Aug. 13, 1963 G. G. GRIMMER ETAL 3,100,452

WELL TOOLS

Filed June 23, 1958 3 Sheets-Sheet 1

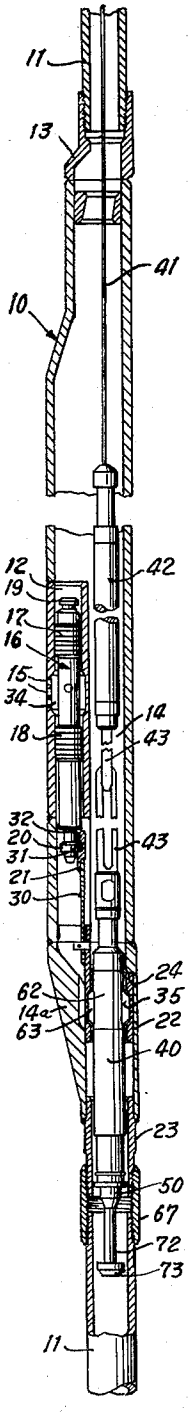

Fig. 1

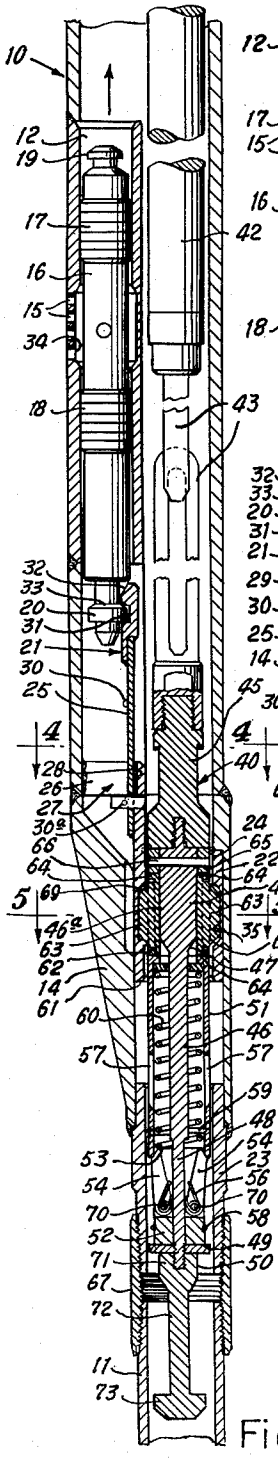

Fig. 2

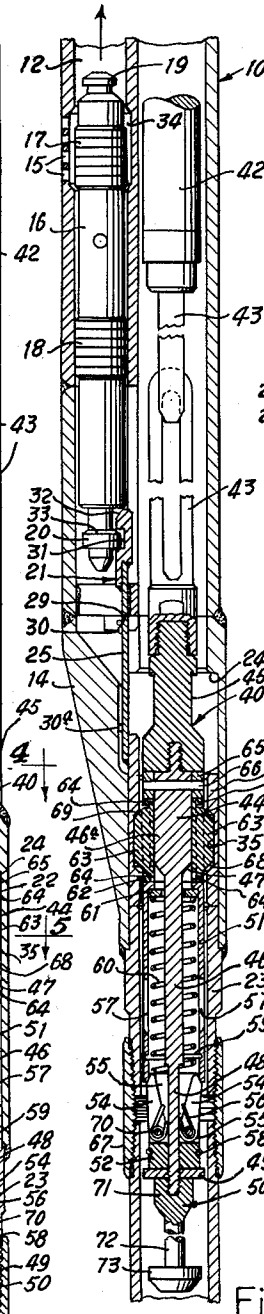

Fig. 3

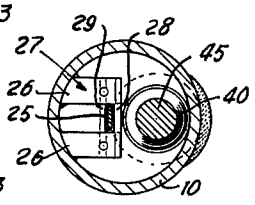

Fig. 4

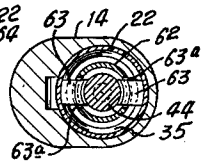

Fig. 5

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WELL TOOLS

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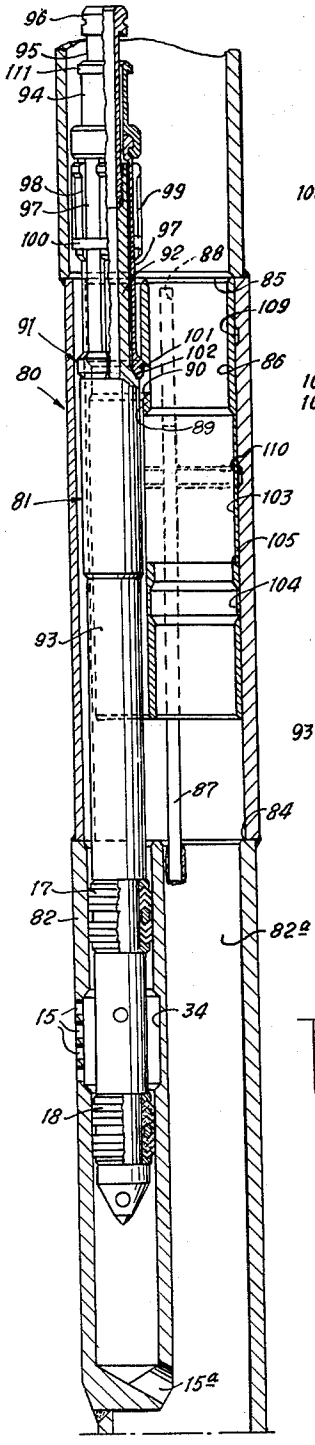

