Aug. 5, 1952 R. C. BAKER 2,605,843

WELL TOOL ANCHORING DEVICE

Original Filed July 7, 1944 2 SHEETS—SHEET 1

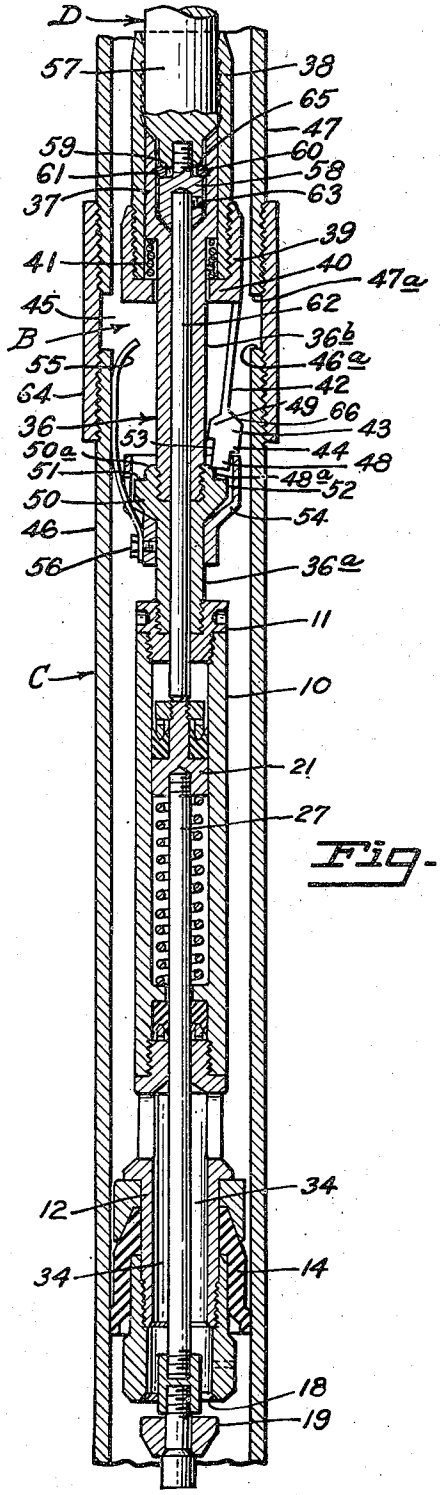
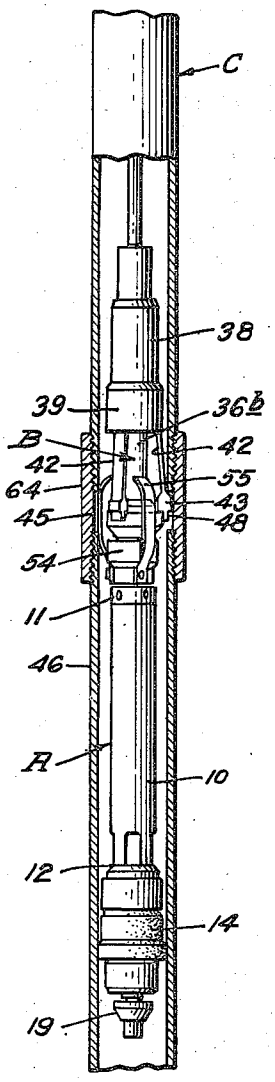


Fig. 2.

Fig. 1



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Fig. 3.

