June 30, 1964 J. V. FREDD ETAL 3,139,141

PIPE HANGERS FOR WELLS

Original Filed Nov. 4, 1957 3 Sheets-Sheet 1

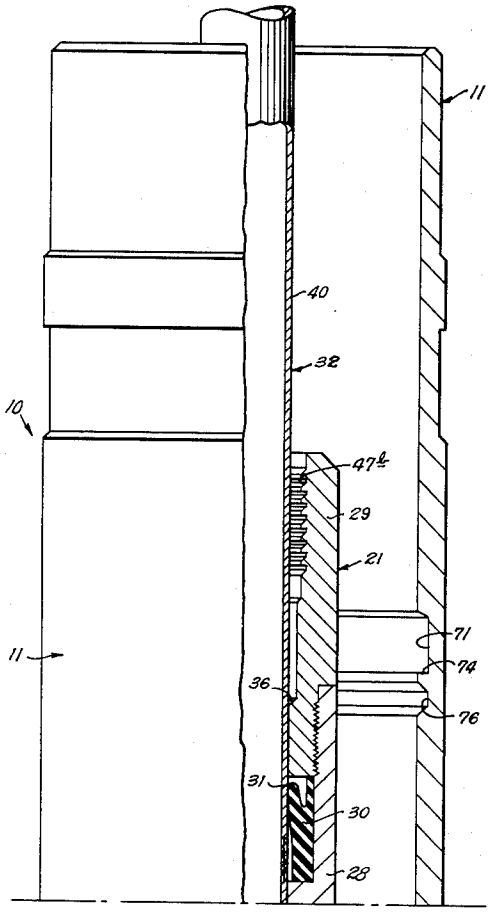


Fig. 1

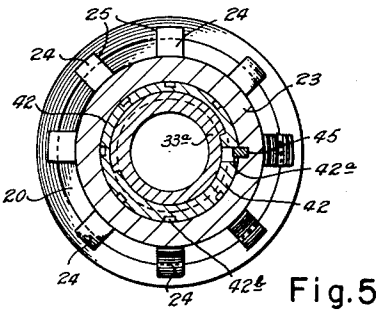


Fig. 5

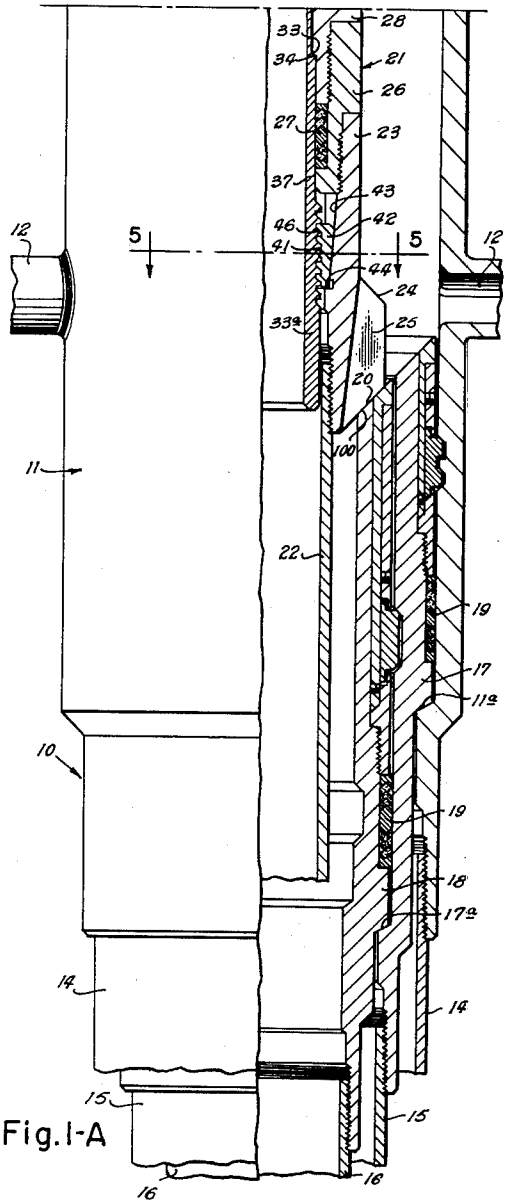


Fig. 1-A

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PIPE HANGERS FOR WELLS

Original Filed Nov. 4, 1957 3 Sheets-Sheet 2

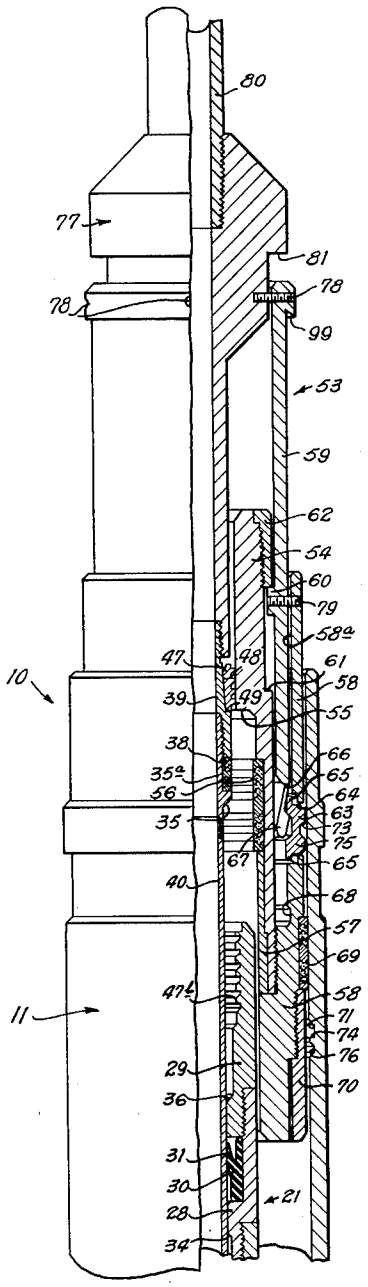


Fig. 2

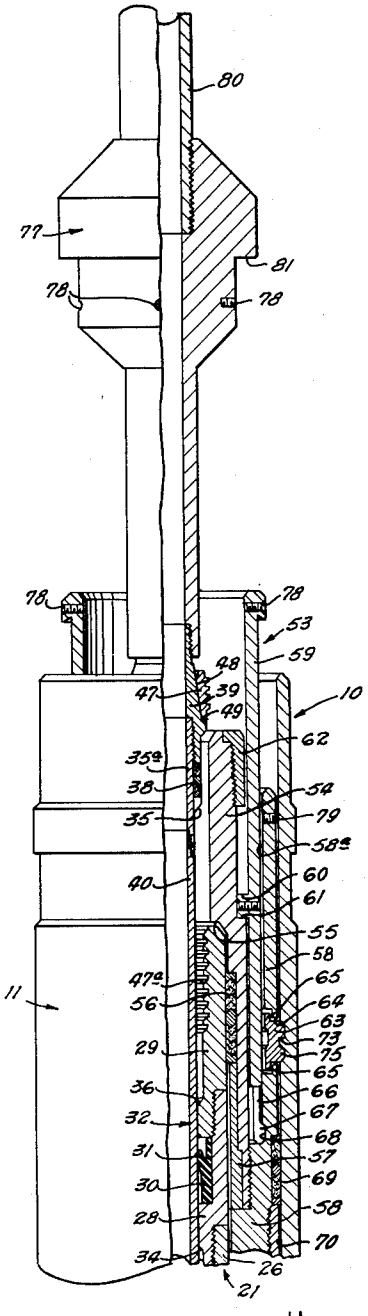


Fig. 3

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PIPE HANGERS FOR WELLS

Original Filed Nov. 4, 1957 3 Sheets-Sheet 3

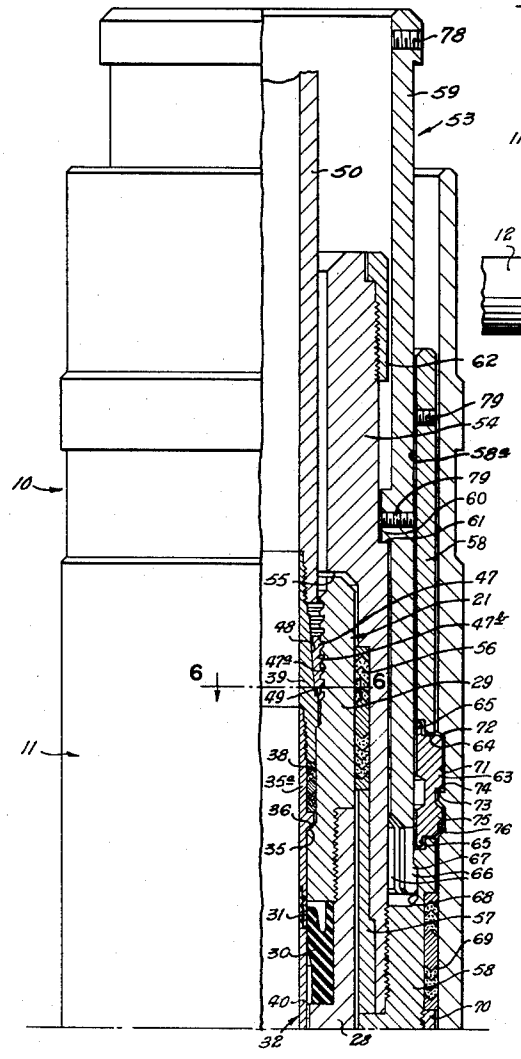


Fig. 4

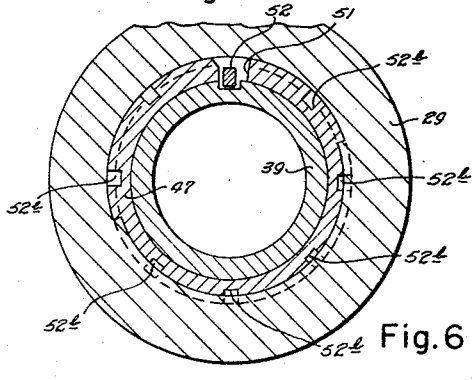


Fig. 6

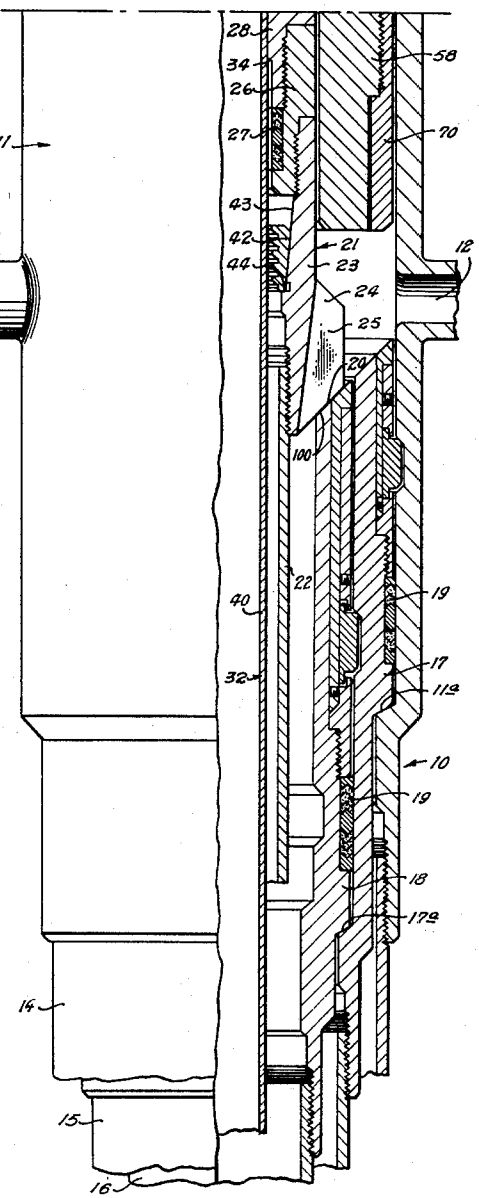


Fig. 4-A

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United States Patent Office

3,139,141

Patented June 30, 1964

3,139,141

PIPE HANGERS FOR WELLS

John V. Fredd, Dallas County, George Max Raulins, Harris County, Tex., and Harry B. Schramm, deceased, late of Dallas, Tex., by Josephine Schramm, administratrix, Dallas, Tex., assignors, by mesne assignments, to Otis Engineering Corporation, Dallas County, Tex., a corporation of Delaware

Continuation of application Ser. No. 694,203, Nov. 4, 1957. This application Oct. 8, 1962, Ser. No. 229,526

30 Claims. (Cl. 166—208)

This invention relates to well tools and more particularly to a supporting member or hanger for well pipe or tubing in a well and to an extension for said tubing which may be extended above the hanger or lowered into the tubing below the hanger.

This application is a continuation of S.N. 694,203, filed Nov. 4, 1957 and now abandoned.

