparted to the running tool when the locking keys are in expanded positions in a lock groove or recess of a landing nipple will first cause the lock mandrel to move upwardly with respect to the locking keys to lock the keys in the expanded positions, then downward jars or force applied to the running tool will cause the lock sleeve to become detached from the tubular member and move downwardly with respect to the locking keys to lock them in expanded positions; whereupon, upward force or jars applied to the running tool will detach the prong from the lock mandrel to free the running tool from the locking device, whereby the latter may be left in double locked position in the landing nipple while the running tool may be removed from the well tubing.

In Figures 13, 14 and 15 is illustrated a locking device 90 which differs from the previously described form of the locking device in that the locking keys 91 each have but a single laterally and outwardly extending box 92 which extends through the windows 32 of the cage 31. The bosses of the locking keys have beveled upper shoulders 93 and lower shoulders 94 which engage the upper and lower annular shoulders 95 and 96 of the internal annular landing recess or groove 97 of the landing nipple 100. The annular landing recess 97 is in an appropriate size and shape to receive the bosses 92 of the keys 91. The locking keys are biased outwardly toward expanded positions by coil springs 98 which are received in appropriate inner recesses 99 of the keys and bear against the lock mandrel and the keys. In all other respects the locking device 90 is identical to the locking device 20 and is operable in the same manner as the locking device 20 by a running tool of the same form as the running tool 53, like parts being given like numbers. No other description of the locking device 90 is therefore necessary.

It will thus be seen that locking devices have been shown and described which are adapted for use with a set of upwardly and downwardly facing stop shoulders in a flow conductor, preferably provided in a suitable landing nipple in the conductor string, and which may be lowered past a plurality of identical sets of stop shoulders, or landing nipples, and locked in locking engagement with any one of a plurality of sets of such stop shoulders.

The position at which the devices are locked may be determined by locating the desired set of shoulders or landing nipples by means of a measuring apparatus of any well known type operating in association or connections with the flexible line running and pulling mechanism by means of which the locking device is lowered in the conductor.

Since the lower shoulders of the bosses on the locking keys are beveled, it will be seen that the locking device may be lowered past any number of sets of shoulders, or landing nipples, each having identical sets of stop shoulders, to a landing nipple located at a desired location in the conductor and in which it may be locked. As the downwardly facing stop shoulders are preferably inclined upwardly and inwardly at a rather abrupt angle with respect to the longitudinal axis of the conductor, preferably at an angle of less than forty-five degrees above a plane normal to the longitudinal axis of said conductor, and the upwardly facing stop shoulders on the bosses of the locking keys have a corresponding configuration, the upward movement of the keys with respect to the landing nipples will be somewhat more greatly restrained than the downward movement was. As has already been explained, the force of the springs biasing the locking keys outwardly, in cooperation with the abrupt shoulders in the conductor and on the bosses of the keys, is sufficient to restrain upward movement of the keys while the lock mandrel is moved upwardly to position the lock shoulders between the keys to positively lock the keys in stop shoul-

der engaging position, after which the other steps of locking the device may be carried out. When the locking device is being removed from within the conductor, the device is lifted by engagement of the retracted portion of the upper end of the lock sleeve, after the lock mandrel has been moved downwardly to its lowermost position to permit the locking keys to move inwardly. Thus, as downwardly facing stop shoulders in the conductor are engaged by the upwardly facing stop shoulders on the bosses of the locking keys, upward force applied to the lock sleeve will readily lift the keys past the stop shoulders, since the lock mandrel is not moved upwardly with respect to said keys, and they may move inwardly against the force of the springs so as to pass the downwardly facing stop shoulders.

Thus, the locking device may be lowered through a plurality of landing nipples to a selected landing nipple, locked therein positively against either upward or downward displacement by fluid pressure differentials, and may be removed upwardly from such position, all by means of suitable running and retrieving tools operated by means of a flexible line.

The foregoing description of the invention is explanatory only, and changes in the details of the constructions illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit or the scope of the invention.