Fig. 6

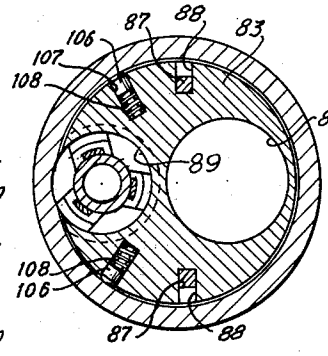

Fig. 8

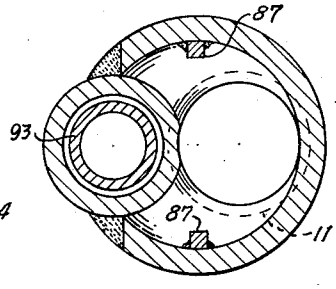

Fig. 9

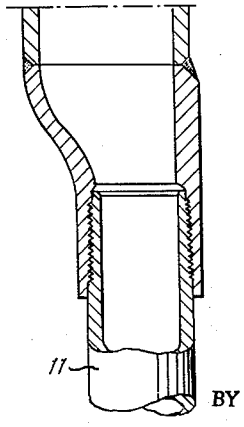

Fig. 6a

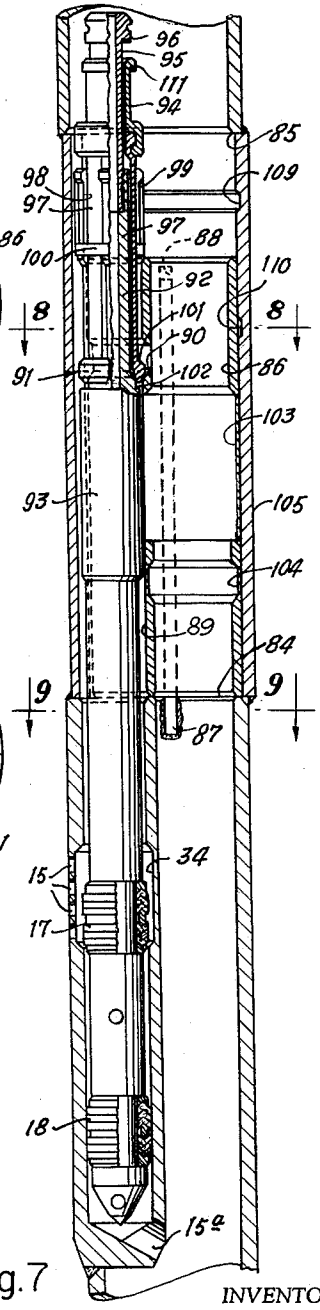

Fig. 7

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WELL TOOLS

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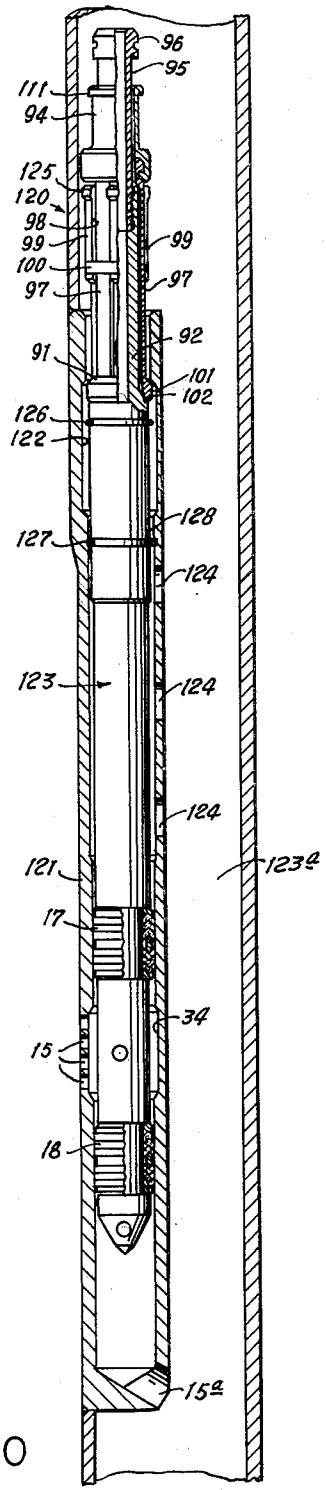

Fig.10

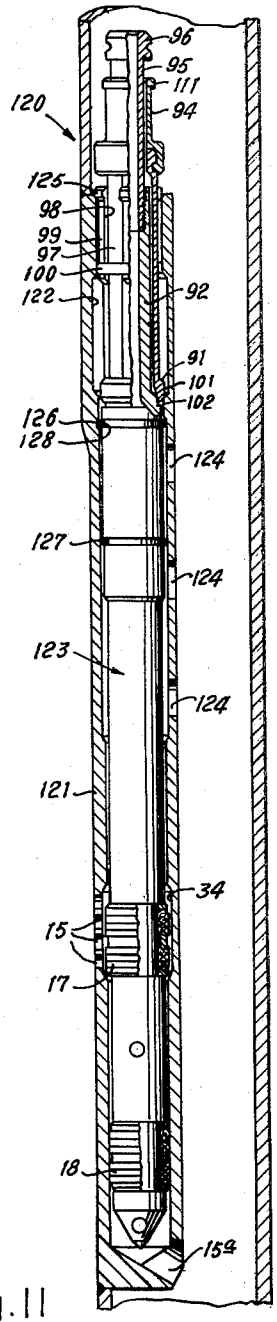

Fig.11

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United States Patent Office 3,100,452 Patented Aug. 13, 1963

3,100,452

WELL TOOLS

George G. Grimmer, Dallas, Tex., and Harry B. Schramm, deceased, late of Dallas, Tex., by Josephine Schramm, executrix, Dallas, Tex., assignors, by mesne assignments, to Otis Engineering Corporation, Dallas, Tex., a corporation of Delaware

Filed June 23, 1958, Ser. No. 743,646
20 Claims. (Cl. 103—232)

This invention relates to well tools and more particularly to gas lift valves and to nipples connectable in a well tubing string for use with such gas lift valves. An object of the invention is to provide a gas lift valve which is removably disposed and locked in position in a well pipe and which may be shifted from one position to another in the well pipe without being released from locked position in the pipe for selectively directing the flow of lifting gas into the well pipe to the gas lift valve directly into the well pipe bypassing the valve.

An object of the invention is to provide a gas lift valve and a ported landing nipple in which the valve is removably positionable, and wherein the gas lift valve is shiftable without removal from the nipple between a first position in which the gas lift valve is disposed adjacent the port of the nipple to direct any fluid flow through the port and through the valve and a second position in which the gas lift valve permits unobstructed fluid flow through the port into the flow passage of the nipple.

Another object of the invention is to provide a landing nipple of the character described wherein the landing nipple is provided with a valve-receiving pocket laterally displaced from bore or flow passage of the nipple and of the bore of the well pipe in which the nipple is installed to provide a continuous unobstructed bore through the well pipe.