In the completion of certain wells, such as those on the floor of a deep body of water, it is desirable to establish the wellhead at a level considerably below the level of the drilling platform. In such a well, it is necessary to install the tubing in the well and to support and lock the upper end of said tubing therein. It is also necessary to provide a means for providing fluid communication between the tubing in the well and the surface of the water.

An object of the invention is to provide a tubing hanger which supports the upper end of a string of tubing in a casing bowl of a well, the hanger including a telescoping extension for the tubing, the extension being extensible and retractable in the hanger.

Another object of the invention is to provide, with a hanger of the type described, a hold-down for positively holding the hanger in place in the well and for sealing between the hanger and the casing bowl, the hold-down being easily removable for removal of the tubing hanger and the tubing from the well.

A further object is to provide, in a hanger of the type described, a telescoping extension which, when moved to its extended or retracted position in the hanger, automatically locks in the extended or retracted positions and which is released easily by rotational movement for movement from one position to the other.

A still further object of the invention is to provide a hanger and an extension of the type described wherein a positive seal is maintained against leakage between the hanger and the extension when the extension is retracted or extended.

Yet another object is to provide an extension of the type described wherein the extension may be made of any length desired.

Another object is to provide an extension and a hanger of the type described wherein the extension is locked in its extended or retracted position by a longitudinal force thereon but is unlocked for movement from either extended or retracted position by rotation, the unlocking rotation being in the same direction in both instances.