What I claim and desire to secure by Letters Patent is:
1. A well tool including: a lock mandrel; a tubular cage mounted on said mandrel for longitudinal movement thereon and having a plurality of windows; locking keys disposed in said cage and having bosses extending laterally outwardly through said windows, said keys being mov-able laterally between expanded positions remote from said lock mandrel and retracted positions adjacent said lock mandrel; means biasing said keys toward expanded positions; lock shoulders on said lock mandrel intermediate the ends thereof, said lock shoulders being disposed substantially normal to the direction of lateral movement of said keys and engageable with said keys upon longitudinal movement of said lock mandrel in said cage when said keys are in said expanded positions; a lock sleeve slidably mounted on said lock mandrel above said keys and between said lock mandrel and said cage and movable downwardly on said lock mandrel independently of movement of said mandrel from an upper unlocked position to a lower locking position, said lock sleeve having lock shoulder engaging means disposed substantially normal to the direction of lateral movement of said keys and engageable with said keys when said keys are in said expanded positions and said lock sleeve is moved downwardly with respect to said sleeve to lock said keys in said expanded positions; cooperative means on said lock sleeve and said keys limiting downward movement of said lock sleeve on said lock mandrel; cooperative means on said cage and said lock sleeve limiting upward movement of said lock sleeve on said lock mandrel; and cooperative means on said cage and said lock mandrel limiting up-ward movement of said cage on said lock mandrel.
2. A well tool including: a lock mandrel; a tubular cage mounted on said mandrel for longitudinal movement thereon and having a plurality of windows; locking keys disposed in said cage and having bosses extending laterally outwardly through said windows, said keys being mov-able laterally between expanded positions remote from said lock mandrel and retracted positions adjacent said lock mandrel; means biasing said keys toward expanded positions; a plurality of spaced laterally projecting bosses on said lock mandrel intermediate the ends thereof, said bosses providing lock shoulders engageable with said keys when said keys are in said expanded positions to lock said keys in said expanded positions upon longitudinal move-
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A lock mandrel; a tubular cage mounted on said mandrel for longitudinal movement thereon and having a plurality of windows; locking keys disposed in said cage and having bosses extending laterally outwardly through said windows; said keys being movable laterally between expanded positions remote from said lock mandrel and retracted positions adjacent said lock mandrel; means biasing said keys toward expanded positions; a plurality of spaced laterally projecting bosses on said lock mandrel intermediate the ends thereof; said bosses providing lock shoulders engageable with said keys when said keys are in said expanded positions; a studly lock sleeve slidably mounted on said lock mandrel above said keys and between said lock mandrel and said cage and moveable longitudinally between an upper unlocked position to a lower locking position, said lock sleeve having lock shoulders engageable with said keys when said keys are in said expanded positions and said lock sleeve is moved downwardly with respect to said lock sleeve to lock said keys in said expanded positions; cooperating means on said lock mandrel and said keys limiting upward movement of said lock mandrel with respect to said keys; cooperating means on said lock sleeve and said keys limiting downward movement of said lock sleeve on said lock mandrel; cooperating means on said cage and said lock sleeve limiting upward movement of said lock sleeve on said lock mandrel; and cooperating means on said cage and said lock mandrel limiting upward movement of said cage on said lock mandrel; said lock mandrel extending above said lock sleeve when said lock mandrel and said lock sleeve are in locking positions.

6. In combination, a well pipe having a plurality of spaced tubular landing sections connected therein at selected levels and each having an identical set of stop shoulders comprising an internal upwardly facing stop shoulder and an internal downwardly facing stop shoulder, and a device for releasably anchoring a well tool in a selected one of said landing sections including; a lock mandrel; locking means mounted on said mandrel biased for lateral movement to a locking position wherein said locking means is disposed to engage said upwardly and downwardly facing stop shoulders of each of said landing sections; said lock mandrel being moveable longitudinally upwardly and downwardly relative to said locking means and having a lock surface engageable with said locking means when said locking means is in locking position in any one of said landing sections to lock said locking means in said locking position; and a lock sleeve slidably mounted on said lock mandrel and slidably longitudinally therein independent thereof, said lock sleeve having a lock surface engageable with said locking means when said locking means has been initially locked in locking position by said lock mandrel to additionally lock said locking means in said locking position.

7. A locking device for releasably anchoring a well tool in a selected one of a plurality of spaced tubular landing sections connected in a well pipe at selected levels in said well pipe and each having an identical set of stop shoulders comprising an internal upwardly facing stop shoulder and an internal downwardly facing stop shoulder, said lock sleeve slidingly mounted on said lock mandrel from an upper unlocked position to a lower locking position, said lock sleeve having lock shoulders engageable with said keys when said keys are in said expanded positions and said lock sleeve is moved downwardly with respect to said lock sleeve to lock said keys in said expanded positions; stop means limiting longitudinal movement of said lock mandrel relative to said keys between locking and unlocking positions; and stop means limiting movement of said lock mandrel to said keys between upper and lower positions; said lock mandrel extending above said lock sleeve when said lock mandrel and said lock sleeve are in locking positions.