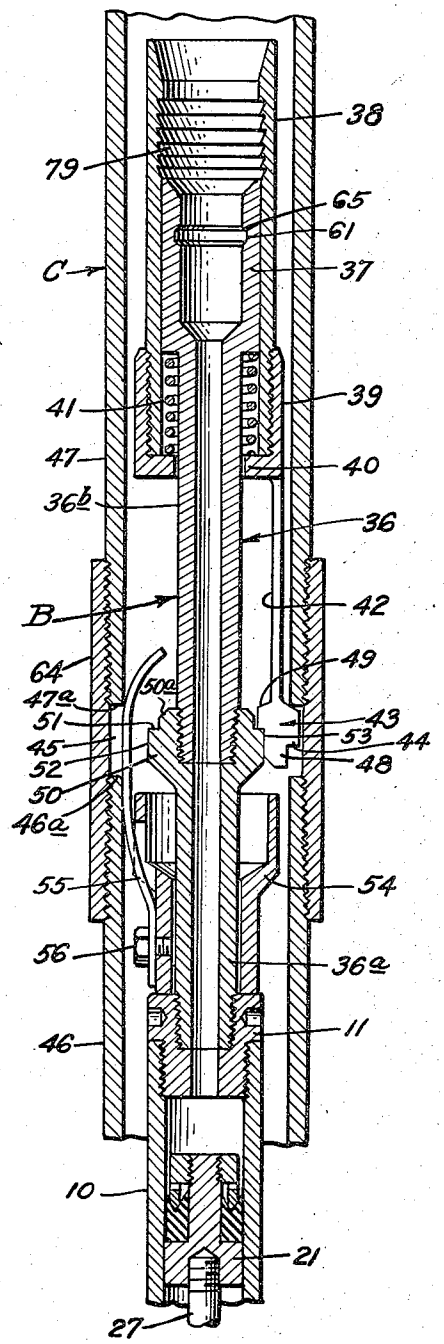
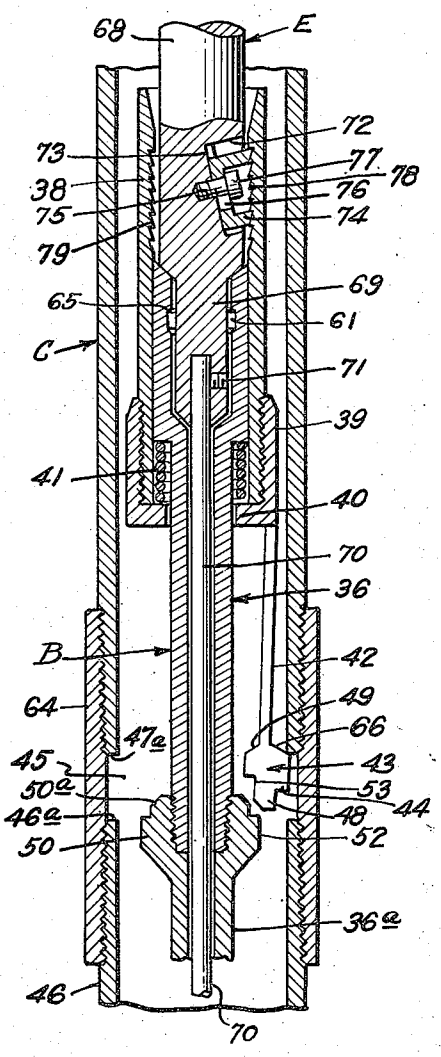


Fig. 4.



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2,605,843

WELL TOOL ANCHORING DEVICE

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Original application July 7, 1944, Serial No. 543,853. Divided and this application January 4, 1947, Serial No. 720,243

16 Claims. (Cl. 166—2)

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The present invention relates to well devices, and more particularly to devices adapted to be anchored in well conduits, such as tubings, casings, liners, etc.

This application is a division of my application for "Devices for Controlling Well Flow," Ser. No. 543,853, filed July 7, 1944, now abandoned because of the filing of a continuation of such application on February 23, 1950, Serial No. 147,631.

An object of the present invention is to provide an improved well tool adapted to be locked in a well conduit at a conduit joint, or other circumferential recess in the conduit.

Another object of the invention involves the provision of a well tool adapted to be locked in a well conduit recess against movement in both longitudinal directions and to be retrievable from the well conduit whenever desired.

A further object of the invention is to provide a well tool having anchoring means adapted to fit within a well conduit recess, such as its coupling joint space, the anchoring means being held positively outward in such recess to prevent longitudinal movement of the tool within the conduit.

One form which the invention may assume is exemplified in the following description and illustrated by way of example in the accompanying drawings, in which:

Fig. 1 is an elevation of an apparatus shown installed in well production tubing.

Fig. 2 is a longitudinal section through the apparatus with its parts in retracted position for lowering through the production tubing.

Fig. 3 is a longitudinal section of the apparatus, shown locked within a tubing joint recess.

Fig. 4 is a longitudinal section illustrating the removal of the apparatus upwardly through the tubing.