A further object of the invention is to provide a hanger and a hold-down therefor for use in a casing bowl wherein a flow course is provided past the supporting shoulder of the hanger and the casing bowl and wherein the seal between the hanger and the casing bowl is provided by the hold-down.

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

FIGURES 1 and 1–A, taken together constitute a view, partly in section and partly in elevation, of a well showing the tubing hanger landed in the well and with the telescoping tubing extension in its extended position;

FIGURE 2 is a view, partly in section and partly in elevation, of the hold-down attached to the running tool and the running tool secured to the extension, the hold-down being positioned in the casing bowl;

FIGURE 3 is a view, similar to FIGURE 2, showing the hold-down in place and the running tool detached therefrom and being removed;

FIGURES 4 and 4–A, taken together, constitute a view, similar to FIGURES 1 and 1–A, showing the hold-down installed in position on the hanger and the extension in retracted or collapsed position;

FIGURE 5 is a cross-sectional view taken on line **5—5** of FIGURE 1–A; and,

FIGURE 6 is a cross-sectional view taken on line **6—6** of FIGURE 4.

Referring now to the drawings, a submarine well **10** is shown as having a casing head, bowl or hanger means **11** at the upper end of the well, the casing bowl being positioned slightly above the floor of the body of water under which the well is located. A pair of opposed lateral flow pipes or casing flow wings **12** extend from the casing bowl and are provided with the necessary valves and fitting (not shown). In deep water, the valves may be remotely controlled by any well known means.

The casing bowl is attached to the upper end of a string of large pipe or surface casing **14**, and additional smaller strings of casing extending to greater depth, such as the intermediate casing **15** and the production or inner casing **16**, are supported in the casing bowl by means of the casing hangers or tubular hanger means **17** and **18**, respectively. The casing hangers may be similar to that shown in our co-pending application, Serial No. 694,204, filed November 4, 1957, now Patent No. 3,054,449, for well tools for submarine wells.

The casing hanger for the intermediate casing string is supported on an upwardly facing internal annular shoulder **11***a* in the casing bowl and is in turn provided with an upwardly facing internal annular support shoulder **17***a* on which the production string hanger is supported. The casing flow wing is located on the casing bowl above the upper end of the casing hangers for the intermediate and production casing strings so that the production casing is in fluid communication with the casing flow wing. Manifestly the casing hangers are provided with seal means **19** so that a seal is provided between the production or inner casing string and the casing bowl. Obviously, a greater or a lesser number of strings of concentric casing can be utilized if desired.

An upwardly facing support shoulder **20** is formed on the upper end of the production string casing hanger for supporting the tubing hanger **21**, the tubing hanger being threadedly attached to the upper end of a still smaller string of well pipe or tubing **22**.

The tubing hanger includes a lower tubular foot piece **23** provided with a plurality of circumferentially arranged lugs **24** which engage the support shoulder **20** on the

production casing hanger. A plurality of longitudinal slots **25** between the lugs provide a flow course past the support shoulder **20** and the hanger for a purpose to be more fully explained hereinafter.

A tubular packing mandrel **26** is threaded into the upper end of the foot piece and is provided with an internal annular packing assembly **27** shown to be of the V or chevron type. A tubular packing retainer sub **28** is threaded into the upper end of the packing mandrel, and a tubular head piece **29** is in turn threaded into the upper end of the retainer sub. A seal element **30** is retained in the upper part of the packing retainer by the lower end of the head piece and is provided with an upwardly and inwardly extending annular lip **31** for sealing with an internal telescoping tubular extension **32**.

The telescoping extension is slidable longitudinally through the tubing hanger, its upward movement being limited by the engagement of an upwardly facing external annular shoulder **33** on a lower locking section **33***a* of the extension with an internal downwardly facing shoulder **34** of the packing retainer sub. Downward movement of the extension is limited by the engagement of a downwardly facing external annular shoulder **35** on a packing sub **35***a* at the upper end of the extension with a corresponding upwardly facing annular internal shoulder **36** of the head piece of the hanger.

When the telescoping extension is in the upper position in the hanger (FIGURE 1–A), the packing assembly **27** in the packing mandrel **26** seals with an enlarged portion **37** of the lower locking section. A packing assembly **38**, shown to be of the V or chevron type, is retained on the outer surface of the packing sub by means of an upper locking section **39** and seals with the inner surface of the head piece of the hanger when the extension is in its lower position in the hanger, FIGURE 4. The extension is made up of at least two sections, the packing sub and the lower locking section of the extension being threaded together or to the ends of adjacent intermediate pipe sections **40** in order to facilitate assembly. Inasmuch as the seal element **30** engages the sections of the extension intermediate the end sections, the threaded joints between the several sections are preferably of the flush-joint type. Manifestly, as many intermediate sections of the extension pipe may be installed as desired.

An external thread **41** is formed on the lower locking section **33***a* for engagement with a corresponding threaded lower locking ring **42** housed in a bore **43** in the foot piece **23** of the hanger. The bore **43** is upwardly and outwardly tapered and is provided with an upwardly facing annular stop shoulder **44** at its lower end, the locking ring being correspondingly tapered on its outer surface. The locking ring is split longitudinally by a slot **42***a* and is of a free diameter to normally be positioned on the lower part of the tapered bore against the stop shoulder. The locking ring is of a longitudinal dimension less than that of the bore and is slidable longitudinally in the bore, its upward movement being limited by engagement with the lower end of the packing mandrel **26**. A longitudinal key **45** in a slot in the foot piece **23** engages in the slot **42***a* in the locking ring to prevent rotation of the ring relative to the foot piece. A plurality of slots **42***b* are provided in the outer surface of the locking ring to provide flexibility to the ring.

The threads **41** of the lower locking section are of the buttress type with abrupt lower faces approximately normal to the axis of the locking section and with downwardly and outwardly beveled upper faces. The internal threads **46** of the locking ring are similarly formed so that, as the lower locking section is elevated into the locking ring, the beveled faces of the threads engage one another. As the locking ring is stopped in its upward movement, further upward movement of the lower locking section causes its threads to expand the locking ring in the enlarged part of the tapered bore **43**, the threads of the locking section ratcheting into engagement with those of the locking ring, the locking ring returning to its normal position in engagement with the lower locking section. As the lower locking section is lowered, the locking ring moves downwardly in the tapered bore, until it engages the stop shoulder **44**, the locking ring thus being wedged firmly between the bore **43***a* of the foot piece and the lower locking section to support the locking section in the tubing hanger **21**.

When it is desired thereafter to move the lower locking section downwardly in the hanger, the extension pipe must be rotated in a direction to advance the threads **41** of the lower locking section in the locking ring and thereby disengage the threads from one another, the key **45** preventing rotation of the locking ring in the hanger. The threads are preferably of right-hand lead so that, as the upper end of the extension pipe is rotated to disengage the buttress threads, the threaded joints making up the extension are tightened rather than loosened.

An upper locking ring **47** is slidable longitudinally on a downwardly and outwardly tapered external surface **48** on the upper locking section **39** between a lower position determined by engagement with an upwardly facing stop shoulder **49** on the upper locking section and an upper position determined by engagement with the lower end of a tubular pipe **50** threaded to the upper end of the upper locking section. The locking ring is externally threaded with buttress threads **47***a* having abrupt upper faces and with downwardly and inwardly beveled lower faces for engagement with corresponding internal threads **47***b* in the tubular head piece **29**.