A further object of the invention is to provide a landing nipple of the character described in which a gas lift valve installed therein may be moved by means of customary flexible line methods and means longitudinally in the nipple between the positions previously described.

A still further object is to provide a landing nipple of the character described wherein a sleeve is slidable longitudinally in the nipple to move the gas lift valve between the first and the second positions in the nipple, the sleeve being slidable by means of a customary flexible line operated mechanism.

Still another object is to provide a landing nipple of the character described wherein a sleeve slidable therein is releasably restrained in its two extreme positions.

A still further object of the invention is to provide a landing nipple and a gas lift valve removably positionable therein of the character described wherein the valve is movable longitudinally in the nipple by the application of a direct upward or downward force thereto.

Another object is to provide a shifting or moving tool having means engageable with a sleeve for shifting the sleeve longitudinally in a landing nipple, the shifting tool being releasable from engagement with the sleeve after the sleeve has been shifted.

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

FIGURE 1 is a view, partly in elevation and partly in section, showing a ported landing nipple in accordance with the invention installed in a string of a well pipe or tubing having a gas lift valve positioned in its pocket of nipple and a shifting tool in position in the movable sleeve, the sleeve and valve being in position to confine any flow through the ports of the nipple to the gas lift valve;

FIGURE 2 is an enlarged view, similar to FIGURE 1, showing details of the shifting tool and the lower end of the landing nipple;

FIGURE 3 is a view similar to FIGURE 2, showing the sleeve and gas lift valve moved to a position wherein the valve does not obstruct the free flow of fluids through the ports of the nipple;

FIGURES 4 and 5 are sectional views taken on the lines 4—4 and 5—5 of FIGURE 2;

FIGURES 6 and 6–A, taken together, constitute a view partly in elevation and partly in section, of a modified form of landing nipple having a movable shifting sleeve therein and a gas lift value installed in the nipple, the sleeve and valve being positioned to direct any flow through the ports of the nipple into the valve;

FIGURE 7 is a view similar to FIGURE 6 showing the valve moved to a position in the nipple wherein flow through the ports of the nipple into the nipple is unobstructed by the valve;

FIGURE 8 is a sectional view taken on the line 8—8 of FIGURE 7;

FIGURE 9 is a sectional view taken on the line 9—9 of FIGURE 7;

FIGURE 10 is a view, partly in elevation and partly in section, of a gas lift valve installed in a still further modified nipple wherein the valve is movable by a direct upward or downward force thereon between a position directing flow through the ports of the nipple into the gas lift valve and a position permitting the flow through the ports directly into the nipple, bypassing the valve, the valve being shown in flow-direction position; and

FIGURE 11 is a view, similar to FIGURE 10, showing the gas lift valve in the position permitting flow directly into the nipple.

Referring now to FIGURES 1 through 5 of the drawings, the numeral 10 refers to a landing nipple which is threadedly connected in a string of well pipe or tubing 11. The landing nipple is enlarged intermediate its ends and is provided with a tubular pocket 12 laterally displaced from the bore through the well pipe. An upper eccentric fitting 13 and a lower eccentric fitting 14*a* provide for the proper displacement of the pocket from the bore of the well pipe and for the alignment of the sections of well pipe above and below the landing nipple to establish an unobstructed passage through bore or flow passage 14 of the nipple unrestricted below the diameter of the well pipe.

A plurality of lateral ports 15 through the outer wall of the pocket provide fluid communication between the exterior of the nipple and the interior of the pocket. A gas lift valve 16 is removably positioned in the pocket and is provided with upper and lower packing means 17 and 18 which are spaced apart to seal on either side of the lateral ports of the pocket. When the packing means seal on either side of the lateral ports, any flow through the ports is controlled by the gas lift valve 15.

The gas lift valve is provided with a fishing neck or head 19 at its upper end by which it is lowered into and installed in the pocket by means of the usual flexible line apparatus. An annular latching flange 20 adjacent the lower end of the valve is provided for engagement by a latch means 21 in a manner to be more fully hereinafter described.