As disclosed in the drawings, the invention is shown by way of example as applied to a flow control device A adapted to determine the extent of upward flow of well production through a string of production tubing C running to the top of a well bore. This combination is described in detail in my above identified application. For purposes of the present invention and to exemplify one use of the anchoring device B, it is sufficient to state that the flow control device includes a cylinder 10 containing piston means 21, 27 adapted to control the flow of fluid through a valve body 12 secured to the lower end of the cylinder, the valve body having mounted thereon a suitable packing cup 14 adapted to seal against

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the wall of the tubing string C. The piston means is connected to a valve head 19 adapted to move upwardly into engagement with a valve seat 18, secured to the body 12, in order to close the passage 34 through the valve body.

The anchoring device B exemplifying the present invention is attached to the cylindrical body 10 to form an upward extension thereof and includes a tubular mandrel 36 having its lower member 36a threaded into the cylinder head portion 11 of the cylinder, and its upper member 36b threaded into the lower member. The upper mandrel member is provided at its upper end with an enlarged head 37 slidably receiving a retrieving sleeve 38 on the lower end of which is threaded a latch carrier 39 having an internal shoulder 40 forming a seat for a helical spring 41 whose upper end engages the mandrel head 37. A plurality of circumferentially spaced spring-like latches 42 are formed integrally with and depend from the latch carrier 39, each latch having a rigid head 43 at its lower end provided with an integral dog or slip 44 of such length as to be able to fit within a coupling space 45 formed between adjacent sections 46, 47 of the well conduit or tubing. The head 43 also has a foot portion 48 depending from the dog 44, and an inwardly projecting lug 49 above the foot. A latch lock or holder 50 is formed on the upper end of the lower mandrel member 36a, and has a shoulder 51 adapted to engage the lower end of the lug 49, and also an outer surface 52 engageable with the inner surface 53 on each foot 48 to prevent inadvertent inward movement of the latch 42 after its outward expansion into the tubing coupling space 45.

When the tool is run downwardly through the tubing, the latches 42 are prevented from moving outwardly, due to their inherent spring action, by a cup-shaped retainer 54 engaging the outer surface of each latch foot 48. This retainer is slidable longitudinally on the lower mandrel member 36a in moving to and from latch retaining position. Circumferentially spaced leaf springs 55 are secured to the latch retainer by screws 56 or the like, and frictionally engage the tubing C, tending to resist movement of the latch retainer 54 therewithin.

A running-in tool D is employed for lowering and setting the tool in the production tubing already installed in the well bore. This tool consists of an upper body 57 received within the retrieving sleeve 38 and having a depending pilot 58 provided with an external circumferential groove 59 in which is positioned a split coupling

ring 60 which inherently tends to expand in an outward direction. A companion internal groove 61 is formed in the mandrel head 37 for reception of the split ring 60 to couple the running-in tool to the mandrel 36. A stinger or valve opening rod 62 is secured to the pilot 58, as by a set screw 63, and extends downwardly through the central passage in the mandrel and cylinder head into engagement with the upper end of the piston 21. The valve opening rod 62 is of such length as to move the piston 21 downwardly against the action of a spring 33, within the cylinder 10, when the coupling ring 60 is in the internal groove 61 to hold the valve in open position while the apparatus is being run downwardly through the tubing C.

The parts are all arranged as disclosed in Fig. 2, with the running-in tool D in proper position within the mandrel 36 and cylinder 10. It is to be noted that the mandrel 36 has been moved down with respect to the retrieving sleeve 38 and latches 42 to dispose the latch lock 50 below the head 43, which allows the latter to be forced inwardly and held in retracted position by the retainer sleeve 54 positioned over the foot portions 48 of the latches. The setting spring 41 has been compressed and is held in such compressed state by engagement of the foot portions 48 of the latches with the tapered portion 50*a* of the mandrel lock 50.

The running-in tool D is secured to a suitable wire line or tubing (not shown) for lowering the entire apparatus through the production tubing C. Body 57 has sufficient weight, which may be supplemented, if required, by a sinker bar (not shown) attached to its upper end, to force the apparatus down through the production tubing. This downward movement is not retarded by the fluid in the tubing, since the stinger 62 holds the valve head 19 open and allows fluid to bypass the packing 14 by flowing upwardly through the valve body 12 and its ports 13. Since the friction springs 55 tend to resist movement of the latch retainer 54 downwardly through the tubing, it remains in position over the foot portions 48 of the heads 43 to hold their dogs or slips 44 in retracted position.