The locking ring is split longitudinally by a slot **51** and is rotatably fixed to the upper locking section by a key **52** welded to one of the threads of the ring and engageable in a slot **52***a* in the upper locking section. The free diameter of the locking ring is such as to engage the threads of the head piece, but the ring may be deformed inwardly by the camming action of the beveled faces of the buttress threads against one another when the locking ring is in an upper position on the tapered surface **48** so that the locking ring may ratchet into engagement with the head piece, a plurality of longitudinal slots **52***b* in the outer surface of the ring providing the required flexibility to the locking ring.

When the upper locking section **39** tubing extension is initially moved downwardly into the head piece **29**, the locking ring is stopped from downward motion by its engagement with the threads **47***b* until it is engaged by the lower end of the pipe **50**. Further downward motion now causes the locking ring to be deformed inwardly on the reduced upper portion of the tapered surface **48** on the upper locking section, the threads of the head section ratcheting into engagement with the threads of the locking ring. Upward movement of the tubing extension is now prevented by the upper lock ring.

The upper locking section, and therefore the tubing extension, is disengaged from the head piece by rotation to unscrew the lock ring from the threads of the head piece. The buttress threads of the locking ring and of the head piece are preferably of left hand lead so that right hand (clockwise when viewed from above) rotation of the extension pipe **50** moves the locking ring upwardly in the head piece. Manifestly an upward pull is exerted on the pipe **50** at the same time that the pipe is rotated to assist in the disengagement of the threads.

A hold-down **53** is provided to secure the tubing hanger **21** in position in the casing bowl **11** and to seal off the space between the upper end of said tubing hanger and the casing bowl. The hold-down includes a central tubular mandrel **54** having an internal annular downwardly facing shoulder **55** engageable with the upper end of the tubing hanger **21**, the lower part of the mandrel extending downwardly around the outer surface of the tubing hanger. A packing assembly **56** is retained in a counterbore in the lower end of the hold-down mandrel by a packing retainer ring **57** and seals with the exterior

surface of the tubing hanger. The mandrel is threaded into the lower end of a tubular housing or housing means 58, the housing holding the packing retainer ring in place in the mandrel 54.

The upper portion of the hold-down housing 58 extends upwardly around the mandrel and is counterbored to provide an annular space 58*a* between the hold-down mandrel and the hold-down housing in which is longitudinally slidably disposed a locking sleeve 59. The locking sleeve is provided with an internal annular flange 60 approximately midway of its length which engages an upwardly facing shoulder 61 on the hold-down mandrel and the lower end of a sleeve retainer ring 62 threaded on the upper end of the hold-down mandrel to limit the longitudinal movement of the locking sleeve on the hold-down mandrel.

A plurality of locking keys 63 are disposed in corresponding radial windows 64 in the hold-down housing for lateral movement therein between outer projecting positions and inner retracted positions, the longitudinally extending projections or ears 65 on either end of the keys limiting outward movement of the keys in the windows.

The lower portion of the locking sleeve is split to provide a plurality of depending resilient collet fingers 66. When the locking sleeve is in its upper position on the mandrel, outwardly projecting locking bosses 67 on the lower ends of the collet fingers engage the inner surfaces of the locking keys to urge the keys outwardly to projecting positions; and, when the locking sleeve is in its lower position on the mandrel, the bosses resiliently enter an internal annular recess 68 in the hold-down housing to releasably hold the sleeve in the lower position. When the locking sleeve is in its lower positions its outer surface engages the inner surfaces of the locking keys to hold the keys in projecting positions.

An external packing assembly 69 is retained on the lower part of the hold-down housing by a retainer nut 70 threaded thereon and seals with the inner surface of the casing bowl 11.

The locking keys 63 engage in an internal annular locking recess or groove 71 in the casing bowl when the hold-down is installed in position on the tubing hanger, the keys being urged into projecting position by the resilient collet fingers 66 of the locking sleeve. When the locking sleeve is moved downwardly in the housing, it holds the keys in the projecting position, the upwardly facing beveled lock shoulders 72 on the keys engaging the corresponding upper face of the locking groove to retain the hold-down in position in the casing bowl. When the locking sleeve is moved upwardly to its upper position, it no longer holds the locking keys in projecting positions; but the keys are free to move inwardly against the resiliency of the collet fingers and are cammed inwardly to retracted positions on upward movement of the hold-down in the casing bowl by virtue of the engagement of the beveled lock shoulders 72 and the upper face of the locking groove.

The keys are provided with downwardly facing abrupt support shoulders 73 engageable with a corresponding upwardly facing support shoulder 74 in the locking groove. The engagement of the support shoulders with one another supports the hold-down in the casing bowl in the event the hold-down is not supported by the upper end of the tubing hanger. A guide lug 75 having beveled upper and lower faces is provided on the lower part of each key to prevent the underside engagement of the support shoulders of the keys with other shoulders or obstructions in the well, and a corresponding annular recess 76 is provided in the bowl below the support shoulder 74 to receive the guide lugs.

When the hold-down is in position on the tubing hanger, the packing elements of the hold-down prevent leakage between the tubing hanger and the casing bowl.

In use, the tubing hanger 21 is installed on the upper end of the tubing string 22 before the tubing string is lowered into the submarine well, the telescoping tubing extension 32 being extended and locked in extended position by the engagement of the lower locking ring 42 and the lower locking section 33*a*. Sufficient sections of pipe are added to the tubing extension so that the upper end of the extension is above water when the tubing hanger is lowered into and seated in the casing bowl. The upper locking ring 47 is omitted or removed from the upper locking section 39 of the extension and a hold-down running tool 77 is threaded to the upper locking section, the hold-down 53 being disposed around the upper part of the extension.

The upper part of the locking sleeve 59 of the hold-down is attached to an enlarged section of the running tool by means of the frangible screws 78, and the locking sleeve is secured in its upper position in the housing 58 of the hold-down by means of a plurality of shearable screws 79.

When the tubing hanger 21 is seated on the shoulder 20 of the casing hanger 18, the telescoping tubing extension 32 is released from its extended position by rotation in a clockwise direction to release the lower locking ring 42 from the threads of the lower locking section 33*a* as previously described, and the tubing extension is lowered into collapsed position in the tubing string of the well. Additional sections of pipe such as the running-in string 80 are attached to the running tool to lower the extension into the well. As the hold-down 53 enters the casing bowl 11, the hold-down mandrel moving downwardly around the upper end of the hanger, the locking keys 63 are deflected inwardly to retracted position by the engagement of the guide lugs 75 with the upper end of the casing bowl.

The locking keys enter the locking recess 71 of the casing bowl under urging of the resilient fingers 66 of the locking sleeve, the support shoulders of the keys engaging the support shoulder of the locking groove to support the hold-down in the bowl.

Downward movement of the running tool now shears the shearable screws 79 holding the locking sleeve 59 in its upper position relative to the hold-down housing 58 and the locking sleeve moves downwardly to the lower position wherein the locking bosses 67 of the collet fingers enter the corresponding recess 68 of the hold-down housing and retains the locking sleeve in the lower position.