The lower part of the bore of the lower eccentric fitting is enlarged, and a sleeve 22 is positioned therein for longitudinal sliding movement. A lower sub 23 is welded in the lower end of the bore of the lower eccentric fitting to provide the connection with the tubing 11 and to limit downward movement of the sleeve in the fitting. Upward movement of the sleeve is limited by its engagement with a downwardly facing shoulder 24 in the bore of the lower eccentric fitting.

A resilient latch arm 25, welded or otherwise affixed to the sleeve, extends upwardly from the sleeve toward the lower end of the pocket and is aligned with the inner wall thereof. The latch arm extends upwardly between the legs 26 of a U-shaped guide channel 27, the ends of the legs being welded to the inner wall of the nipple below the pocket to maintain the latch arm in proper alignment with the pocket. The transverse member 28 connecting the ends of the legs of the guide channel serves as a stop member to limit lateral movement of the latch arm away from the pocket. A lateral pin 29 extends between the latch arm to restain the latch arm from movement toward the pocket and cooperates with an upper protrusion 30 on the outer surface of the latch arm to form a detent means to hold the sleeve and latch arm in its lower position, the lateral pin deflecting resiliently to allow the protrusion 30 to pass the pin on the application of a sufficient longitudinal force to the sleeve. The sleeve and latch arm, on movement to the lowermost position in the nipple, are thus releasably held in the lowermost position against inadvertent movement therefrom. A similar lower protrusion 30*a* on the latch arm coacts with the lateral pin to releasably hold the sleeve and the latch arm in the uppermost position against inadvertent movement therefrom when the sleeve is moved to the uppermost position.

The upper face of the latch means is provided with a latching notch or groove 31 in its outer face which engages the latching flange 20 of the gas lift valve to lock the gas lift valve to the latch means. The upper face of the latch means is downwardly and outwardly beveled at 32 for engagement by the latching flange of the gas lift valve as the valve is inserted into the pocket so that the flange cams the latch means away from the pocket to allow the latching flange to enter the latching groove. The upper face 33 of the latching flange is slightly beveled downwardly to provide a cam to deflect the latch means away from the pocket on the application of a certain upward force to the gas lift valve, thereby allowing the valve to be disengaged from the latch groove or recess of the latch means on upward movement of the valve. With the latch means disengaged from the valve, the valve can be removed upwardly from the pocket and from the well.

The gas lift valve is thus locked in position in the pocket by means of the latch means 21 attached to the sleeve 22. When the sleeve is in the upper position as shown in FIGURE 2 the packing means 17 and 18 are positioned to seal above and below, respectively, the lateral ports 15 of the pocket, thereby directing any flow through the ports into the gas lift valve, thence into the pocket 12 and upwardly into the flow passage 14 of the nipple.

The gas lift valve is of any suitable design, for example the type shown in the patent to Bryan, 2,828,698, and is therefore not described in detail.

When the sleeve is moved to the lower position as shown in FIGURE 3, the upper packing means 17 is moved out of sealing engagement with the pocket above the lateral ports and into alignment with an internal annular recess or groove 34 in the pocket into which the ports 15 open. With the valve thus positioned in the pocket, a flow course is provided from the lateral ports upwardly around the upper packing means and around the upper end of the valve through the upper end of the pocket into the flow passage 14.

The sleeve 22 has an internal annular groove 35 which is beveled at its upper and lower ends for engagement by a suitable shifting tool so that the sleeve and consequently the gas lift valve may be moved longitudinally in the nipple between the upper and lower positions.

A shifting tool, designated generally by the numeral 40 is lowered by means of the customary flexible line 41 and flexible line operated tool 42 which tools include a set of stroke jars 43 for delivering upward or downward jarring blows to the shifting tool.

The shitfing tool includes a central mandrel 44 which is attached to the lower end of a fishing neck 45 which is in turn attached to the flexible line operated tools. The intermediate section 46 of the mandrel is reduced in diameter from the diameter of the enlarged or upper portion 46*a* and a tapered shoulder 47 is provided at the point of reduction of the intermediate section. The lower section 48 of the mandrel is further reduced in diameter and is threaded into a locking washer 49 and a lower sub 50.