When the approximate depth at which the apparatus is to be anchored in the well tubing is reached, the wire line is moved upwardly causing the entire apparatus to be elevated, with the exception of the latch retainer 54, whose upward movement is prevented by the friction springs 55. Such upward movement releases the latch retainer from the foot portions 48 of the latches 42 and allows them to expand outwardly under their inherent spring action against the wall of the tubing. This outward expanding action may be assisted by the force of the compressed setting spring 41 tending to move the lock 50 upwardly with respect to the latches to shift its conical expander portion 50*a* upwardly against and along the companion inclined surfaces 48*a* at the inner lower ends of the foot portions of the dogs or slips.

The entire apparatus is elevated until the next higher coupling space 45 formed by a coupling 64 connecting adjacent sections 46, 47 of tubing together is reached, whereupon the dogs 44 on the latches can inherently expand outwardly into the space 45, the setting spring elevating the upper mandrel member 36*b* and attached lower mandrel member 36*a* to position the latch lock or holder 50 behind the latches, as shown in Fig. 3, in which the lock shoulder 51 engages the lugs 49 and the periphery 52 of the lock engages the inner surfaces 53 of the foot portions 48 of the latches. When in this position, the apparatus cannot move upwardly except to a very slight extent as limited by the coupling space, since the latches 42 are prevented from moving inwardly out of the coupling space 45 by engagement of the heads 43 with the periphery 52 of the latch holder 50. A continuation of the upward strain on the wire line or tubing attached to the running-in tool D causes the split coupling ring 60 to bear against the tapered upper surface 65 of the internal groove 61, which will shift it inwardly to release the running-in tool D from the mandrel head 37, permitting withdrawal of the running-in tool to the surface of the well bore and also withdrawing valve opening rod 62 from the mandrel 36 and cylinder 10. While this upward force is being exerted on the running-in tool to release its upper mandrel, the upwardly and inwardly inclined surfaces 66 on the latch heads 43 engage the end 47*a* of the upper tubing section 47, but the latch holder 50 still prevents the dogs from moving inwardly and holds the apparatus locked to the production tubing C against upward movement. Downward movement is prevented by engagement of the dogs 44 with the end 46*a* of the lower tubing section 46.

The device may be retrieved from the well bore whenever desired by running a retrieving tool E into the production tubing C on the end of a wire line or other suitable string (see Fig. 4). The retrieving tool includes a body 68 adapted to be received within the retrieving sleeve 38, which is provided with a pilot 69 for reception within the mandrel head 58. This pilot also carries a depending stinger or valve opening rod 70 secured to it in any suitable fashion, as by a set screw 71, which extends through the mandrel 36 and engages the piston 21 to force it downwardly against the action of the spring 33 and move the valve head 19 from its seat 18. The tool body is provided with a slip receiving groove 72 whose base portion forms a slip expander 73 inclined in a downward and outward direction. A slip 74 is received within this groove 72 and is held therein by a retainer screw 75 extending through an elongated slot 76 in the base portion of the slip and threaded into the body 68 of the retrieving tool. The head 77 of this screw engages the base of the slip to prevent its loss from the body, but still permits sliding action of the slip on the expander portion 73 of the body. This slip 74 is provided with external wickers 78, preferably formed as a portion of a helical thread, which are adapted to engage companion internal ratchet threads 79 formed on the interior of the retrieving sleeve 38.

When moving the tool downwardly, the slip 74 tends to move and remain in an inward position free from engagement with the ratchet teeth 79 on the interior of the retrieving sleeve, but upon upward movement of the wire line and body 68 the expander 73 forces the slip 74 outwardly and causes its wickers 78 to engage the ratchet teeth 79. In effect, the slip and ratchet teeth on the retrieving sleeve form a one-way clutch, which allows downward movement of the body 68 and attached stinger 70 with respect to the retrieving sleeve 38, but prevent their relative upward movement.