Further downward movement of the running tool now shears the frangible screws 78 to release the running tool from the hold-down, and the running tool moves downwardly in the sleeve until an annular shoulder 81 on the running tool engages the upper end of the sleeve, insuring that the sleeve is in the lowermost position. The telescoping extension 32 with the attached running tool is then raised, leaving the hold-down secured in position in the casing head or bowl for retaining therein the tubing hanger.

The telescoping extension is raised to its upper position, the lower locking ring 42 engaging the lower locking section 33*a* to hold the extension in the raised or extended position. The running-in string of pipe and the running tool are removed from the extension, and the upper locking ring 47 is installed on the upper locking section 39.

The tubular pipe 50 is attached to the upper locking section, and an assembly of fittings and valves (not shown) for control of flow through the tubing string and through the extension 32 may be installed therein. The extension is rotated in a clockwise direction (when viewed from above) to release the lower locking section from the lower locking ring, and the extension is lowered into the well. The upper locking ring 47 engages and locks in the internal threads of the head piece 29 of the tubing hanger in the manner previously described to hold the extension in the retracted or collapsed position. The assembly of flow control fittings on the pipe 50 is thus secured in position adjacent the wellhead. The packing

assembly 38 on the packing sub seals with the head piece 29 of the tubing hanger to positively seal between the extension and the tubing hanger.

When it is desired to raise the flow control assembly, the tubing extension is rotated in a clockwise direction (as viewed from above) by means of the attached flow control assembly. The upper locking ring is disengaged from the head piece of the hanger in the manner already described, whereupon the extension is elevated to extended position.

If it is desired to remove the tubing hanger and the tubing from the well, the tubing extension 32 is elevated to extended position and the flow control assembly is removed therefrom. The well is first loaded with a weighted fluid such as drilling mud, or blowout preventers (not shown) are installed atop the casing bowl to close off around the well tubing and fittings to be removed. An overshot or pulling tool of any well-known type is installed on the upper end of the telescoping tubing extension, and the tubing extension is then lowered to the collapsed or telescoped position until the pulling tool engages under the external flange or fishing neck 99 on the upper end of the locking sleeve 59 of the hold-down.

An upward pull delivered through the pulling tool moves the locking sleeve upwardly to its upper position, the lugs 67 on the lower end of the locking sleeve being released from the recess 68 in the hold-down by virtue of the camming action of their upper shoulders against the upper edge of the recess. The locking keys 63 are thus freed to move inwardly against the outward bias of the resilient fingers 66 of the locking sleeve. Further upward movement of the sleeve causes the hold-down mandrel 54 and the hold-down housing 58 to be moved upwardly by virtue of the engagement of the flange 60 with the sleeve retainer ring 62, and the locking keys 63 are cammed inwardly by the co-action of their beveled upper faces 72 with the upper surface of the locking recess 71 in the casing bowl. The hold-down is thus released from and is removed from the well as the tubing extension is moved upwardly to extended position.

When the tubing extension is fully extended, the tubing 22 and the tubing hanger 21 are removed by a direct upward pull on the tubing extension, the shoulder 33 on the lower locking section 33*a* engaging the shoulder 34 of the tubing hanger to lift the hanger.

It is noteworthy that the lower faces of the lugs 24 on the foot piece of the tubing hanger are provided with a plurality of sharp edges 100 and these sharp edges engage the support shoulders 20 of the production casing hanger 18 to prevent rotation of the tubing hanger 21 while the telescoping tubing extension 32 is being rotated for release from extended and retracted positions.

While the tubing hanger 21 has been shown as being supported on a shoulder in a production casing hanger 18, obviously it could be supported on a similar upwardly facing shoulder of other elements, for example the casing bowl.

Thus it will be seen a tubing hanger and hold-down have been shown and described to support the upper end of a string of tubing in a well, to lock the tubing hanger in position against upward displacement in the well, and to seal between the tubing hanger and the well. It will be seen that the tubing hanger and the hold-down may be installed in the well at a depth remote and inaccessible from a level such as a drill barge or vessel without manual operations at the wellhead.

It will also be seen that a telescoping tubing extension 32 has been provided in the tubing hanger for extending the tubing from the wellhead to a point elevated therefrom, such as a drill barge. It will be seen that the telescoping tubing extension seals with the tubing hanger when in either the extended or retracted position to provide an exclusive flow conduit from the tubing. Further, it will be seen that a seal means 30 is provided to prevent the intrusion of foreign substances into the tubing and the well when the extension is in an intermediate position.

It will be seen that the tubing extension may be locking in either its extended or retracted position and that the extension is released for movement in either direction simply by rotation. It will be seen that the releasing rotation is in the same direction no matter whether the extension is extended or retracted, thus eliminating the danger of inadvertent release of any of the threaded joints making up the various pieces of equipment.

It will further be seen that the tubing hanger and hold-down may be easily and quickly removed from the well by operations at a level above the wellhead such as at a drill barge or vessel floating on the surface of a body of water over the formation in which the well is located.

It will also be seen that a tubular member or tubing 22 has been shown in the string which may be positioned in a well by means of a supporting member, such as the tubing hanger 21.

It will be seen further that a hold-down 53 has been provided which is releasably locked in a well to engage the tubing hanger to hold it against upward movement in the well.

It will likewise be seen that an extension member or tubing extension 32 is telescoped in the tubular member 22 and is movable between a lower retracted position wherein it is substantially fully telescoped within the tubular member and in extended position wherein its upper end extends upwardly outwardly of the tubular member, and that locking means are provided on the upper and lower ends of the tubular extension which are engageable with cooperating locking means carried by the hanger member 21 for releasably locking the extension member in the retracted and extended positions.

Further, the cooperating locking means for extension member in extended position includes external threads provided on the lower end of the extension member and a threaded lock ring longitudinally movably supported in the hanger member 21 and that the cooperating means for holding the extension member in the upper position includes threaded lock ring longitudinally movably mounted on the upper end of the extension member and internal threads provided in the upper portion of the hanger member 21. Also the threads of the lock rings are appropriately beveled and the lock rings are split whereby the lower threads of the extension member may be engaged in the lower lock ring by longitudinal upward movement of the extension member relative to the lock ring and the threads of the upper lock ring are engaged with the threads of the hanger member upon downward longitudinal movement of the extension member relative to the hanger member.

It will be further seen that the disengagement or release of the extension member from either of its two operative positions is accomplished by rotation thereof to disengage the appurtenant lower lock rings from the threaded engagement with their respective co-engaging threads.

Furthermore, the tubular member is lowered into operative position in the well by means of a running tool which is attached to the upper part of the extension member while the extension member is in its extended position, and the running-in tool simultaneously supports a hold-down member which engages the tubing hanger when the extension member is moved into retracted position after the tubing member has been properly positioned in the well to anchor the tubing member against upward movement in the well.

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

What is claimed and desired to be secured by Letters Patent is:

1. A well tool including: hanger means adapted to be connected to a well casing and having a longitudinal bore, said hanger means having means therein providing an upwardly facing shoulder in said bore; a tubing hanger having external shoulder means thereon providing an external support for engagement with said upwardly facing shoulder in said hanger means; said tubing hanger having a longitudinal bore therethrough; an inner tubular member in said tubing hanger bore, and slidable longitudinally in said tubing hanger bore between a first position and a second position; first means on said inner member and said tubing hanger coengageable when said inner member is in said first position in said tubing hanger to hold said inner member in said first position; second means on said inner member and said tubing hanger coengageable when said inner member is in said second position in said tubing hanger to hold said inner member in said second position, said inner member being movable between said first and said second positions when said first means and said second means are released to permit movement of said inner member relative to said tubing hanger, longitudinal movement of said inner member being limited to movement between said first and said second positions; and hold-down means in said hanger means and releasably locked in position in said hanger means, said hold-down means having means engaging and releasably holding said tubing hanger in said hanger means against upward movement therein.