A tubular body 51 is provided above the locking washer 49 and loosely surrounds the mandrel. A catch dog holder 52 is disposed on the lower section of the mandrel for limited sliding movement between a lower position abutting the upper surface of the locking washer and an upper position abutting a downwardly facing annular shoulder 53 of the mandrel. A plurality of catch dogs 54 are swingably mounted at their lower ends in corresponding longitudinal slots 55 in the dog holder, and their upper ends are biased outwardly by the dog springs 56. The upper ends of the dogs protrude outwardly and upwardly through corresponding slots 57 in the body when the body is in a lower position abutting the locking washer 49. A snap wire 58 is carried on the outer surface of the dog holder for engagement in an internal groove 59 of the body to retain the body in the lower position.

A compression spring 60 is disposed in the body and abuts the upper end of the dog holder and the lower face of a bearing washer 61 which engages an inturned annular flange at the upper end of the body, the spring urging the body upwardly relative to the dog holder against the restraining action of the snap wire in the groove 59.

A tubular shifting key carrier 62 is slidably positioned on the mandrel 44 above the tubular body 51 and carries a plurality of shifting keys 63 in corresponding key slots 63*a* provided in the carrier. The keys are movable laterally in the key slots between inner retracted positions and outer projecting positions, the outward movement of said keys being limited by retaining ears 64 on the ends of the keys which engage the carrier.

Upward movement of the tubular body 51 and the key carrier 62 is limited by the engagement of the carrier with the lower face of an annular collar 65 which is secured by means of a pin 66 to the upper part of the mandrel. The upper face of the collar abuts the lower end of the fishing neck to form a solid metal-to-metal contact therebetween.

The shifting tool is assembled with the catch dogs 54 moved inwardly against the biasing force of the dog springs 56 and the tubular body moved against the resiliency of the compression spring to its lower position around catch dogs to abut the locking washer, the slots 57 in the body being aligned with the catch dogs so that the upper end of the dogs protrude through the slots. The dog carrier is retained in its upper position engaging the shoulder 53 on the mandrel by the engagement of the snap wire 58 in the internal groove 59 in the body.

The intermediate reduced section of the mandrel is then positioned behind the shifting keys, the reduced section permitting the keys to move inwardly to retracted position. As the shifting tool is lowered through the tubing string and the landing nipple, the upper ends of the catch dogs are biased into contact with the walls of said tubing and landing nipple and are cammed inwardly on meeting obstructions. The beveled shoulders 68 of the keys cam them inwardly toward retracted positions as the tool meets and passes obstructions.

When the shifting tool descends into the landing nipple 10 to a position wherein the dogs 54 are positioned below the lower sub 23, the shifting tool is raised, and the catch dogs engage the lower end of the lower sub since they then protrude into the recess formed at the coupling 67. An upward pull on the mandrel then causes the snap wire

58 on the dog holder 52 to be disengaged from the groove 59 in the body, and the compression spring 60 moves the dog holder downwardly against the locking washer 49 and simultaneously urges the tubular body 51 upwardly.

Upward movement of the tubular body causes the lower edges of the slots 57 to engage the catch dogs and cam the dogs inwardly against the bias of the dog springs, the dogs thus being retracted within the body. As the body is moved upwardly on the mandrel, the tapered shoulder 47 of the mandrel engages the inner surfaces of the shifting keys to cam the keys outwardly toward projecting position.

As the upward movement of the shifting tool is continued, the keys 63 enter the recess 35 in the sleeve 22, whereupon the relative movement between the body and the mandrel is completed, the upper section 46*a* of the mandrel being positioned behind the shifting keys and abutting the inner surfaces of said keys to retain them in projecting position.

Downward jarring blows are then delivered to the shifting tool by means of the flexible line and the stroke jars 43 to move the sleeve 22 downwardly in the housing from the position shown in FIGURE 2 to that shown in FIGURE 3, the jarring blows being transmitted through the fishing neck 45, the collar 66 and the keys 63 to the sleeve. The protrusion 30 and the lateral pin 29 engage one another to hold the sleeve in its lower position in the manner already noted. The gas lift valve is thus moved from the position directing flow from the ports 15 of the nipple through the valve (FIGURE 2) to the position in which said flow through said ports is directed upwardly around the gas lift valve through the pocket 12 of the landing nipple (FIGURE 3) into the bore or flow passage 14 thereof.