The retrieving tool E is lowered through the production tubing C until it enters the mandrel 36 and retrieving sleeve 38. Engagement of the dogs 44 with the end of the lower tubing section

46 prevents downward movement of the latches 42 and retrieving sleeve 38, and allows the weight of the body 68 to be imposed on the stinger 70 to open the valve against the force of the spring 33 and production tubing pressure. This weight also forces the mandrel 36 down to recompress the setting spring 41 and shift the latch holder 50 downwardly from the latch dogs. The latch holder 50 is held in this lower position and the valve maintained open by the clutching engagement of the slip 74 with the retrieving sleeve 38 and engagement of the body 68 with the mandrel head 37. Upward movement of the wire line then elevates the entire mechanism through the production tubing, the inclined surfaces 66 of the latch heads 43 engaging the lower end 47*a* of each tubing section 47 to be forced inwardly free of the coupling spaces 45 during upward travel of the mechanism. These latches 42 ride along the walls of the tubing sections until the entire device is withdrawn from the tubing at the surface of the well bore. The retrieving tool E can then be withdrawn from the mandrel by unscrewing the body 68 and its slip 74 from the ratchet threads 79 in the retrieving sleeve 38.

It is, accordingly, apparent that an anchoring device has been devised capable of securing a well tool in a recess within a well conduit, such as the tubing string referred to above. The latches 42 spring outwardly into the recess or coupling space 45 and are maintained positively in such outward position to prevent longitudinal movement of the well tool in both directions within the well conduit by the action of the holder 50, which provides a backing for the latches 42 and prevents them from moving inwardly upon engagement of their inclined surfaces 66 with the lower ends 47*a* of the upper tubing sections. When it is desired to remove the tool, however, the backing or locking member 50 is removed from its locked engagement with the latches, which permits them to be forced inwardly out of the coupling space and the entire tool withdrawn from the well bore.

While I have shown the preferred form of my invention, it is to be understood that various changes may be made in its construction by those skilled in the art without departing from the spirit of the invention as defined in the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A well tool of the type adapted to be lowered by a running-in device into a well tubing having an internal annular recess at the tubing joints, said tool including a mandrel, a collar slidable on the mandrel, locking members, springs interconnecting the collar and locking members and tending to move the locking members outwardly, means for releasably locking the locking members against the mandrel, said springs moving the locking members into the tubing joint recess as the mandrel is pulled upwardly by the running-in device to release said locking means, a backing wall carried by the mandrel and positioned behind the locking members when the mandrel is elevated after the locking members have been set in the recess to prevent the locking members from being retracted out of said recess.

2. A well tool of the type adapted to be lowered by a running-in device into a tubular string having an internal annular recess, said tool including a mandrel, a collar slidable on the mandrel, locking members, springs interconnecting the collar and locking members and tending to move the locking members outwardly, means slidable on said mandrel for holding the locking members retracted against the mandrel during lowering of said mandrel, said springs moving the locking members into the recess as the mandrel is pulled upwardly by the running-in device to release said slidable means from said locking members, a backing wall carried by the mandrel and positioned behind the locking members when the mandrel is elevated after the locking members have been set in the recess to prevent the locking members from being retracted out of said recess.

3. A well tool adapted to be lowered through a tubular string having an internal annular recess, said tool including a mandrel, a collar slidable on the mandrel, locking members, springs interconnecting the collar and locking members and tending to move the locking members outwardly, means for releasably locking the locking members against the mandrel, said springs moving the locking members into the annular recess as the mandrel is moved longitudinally through the tubular string to release said locking means, and a backing wall carried by the mandrel and positioned behind the locking members when the mandrel is moved longitudinally through the tubular string after the locking members have been set in the recess to prevent retraction of the locking members out of said recess.

4. A well tool adapted to be lowered through a tubular string having an internal annular recess, said tool including a mandrel, locking members, spring means on said mandrel and connected to said locking members, said spring means tending to move the locking members outwardly, means for holding said locking members in retracted position on said mandrel or for releasing said locking members from such retracted position, said spring means moving the locking members into the annular recess as the mandrel is moved longitudinally through the tubular string to release said holding means from said locking members, and a backing wall carried by said mandrel and positioned behind the locking members upon longitudinal movement of said mandrel through the tubular string after the locking members have been set in the recess to prevent retraction of the locking members from said recess.