2. A well tool including: hanger means adapted to be connected to a well casing and having a longitudinal bore, said hanger means having means therein providing an upwardly facing shoulder in said longitudinal bore; a tubing hanger having a longitudinal bore therethrough and having external shoulder means thereon providing an external support for engagement with said upwardly facing shoulder in the bore of said hanger means; an inner tubular member in said tubing hanger bore and slidable longitudinally therein between a first position and a second position; means on said inner member and said tubing hanger limiting longitudinal movement of said inner member in said tubing hanger to movement between said first and said second positions; first holding means on said tubing hanger and on said inner member coengageable when said inner member is in said first position in said tubing hanger for releasably holding said inner member in said first position; second holding means on said tubing hanger and said inner member coengageable when said inner member is in said second position in said tubing hanger for releasably holding said inner member in said second position, said inner member being movable between said first and second positions when said first holding means and said second holding means are released to permit said inner member to move relative to said tubing hanger; and tubular hold-down means within said hanger means and telescoping the upper end of said tubing hanger, said hold-down means having means engaging said hanger means for releasably locking said hold-down means in position therein, said hold-down means engaging said tubing hanger and releasably holding said tubing hanger in said hanger means against movement out of said hanger means.

3. A well tool of the character set forth in claim 1 and including: first sealing means on said tubing hanger and said inner member sealing therebetween when said inner member is in said first position in said tubing hanger; and second sealing means on said tubing hanger and said inner member sealing therebetween when said inner member is in said second position in said tubing hanger.

4. A well tool including: hanger means having a longitudinal bore and adapted to be connected to a well casing, said hanger means having means therein providing an upwardly facing shoulder in said bore; a tubing hanger having a longitudinal bore therethrough and having external shoulder means thereon adapted to engage said upwardly facing shoulder in said hanger means to support said tubing hanger against downward movement out of said hanger means; an inner tubular member extending through said tubing hanger bore and slidable longitudinally therein between a lower position and an upper position; means on said tubing hanger and said inner member limiting longitudinal movement of said inner member to movement between said lower position and said upper position; sealing means on said hanger and said inner member sealing therebetween; first holding means on said tubing hanger and said inner member coengageable when said inner member is in said upper position to releasably hold said inner member in said upper position against movement toward said lower position; and second holding means on said inner member and said tubing hanger coengageable when said inner member is in said lower position releasably holding said inner member against movement from said lower position toward said upper position with respect to said tubing hanger, said inner member being movable between said first and second positions when said first holding means and said second holding means are released to permit movement of said inner member in said tubing hanger.

5. A well tool for use in a well conductor having a hanger means connected therewith and provided with an upwardly facing shoulder therein, said tool including: a tubing hanger having a longitudinal bore therethrough; an external support means on said tubing hanger engageable with said upwardly facing shoulder in said hanger means to support said tubing hanger therein; hold-down means having a downwardly facing shoulder thereon engageable with said tubing hanger and having external lock means thereon engageable with said hanger means for releasably anchoring said tubing hanger in said hanger means against upward movement out of said hanger means; an inner tubular member in the bore of said tubing hanger and slidable longitudinally thereof between an upper position and a lower position therein; first holding means on said tubing hanger and said inner member coengageable to limit movement of said inner member upwardly of said tubing hanger to movement to said upper position in said tubing hanger and to releasably hold said inner member in such upper position; and second holding means on said tubing hanger and said inner member coengageable to limit movement of said inner member downwardly through said tubing hanger to movement to said lower position and to releasably hold said inner member in said lower position, said inner member being movable between said first and second positions when said first holding means and said second holding means are released to permit movement of said inner member in said tubing hanger.

6. A well tool for use in a well conductor having a hanger means connected therewith and provided with an upwardly facing shoulder therein, said well tool including: a tubing hanger having a longitudinal bore therethrough; an external support means on said tubing hanger engageable with said upwardly facing shoulder in said hanger means to support said tubing hanger therein against downward movement; hold-down means having means thereon engaging said tubing hanger and having external anchoring means thereon engageable with said hanger means for anchoring said tubing hanger in said hanger means against upward movement therein; an inner tubular member slidable longitudinally through the bore of said tubing hanger between an upper position and a lower position therein; means on said tubing hanger and said inner member engageable to limit longitudinal movement of said inner member in said tubing hanger to movement to and between said upper position and said lower position; first holding means on said tubing hanger and said inner member coengageable with one another on longitudinal movement of said inner member in said tubing hanger to said upper position to releasably hold

said inner member in said upper position; second holding means on said tubing hanger and said inner member coengageable with one another on longitudinal movement of said inner member with respect to said tubing hanger to said lower position to releasably hold said inner member in said lower position, said inner member being movable between said first and second positions when said first holding means and said second holding means are released to permit said inner member to move relative to said hanger; and seal means between said tubing hanger and said inner member.

7. A well tool of the character set forth in claim 6 including: sealing means on said hanger and said inner member sealingly engaging one another when said inner member is in said upper position and when said inner member is in said lower position with respect to said hanger.

8. A well tool for use in a well, said tool including: a tubular hanger means having an upwardly facing support shoulder and a downwardly facing lock shoulder therein; a body having a longitudinal bore therethrough; an inner tubular member in said bore and extending through said body, said inner member being slidable longitudinally in said body between an upper and a lower position therein; means on said body and said inner member limiting movement of said inner member to movement to and between said upper and said lower positions; means on the exterior of said body engageable with said support shoulder in said hanger means to support said body therein; a housing slidable downwardly around said body; locking means on said housing releasably engaging said downwardly facing lock shoulder in said hanger means to lock said housing in said hanger means; and means on said housing engaging said body to hold said body against upward movement in said hanger means.

9. A well tool for use in a well, said tool including: a tubular hanger means having means therein providing an upwardly facing support shoulder and a downwardly facing lock shoulder spaced apart longitudinally therein; a body having a longitudinal bore therethrough; an inner tubular member in said bore and extending through said body, said inner member being slidable longitudinally in said body between an upper and a lower position therein; means on said body and said inner member limiting movement of said inner member to movement to and between said upper and said lower positions; external shoulder means on said body engaging said support shoulder in said hanger means to support said body therein; a tubular housing slidable downwardly around said body; locking means on said housing movable laterally thereof between an inner retracted position and an outer projecting position engageable with said downwardly facing lock shoulder in said hanger means; resilient means in said housing urging said locking means to projecting position; retaining means for releasably holding said locking means in projecting position engaging said lock shoulder to lock said housing in said hanger means when said locking means is in projecting position; and means on said housing engaging said body to hold said body against upward movement.