The shifting tool may be removed by an upward pull thereon, the mandrel initially being moved upwardly relative to the body and the shifting keys against the biasing force of the compression spring. As the mandrel is moved upwardly relative to the keys, the reduced intermediate section 46 of the mandrel is positioned behind the keys, thus freeing the keys for inward movement. The upper shoulders 69 of the keys are beveled so that they are cammed inwardly on contact with the beveled upper edge of the recess 35. The shifting tool is thus removed from the landing nipple and from the tubing string leaving the gas lift valve in the lower position shown in FIGURE 3, upward movement of the sleeve 22 and of the valve being restrained by the engagement of the protrusions or boss 30 with the pin 29.

When it is desired to move the sleeve to the upper position (FIGURE 2) in which the gas lift valve is located to direct the flow of fluids from the ports 15 of the pocket through said valve, the shifting tool is altered as will now be described.

The mandrel 44 of the shifting tool, together with the locking washer 49, the catch dog holder 52, the body 51, the compression spring 60, the bearing washer 61, the key carrier 62, the keys 63, the collar 66 and the pin 67 are removed as a unit from the fishing neck 45 and from the lower sub 50. The mandrel and the attendant members are turned end-for-end and reconnected to the fishing neck and to the lower sub so that the catch dog holder is near the upper part of the shifting tool and the key carrier is near the lower end of said tool. The locking member 49 then engages the lower end of the fishing neck 45 and the annular collar 65 is abutted by the upper end of the lower sub 50. The catch dogs and the dog springs are removed by driving out the dog pivot pins 70 by which the dogs are attached to the dog holder, and the snap wire 58 is removed from the dog holder as it is not now desired to latch the body to the dog holder.

The compression spring urges the body downwardly on the mandrel and thus urges the key carrier and the keys downwardly around the enlarged portion 46*a* of the mandrel so that the enlarged portion abuts the inner surfaces of the keys to hold the keys in projecting position. The key carrier abuts the collar 65 which limits the downward movement of the carrier on the mandrel. The diameter of the upper portion 71 of the lower sub is the same as that of the enlarged portion 46*a* of the mandrel, that the intermediate section 72 of said lower sub is reduced, and that an enlarged lower head 73 of diameter greater than that of the upper portion is provided on the lower end of the lower sub. The purpose of this configuration of the lower sub will be explained more fully hereinafter.

Manifestly, the key carrier and the body may be moved upwardly on the mandrel against the force of the compression spring so that the reduced intermediate section 46 of the mandrel is positioned behind the shifting keys so that the keys are freed for inward movement to retracted positions. When the tool is inserted in the tubing string for lowering therein, the compression spring urges the body and the key carrier downwardly on the mandrel, the keys being cammed outwardly into engagement with the wall of the tubing by their engagement with the tapered surface 47 on the mandrel. The dimensions of the keys and the diameter of the tubing are such, however, that the keys may not move to fully projecting positions, and the carrier is thus prevented from moving downwardly over the enlarged portion 46a of the mandrel. As the tool moves through an enlarged section in the tubing string, such, for example, as the upper section of the landing nipple 10, the keys are freed for outward movement and the carrier and the body move downwardly on the mandrel to the position in which the keys are moved to their fully projecting positions.

As the tool re-enters a smaller section of the tubing having a diameter corresponding to the main portion of the tubing string, as for example, the sleeve 22, the beveled shoulders 69 of the keys engage the upper end of said section to arrest the downward movement of the carrier and the housing. The mandrel is moved downwardly against the force of the compression spring until the intermediate section is positioned behind the keys whereupon the keys are freed for inward movement, the beveled shoulders 69 camming the keys inwardlly.

The keys are cammed outwardly into the recess 35 of the sleeve 22 by the action of the compression spring and the cam shoulder 47 in the manner previously described, and the enlarged section of the mandrel is moved upwardly behind the keys to hold the keys in expanded positions.