5. A well tool adapted to be lowered through a tubular string having an internal annular recess, said tool comprising a mandrel, means on said mandrel including spring-like locking members tending to move inherently outwardly into said tubular recess, means for holding said locking members in retracted position on said mandrel or for releasing said locking members from such retracted position upon elevation of said mandrel in said tubular string, a backing wall carried by said mandrel and positioned behind said locking members when the mandrel is elevated after the locking members have been set in the recess to prevent retraction of said locking members from said recess.

6. A device adapted to be lowered through a tubular string positioned in a well bore, including a mandrel, means on said mandrel for anchoring it to said tubular string, said means including instrumentalities for expanding said anchoring means outwardly into engagement with said tubular string, a tool for lowering said device through said tubular string, releasable means coupling said tool to said mandrel and detachable upon the taking of a predetermined upward pull on said tool to free said tool from said mandrel, means slidable on and engaging said mandrel and

adapted for frictional engagement with said tubular string for engaging and retaining said anchoring means in retracted position during lowering of the device through said tubular string, said retaining means being slidable relatively downwardly on said mandrel upon upward movement of said tool and mandrel relative to said tubular string to release and allow expansion of said anchoring means into engagement with said tubular string.

7. A device adapted to be lowered through a tubular string positioned in a well bore, including a mandrel, means on said mandrel for anchoring it to said tubular string, said means including instrumentalities for expanding said anchoring means outwardly into engagement with said tubular string, means on said mandrel for holding said anchoring means outwardly against said tubular string, yieldable means between said anchoring means and holding means tending to maintain latter in position to prevent inward movement of said anchoring means, means slidable on said mandrel and adapted for frictional engagement with said tubular string for engaging and retaining said anchoring means in retracted position during lowering of the device through said tubular string, said retaining means being slidable relatively downwardly on said mandrel upon upward movement of said mandrel relative to said tubular string to release said anchoring means for expansion into engagement with said tubular string and to allow said yieldable means to shift said holding means to a position maintaining such engagement of said anchoring means with said tubular string.

8. A device adapted to be lowered through a tubular string positioned in a well bore, including a mandrel, a carrier sleeve slidable on said mandrel, a plurality of latches depending from said carrier sleeve and movable outwardly into anchoring engagement with said tubular string, a lock on said mandrel engageable with said latches for holding them in such anchoring engagement with said tubular string, a spring between said mandrel and carrier sleeve tending to maintain the lock behind said latches to prevent their inward movement from anchoring engagement with said tubular string, means comprising a retainer slidable on said mandrel and engageable with said latches to hold them in retracted position with respect to said lock and to hold said carrier sleeve in an upward position on said mandrel against the force of said spring, said means also comprising means adapted to engage said tubular string for sliding said retainer downwardly on said mandrel upon upward movement of said mandrel within said tubular string to release and allow expansion of said latches into engagement with said tubular string and to allow said spring to shift said lock behind said latches to maintain them in engagement with said tubular string.

9. A device adapted to be lowered through a tubular string positioned in a well bore, including a mandrel, a carrier sleeve slidable on said mandrel, a plurality of latch dogs depending from said carrier sleeve and movable outwardly into a coupling space between adjacent sections of said tubular string, a lock on said mandrel engageable with said latch dogs for holding them in such coupling space, a spring between said mandrel and carrier sleeve tending to maintain said lock behind said latch dogs to prevent their inward movement from such coupling space, means comprising a retainer slidable on said mandrel and engageable with said latch dogs to hold them inwardly from said coupling space and to hold said carrier sleeve in an upward position on said mandrel against the force of said spring, said means also comprising means adapted to engage said tubular string for sliding said retainer downwardly on said mandrel from engagement with said latch dogs upon upward movement of said mandrel within said tubular string to release and allow expansion of said latch dogs into said coupling space and to allow said spring to shift said lock behind said latch dogs to maintain the latter in said coupling space.

10. A device as defined in claim 9, including a tool adapted to be lowered through said tubular string into engagement with said mandrel to shift said mandrel downwardly relative to said carrier sleeve against the force of said spring to remove said lock from behind said latch dogs to permit inward movement of the latter from such coupling space, said tool having means engaging said carrier sleeve for holding said lock in such downward position.