10. A well tool for use in a well, said tool including: a tubular hanger means having means therein providing an upwardly facing support shoulder and a downwardly facing lock shoulder spaced apart longitudinally therein; a body having a longitudinal bore therethrough; and inner tubular member in said bore and extending through said body, said inner member being slidable longitudinally in said body between an upper and a lower position therein; means on said body and said inner member limiting movement of said inner member to movement to and between said upper and said lower positions; external shoulder means on said body engaging said support shoulder in said hanger means to support said body therein; a tubular housing slidable downwardly around said body; a locking key on said housing movable laterally thereof between an inner retracted position and an outer projecting position engageable with said downwardly facing lock shoulder in said hanger means; resilient means in said housing urging said key to projecting position; retaining means releasably holding said key in projecting position engaging said lock shoulder to lock said housing in said hanger means when said key is in projecting position; means on said housing engaging said body to hold said body against upward movement; first sealing means on said housing and said body sealing therebetween; and second sealing means on said housing sealing with said hanger means.

11. A well tool for use in a well, said tool including: a tubular hanger means having means therein providing an upwardly facing support shoulder and a downwardly facing lock shoulder spaced apart longitudinally therein; a body having a longitudinal bore therethrough; an inner tubular member in said bore and extending through said body, said inner member being slidable longitudinally in said body between an upper and a lower position therein; means on said body and said inner member limiting movement of said inner member to movement to and between said upper and said lower positions; external shoulder means on said body engaging said support shoulder in said hanger means to support said body therein; a tubular housing slidable downwardly around said body; a locking key on said housing movable laterally thereof between an inner retracted position and an outer projecting position engageable with said downwardly facing lock shoulder in said hanger means; resilient means in said housing urging said key to projecting position; retaining means releasably holding said key in projecting position engaging said lock shoulder to lock said housing in said hanger means when said key is in projecting position; means on said housing engaging said body to hold said body against upward movement; first sealing means on said housing and said body sealing therebetween; second sealing means on said housing sealing with the wall of said hanger means; and holding means operatively associated with said body and said inner member engageable with one another when said inner member is in said upper position to releasably hold said inner member in said upper position and when said inner member is in said lower position to releasably hold said inner member in said lower position.

12. A well tool for use in a well, said tool including: a tubular hanger means having means therein providing an upwardly facing support shoulder and a downwardly facing lock shoulder spaced apart longitudinally therein; a body having a longitudinal bore therethrough; an inner tubular member in said bore and extending through said body, said inner member being slidable longitudinally in said body between an upper and a lower position therein; means on said body and said inner member limiting movement of said inner member to movement to and between said upper and said lower positions; external shoulder means on said body engaging said support shoulder in said hanger means to support said body therein; a tubular housing slidable downwardly around said body; a locking key on said housing movable laterally thereof between an inner retracted position and an outer projecting position engageable with said downwardly facing lock shoulder in said hanger means; resilient means in said housing urging said key to projecting position; retaining means releasably holding said key in projecting position engaging said lock shoulder to lock said housing in said hanger means when said key is in projecting position; means on said housing engaging said body to hold said body against upward movement; first sealing means on said housing and said body sealing therebetween; second sealing means on said housing sealing with the wall of said hanger means; holding means on said body and said inner member engageable with one another when said inner member is in said upper position to releasably hold said inner member in said upper position and engageable when said inner

member is in said lower position to releasably hold said inner member in said lower position; and packing means on said body and said inner member sealing therebetween.

13. A well tool of the character set forth in claim 12, the holding means on said body and said inner member being formed to be engageable on longitudinal movement of the inner member to the upper and lower positions, said holding means being formed to be moved to release the holding engagement thereof on rotation of said inner member in the body.

14. A well tool for use in a well, said tool including: a tubular hanger means having means therein providing an upwardly facing support shoulder and a downwardly facing lock shoulder spaced apart longitudinally therein; a body having a longitudinal bore therethrough; a tubular mandrel extending through said bore and slidable longitudinally therein; means on said mandrel and said body limiting movement of said mandrel to movement to and between an upper and a lower position in said body; external shoulder means on said body engaging said upwardly facing shoulder in said hanger means to support said body therein; a housing slidable in said hanger means and engageable with said body to prevent upward movement of said body in said hanger means; a locking key on said housing movable laterally thereof between an inner retracted and an outer projecting position engageable with said downwardly facing lock shoulder in said hanger means; resilient means in said housing urging said key to projecting position; retaining means movable to position engaging and holding said key in projecting position on movement of said key to projecting position, said key engaging said lock shoulder to lock said housing in said hanger means; a first helical means on one of the lower end of said mandrel and the lower end of said body; a second helical means on the other of the lower end of said mandrel and said body and engageable with said first helical means, said second helical means being movable laterally into and out of engagement with said first helical means; means biasing said second helical means into said engagement, the lower face of the helical means on said body and the upper face of the helical means on said mandrel being beveled to cam said second helical means away from engagement with said first helical means on upward longitudinal movement of said mandrel in said body, said second helical means being moved resiliently into engagement with said first helical means to support said mandrel; said first and second helical means being disengageable on rotation of said mandrel to permit movement of said mandrel downwardly in said body; a third helical means on one of the upper end of said mandrel and the upper end of said body; a fourth helical means on the other of the upper ends of said mandrel and said body, said fourth helical means being movable laterally into and out of engagement with said third helical means; and means biasing said fourth helical means into said engagement, the upper face of one of the third and fourth helical means on said body and the lower face of the other of the third and fourth helical means on said mandrel being beveled to cam said fourth helical means away from engagement with said third helical means on downward longitudinal movement of said mandrel in said body, said fourth helical means being moved resiliently into engagement with said third helical means to retain said mandrel against upward movement in said body.

15. A well tool of the character set forth in claim 14 including: sealing means on the body and the mandrel sealing therebetween; and packing means on said housing sealing between said housing and the wall of the hanger means and between said housing and said body.

16. A well tool of the character set forth in claim 15 wherein a flow course is provided around the body past the support shoulder in the hanger means in which said body is seated.

17. A well tool including: a tubular hanger means, said hanger means having support means; a tubular body member insertable in said hanger means and having means on its exterior engageable with said support means of said hanger means for supporting said body in said hanger means; an extension member longitudinally slidable through said tubular body member and movable therethrough between a first position and a second position; connecting means on said body member and said extension member coengageable when said extension member is in said first position to lock said extension member in said position; and connecting means on said body member and said extension member coengageable when said extension member is in said second position to lock said extension member in said second position against longitudinal movement relative to said body member.

18. A well tool including: a tubular hanger means, said hanger means having support means; a tubular body member insertable in said hanger means and having means on its exterior engageable with said support means of said hanger means for supporting said body in said hanger means; an extension member longitudinally slidable through said tubular body member and movable therethrough between a first position and a second position; first retaining means on said body member and said extension member coengageable when said extension member is in said first position to lock said extension member in said position against longitudinal movement relative to said body member toward said second position; and second retaining means on said body member and said extension member coengageable when said extension member is in said second position to lock said extension member in said second position against longitudinal movement relative to said body member toward said first position, each of said retaining means being releasable by rotation of said extension member relative to said tubular body member to permit movement of said extension member from one of said positions to the other of said positions.