5. A well tool including; a lock mandrel; a tubular cage mounted on said mandrel for longitudinal movement thereon and having a plurality of windows; locking keys disposed in said cage and having bosses extending laterally outwardly through said windows, said keys being movable laterally between expanded positions remote from said lock mandrel and retracted positions adjacent said lock mandrel; means biasing said keys toward expanded positions; lock shoulders on said lock mandrel intermediate the ends thereof, said lock shoulders being engageable with said keys upon longitudinal movement of said lock mandrel in said cage when said keys are in said expanded positions; a lock sleeve slidably mounted on said lock mandrel above said keys and between said lock mandrel and said cage and moveable downwardly on said lock mandrel from an upper unlocked position to a lower locking position, said lock sleeve having lock shoulders engageable with said keys when said keys are in said expanded positions and said lock sleeve is moved downwardly with respect to said lock sleeve to lock said keys in said expanded positions; cooperating means on said lock mandrel and said keys limiting upward movement of said lock mandrel with respect to said keys; cooperating means on said lock sleeve and said keys limiting downward movement of said lock sleeve on said lock mandrel; cooperating means on said cage and said lock sleeve limiting upward movement of said lock sleeve on said lock mandrel; and cooperating means on said cage and said lock mandrel limiting upward movement of said cage on said lock mandrel; said lock mandrel extending above said lock sleeve when said lock mandrel and said lock sleeve are in locking positions.
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11. A well tool including: a lock mandrel; a plurality of locking members each having a laterally extending boss portion adapted to engage locking shoulders in a well conductor and mounted on said lock mandrel and movably supporting said locking means in said projecting position relative to said lock mandrel; retaining means slidably longitudinally on said lock mandrel and movably supporting said locking means in said projecting position relative to said lock mandrel; said locking means intermediate its ends providing a lock surface engageable with said locking means when said locking means is in projecting position to lock said locking means in such projecting position upon longitudinal movement of said lock mandrel toward said locking means to said locking position to lock said locking means in said projecting position; stop means limiting longitudinal movement of said lock mandrel relative to said locking means between unlocking and locking positions; and stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

12. A well tool including: a lock mandrel; said boss portions of said locking members being engageable with said locking members when said locking members are in projecting position; stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

13. A well tool including: a lock mandrel; a plurality of locking members each having a laterally extending boss portion adapted to engage locking shoulders in a well conductor and mounted on said lock mandrel and movably supporting said locking means in said projecting position relative to said lock mandrel; retaining means slidably longitudinally on said lock mandrel and movably supporting said locking means in said projecting position relative to said lock mandrel; said locking means intermediate its ends providing a lock surface engageable with said locking means when said locking means is in projecting position to lock said locking means in such projecting position upon longitudinal movement of said lock mandrel toward said locking means to said locking position to lock said locking means in said projecting position; stop means limiting longitudinal movement of said lock mandrel relative to said locking means between unlocking and locking positions; and stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

14. A well tool including: a lock mandrel; said boss portions of said locking members being engageable with said locking members when said locking members are in projecting position; stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

15. A well tool including: a lock mandrel; said boss portions of said locking members being engageable with said locking members when said locking members are in projecting position; stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

16. A well tool including: a lock mandrel; said boss portions of said locking members being engageable with said locking members when said locking members are in projecting position; stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

17. A well tool including: a lock mandrel; said boss portions of said locking members being engageable with said locking members when said locking members are in projecting position; stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

18. A well tool including: a lock mandrel; said boss portions of said locking members being engageable with said locking members when said locking members are in projecting position; stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

19. A well tool including: a lock mandrel; said boss portions of said locking members being engageable with said locking members when said locking members are in projecting position; stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

20. A well tool including: a lock mandrel; said boss portions of said locking members being engageable with said locking members when said locking members are in projecting position; stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

21. A well tool including: a lock mandrel; said boss portions of said locking members being engageable with said locking members when said locking members are in projecting position; stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

22. A well tool including: a lock mandrel; said boss portions of said locking members being engageable with said locking members when said locking members are in projecting position; stop means limiting movement of said lock sleeve relative to said locking members between said unlocking and locking positions.

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flange being reduced in diameter beginning at a point spaced a distance below said downwardly facing stop and lock shoulder, said reduced bore having at its upper end an upwardly facing shoulder inclined inwardly and downwardly with respect to the longitudinal axis of said member at an angle of at least forty-five degrees with respect to a plane normal to the longitudinal axis of said member, and a downwardly facing shoulder at the lower end of said reduced portion of the bore of said member inclined downwardly and outwardly with respect to the longitudinal axis of said member, the bore of said member being unrestricted below said reduced portion; the bore of the member between said flange and said reduced portion forming an internal annular locking groove in said member having the downwardly facing stop and lock shoulder inclined at an angle of less than forty-five degrees defining the upper limit of said groove and the upwardly facing downwardly and inwardly inclined shoulder at the upper end of the reduced portion of the bore defining the lower limit of said locking groove; said locking groove being adapted to receive the locking member of a removable well device for stopping and anchoring said well device in said landing section, said downwardly facing stop and lock shoulder at the upper end of said groove offering substantial resistance to upward movement of said lock member from said groove, said upwardly facing shoulders at the upper end of said flange and at the upper end of the reduced portion of the bore of said landing section providing camming surfaces facilitating passage of said locking member through said section, whereby said locking member may pass through the locking groove and through the locking section to permit said well tool to be movable therethrough to a position below said landing section.

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