11. A device adapted to be lowered through a tubular string positioned in a well bore, including a mandrel, means on said mandrel including spring-like locking members tending to move inherently outwardly into engagement with the tubular string for anchoring said mandrel to said tubular string, a tool for lowering said device through said tubular string, releasable means coupling said tool to said mandrel and detachable upon the taking of a predetermined upward pull on said tool to free said tool from said mandrel, means slidable on and engaging said mandrel and adapted for frictional engagement with said tubular string for engaging and retaining said anchoring means in retracted position during lowering of the device through said tubular string, said retaining means being slidable relatively downwardly on said mandrel upon upward movement of said tool and mandrel relative to said tubular string to release and allow expansion of said anchoring means into engagement with said tubular string.

12. A device adapted to be lowered through a tubular string positioned in a well bore, including a mandrel, means on said mandrel including spring-like locking members tending to move inherently outwardly into engagement with the tubular string for anchoring said mandrel to said tubular string, means on said mandrel for holding said anchoring means outwardly against said tubular string, yieldable means between said anchoring means and holding means tending to maintain the latter in a position to prevent inward movement of said anchoring means, means slidable on said mandrel and adapted for frictional engagement with said tubular string for engaging and retaining said anchoring means in retracted position during lowering of the device through said tubular string, said retaining means being slidable downwardly on said mandrel upon upward movement of said tool and mandrel relative to said tubular string to release said anchoring means for expansion into engagement with said tubular string and to allow said yieldable means to shift said holding means to a position maintaining such engagement of said anchoring means with said tubular string.

13. A device adapted to be lowered through a tubular string positioned in a well bore, including a mandrel, a carrier sleeve slidable on said mandrel, a plurality of latches depending from said carrier sleeve for anchoring engagement with

said tubular string, spring means connecting said latches to said carrier sleeve and tending to move said latches outwardly, a lock on said mandrel engageable with said latches for holding them in such anchoring engagement with said tubular string, a spring between said mandrel and carrier sleeve tending to maintain the lock behind said latches to prevent their inward movement from anchoring engagement with said tubular string, means comprising a retainer slidable on said mandrel and engageable with said latches to hold them in retracted position with respect to said lock and to hold said carrier sleeve in an upward position on said mandrel against the force of said spring, said last-mentioned means also comprising means adapted to engage said tubular string for sliding said retainer downwardly on said mandrel away from said latches upon upward movement of said mandrel within said tubular string to allow expansion of said latches into engagement with said tubular strings and to allow said spring to shift said lock behind said latches to maintain them in engagement with said tubular string.

14. A device adapted to be lowered through a tubular string positioned in a well bore, including a mandrel, a carrier sleeve slidable on said mandrel, a plurality of latch dogs depending from said carrier sleeve for reception within a coupling space between adjacent sections of said tubular string, spring means connecting said latch dogs to said carrier sleeve and tending to move said dogs outwardly, a lock on said mandrel engageable with said latch dogs for holding them in such coupling space, a spring between said mandrel and carrier sleeve tending to maintain said lock behind said latch dogs to prevent their inward movement from such coupling space, means comprising a retainer slidable on said mandrel and engageable with said latch dogs to hold them inwardly from said coupling space and to hold said carrier sleeve in an upward position on said mandrel against the force of said spring, said last-mentioned means also comprising means adapted to engage said tubular string for sliding said retainer downwardly on said mandrel from engagement with said latch dogs upon upward movement of said mandrel within said tubular string to allow expansion of said latch dogs into said coupling space and to allow said spring to shift said lock behind said latch dogs to maintain the latter in said coupling space.

15. A device as defined in claim 14, including a tool adapted to be lowered through said tubular string into engagement with said mandrel and sleeve to shift said mandrel downwardly against the force of said spring to remove said lock from behind said latch dogs to permit inward movement of the latter from such coupling space, said tool and sleeve having inter-engageable means for holding said lock in such downward position.

16. A tool adapted to be lowered through a tubular string, said tool comprising a mandrel, a first means relatively movable on said mandrel and including a supporting member and spring-like locking members depending from said supporting member, said locking members tending to move inherently outwardly against the tubular string, and retaining means slidable on said mandrel below said locking members and engaging said locking members to hold said locking members in retracted position, said retaining means having means for resisting upward movement of the retaining means upon elevation of said mandrel to release said retaining means from said locking members.

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