19. A well tool including: a tubular hanger means, said hanger means having support means; a tubular body member insertable in said hanger means and having means on its exterior engageable with said support means of said hanger means for supporting said body in said hanger means; an extension member longitudinally slidable in said tubular body member and movable therethrough between a first position and a second position; connecting means on said body member and said extension member coengageable when said extension member is in said first position to lock said extension member in said position against movement longitudinally of said body member toward said second position; second connecting means on said body member and said extension member coengageable when said extension member is in said second position to lock said extension member in said position against longitudinal movement relative to said body member toward said first position; and hold-down means engageable with said tubular body means and with said tubular hanger means for releasably locking said body member in said hanger means against movement away from said support means, said hold-down means being releasable to permit said body member to be removed from within said hanger means.

20. A well tool of the character set forth in claim 17 wherein: sealing means is provided on said tubular hanger member and said tubular body member for sealing between said members to prevent fluid flow therebetween; and sealing means is provided on said extension member and said tubular body member for sealing between said members to prevent fluid flow therebetween.

21. A well tool including: a tubular hanger means, said hanger means having support means; a tubular body member insertable in said hanger means and having means on its exterior engageable with said support means of said hanger means for supporting said body member in said hanger means; an extension member slidable longitudinally in said tubular body member between a first position

and a second position; first retaining means on said extension member and said tubular body member coengageable when said extension member is in said first position to retain said extension member in said first position against longitudinal movement relative to said body toward said second position; second retaining means on said extension member and said tubular body member coengageable when said extension member is in said second position to retain said extension member in said second position against longitudinal movement relative to said body toward said first position, said first and second retaining means being releasable to free said extension member for movement between said first and second positions; and hold-down means for locking said tubular member in said hanger means against upward movement from said support means of said hanger means and including a locking sleeve engageable with said body member and having locking means laterally movable thereon and engageable with said hanger means to lock the sleeve in place in said hanger means to hold said body member in said hanger means.

22. A well tool of the character set forth in claim 21 and a running in tool connected with said hold-down means for lowering the same into the hanger member and means releasably connecting said running in tool with said hold-down means after said hold-down means has been actuated to lock said body member in said hanger member.

23. A well tool including: a tubular hanger means, said means having support means; a tubular body member insertable in said hanger means and having means on its exterior engageable with said support means of said hanger means for supporting said body in said hanger means; and hold-down means engageable with said body member and said hanger means for holding said body member in place in said hanger means, against movement away from said support means, said hold-down means including a tubular sleeve having means thereon engageable with said body member and laterally movable locking members on said sleeve movable between expanded locking position and retracted releasing position thereon, said locking members being disposed to engage said tubular hanger means when in expanded position to lock said hold-down means in place in said hanger means to hold said tubular body member in said hanger member.

24. A well tool of the character set forth in claim 23 including: sealing means on said hold-down means sealing between said sleeve and said hanger means to prevent fluid flow therebetween; and second sealing means on said hold-down means sealing between said sleeve and said tubular body member to prevent flow of fluids therebetween.

25. A well tool of the character set forth in claim 18 wherein each of said retaining means includes means releasable from locking engagement between said extension member and said body member upon rotation of said extension member in the same direction relative to said body member to effect release of said retaining means permitting longitudinal movement of said extension member relative to said body member.

26. A well tool including: a tubular casing head having a bore with an internal upwardly facing shoulder therein; support means in said casing head supported against downward movement therein by said upwardly facing shoulder and providing an upwardly facing support shoulder in said casing head, said support means comprising at least one casing hanger means having means thereon for connecting a casing string thereto and having an external shoulder engaging said upwardly facing shoulder in said casing head; a tubing hanger insertable in said casing head and having means on its exterior engageable with at least one casing hanger means for supporting said tubing hanger in said casing head; and hold-down means engaging with said tubing hanger and with said casing head for holding said tubing hanger in place in said casing head against movement away from said support means, said hold-down means including a tubular sleeve having laterally movable locking members thereon disposed to engage said casing head to lock said hold-down means in place therein.

27. A well tool including: a tubular casing head having a bore with an internal upwardly facing shoulder therein; support means in the casing head comprising a plurality of casing hanger means, each of said casing hanger means having a means thereon for connecting a casing string thereto, and including at least one casing hanger means having an external shoulder engaging the upwardly facing shoulder of said casing head; a tubular tubing hanger having a means on its exterior engageable with at least one of said casing hanger means for supporting said tubing hanger in said casing head; hold-down means engaging said tubing hanger and comprising a tubular sleeve having thereon laterally movable locking means engaging said casing head for holding said tubing hanger in place in said casing head against movement away from said support means; and a tubular extension member slidable longitudinally in said tubing hanger between two longitudinally spaced positions therein.

28. A well tool including: a tubular casing head having a bore therethrough and means for connecting it to the upper end of a casing string, said casing head having a lateral flow outlet intermediate its ends communicating with the bore thereof and having an upwardly facing supporting shoulder in its bore below said lateral flow outlet; at least one tubular casing hanger means having an external shoulder thereon engageable with said upwardly facing shoulder in the bore of said casing head for supporting said casing hanger means in said head, said hanger means having means thereon for connecting it with a string of casing to support said casing and having external laterally movable locking means thereon engageable with said casing head for securing said casing hanger means in place in said casing head, said casing hanger means having an internal shoulder in its bore disposed to be engaged by another casing hanger means for supporting said other casing hanger means therein; a tubing hanger having a longitudinal bore therethrough and having external support shoulder means thereon engageable with said at least one casing hanger means for supporting said tubing hanger against downward movement in said casing head, said tubing hanger having means providing a fluid flow course exteriorly thereof between said tubing hanger and said casing hanger means whereby fluids may flow therethrough to the lateral flow outlet of said casing head, said tubing hanger having means thereon for connecting a tubing string thereto to be supported by said tubing hanger; and hold-down means telescopable over said tubing hanger and having a hold-down shoulder provided therein engaging said tubing hanger to limit upward movement of said tubing hanger from within said casing head, said hold-down means having laterally movable locking means thereon projecting to engage said casing head for locking said hold-down in said casing head to prevent displacement of said hold-down means and said tubing hanger from said casing head.

29. A well device of the character set forth in claim 28 including: an elongate tubing extension member slidable in the bore of said tubing hanger between a first upper extended position and a second lower telescoped position with respect to said tubing hanger; first thread-like retaining means on said extension member and said tubing hanger coengageable upon longitudinal movement of said extension member with respect to said tubing hanger to said first extended position to retain said extension member in said first extended position against longitudinal movement relative to said tubing hanger toward said second lower telescoped position; second thread-like retaining means on said extension member and said tubing hanger coengageable when said extension member is moved longitudinally with respect to said tubing hanger to said second lower telescoped position to retain said extension member in said second position against longi-

tudinal movement relative to said tubing hanger toward said first extended position; seal means on said extension member and said extension hanger preventing flow of fluids therebetween when said extension member is in said first and second positions with respect to said tubing hanger; each of said retaining means being releasable to permit movement of said extension member relative to said tubing hanger upon rotative movement of said extension member relative to said tubing hanger to release said thread-like retaining means from coengagement.

30. A well device of the character set forth in claim 29 wherein said first thread-like retaining means and said

second thread-like retaining means are of opposite lead whereby said retaining means are each releasable upon rotation of said extension member in the same direction with respect to said tubing hanger.

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