Upward jarring blows are then delivered to the shifting tool by means of the stroke jars and the flexible line to move the sleeve and the gas lift valve upwardly from the position shown in FIGURE 3 to that shown in FIGURE 2. The protrusion 30 and the lateral pin 29 releases the sleeve for upward movement on the application of a sufficient upward force, as previously noted until upward movement of the sleeve 22, and therefore of the valve, is stopped by the engagement of the protrusion or boss 30*a* with the pin 29.

Upward jarring blows of greater magnitude then delivered to the mandrel shear the pin 66, and the mandrel moves upwardly relative to the key carrier and the collar until the head 73 of the lower sub engages the collar. The intermediate section of the lower sub is now positioned behind the keys to free the keys for inward movement. The beveled shoulders 68 of the keys cam the keys inwardly, disengaging the shifting tool from the sleeve so that the tool may be removed upwardly from the nipple and from the tubing string.

The gas lift valve is initially installed in the pocket of the landing nipple by means of a suitable flexible line operating mechanism including a deflecting tool (not shown) and is locked in position in the pocket by the latch means 21 in the manner already described.

When it is desired to remove the gas lift valve from the nipple, a retrieving tool (not shown) suitable for en-

gaging the fishing neck 19 of the valve is lowered by means of the flexible line and laterally deflected in the nipple by means of a deflecting tool (not shown) to engage and grip the valve. An upward pull of sufficient magnitude on the valve disengages the latching flange 20 from the latching groove 31 of the latch means, the beveled upper face 33 of the flange camming said latch means away from holding engagement with said flange. The gas lift valve is thus freed for removal from the nipple and from the tubing string.

It is obvious that a dummy valve or "blind" valve (not shown) which does not permit flow therethrough can be installed instead of the gas lift valve 16 in which event, when the dummy valve is in the upper position shown in FIGURE 2, flow through the ports 15 is completely closed off, and when such dummy valve is in the lower position of FIGURE 3 the ports 15 are opened as previously described to permit flow therethrough.

It is also obvious that any other suitable shifting tool could be used to move the sleeve longitudinally in the landing nipple.

It will be seen that a ported landing nipple and a removable gas lift valve therefor have been shown and described, the landing nipple including movable means by which the gas lift valve is shiftable between a position wherein the flow from the exterior of the nipple through the ports of said landing nipple is directed through the valve to the flow passage of the nipple and a position wherein the flow is directed to the flow passage without passage through the valve.

It will be seen that the valve is shifted longitudinally in the nipple by means of a sliding sleeve and that a means is provided to releasably hold the sleeve and valve in the lower and upper positions in the nipple.

It will also be seen that the valve is installed in and removed from position in the landing nipple by means of a direct downward or upward force thereon.

Referring now to FIGURES 6 through 9, a modified form of landing nipple 80 and gas lift valve 81 are shown. A pocket 82 offset laterally from the bore or flow passage 82*a* of the nipple provides a sealing surface for the upper and lower packing means 17 and 18 of the gas lift valve for sealing therewith above and below the lateral ports 15 of the nipple when the valve is in an upper position as shown in FIGURE 6. As shown in FIGURE 7, when the valve is moved to a lower position, the upper packing means 17 moves into alignment with the recess 34 in the nipple adjacent the ports to permit unobstructed flow from the ports upwardly around the valve and into the flow passage of the nipple. A flow port 15*a* opens from the lower end of the pocket to the interior of the nipple to permit fluids flowing through the gas lift valve to enter into the flow passage.

A movable sleeve 83 is positioned in the landing nipple and is slidable longitudinally therein between a lower position abutting an upwardly facing shoulder 84 in the nipple adjacent the upper end of the pocket and an upper position abutting a downwardly facing shoulder 85 in said nipple. A longitudinal bore 86 extends through the sleeve and is of a diameter corresponding to the string of tubing 11 to which the nipple is connected. A pair of longitudinal guides or ribs 87 are affixed to the inner surface of the nipple as by welding and extend upwardly in corresponding guide slots 88 in the sleeve to maintain the sleeve in angular alignment with the nipple.

An offset longitudinal bore 89 through the sleeve, laterally displaced from the bore 86, is aligned with the upper end of the pocket and is provided with a locking recess 90 therein in which the locking means 91 of the gas lift valve is engageable.

The locking means 91 of the gas lift valve, of the type shown in detail in the patent to Herbert C. Otis, No. 2,144,850, includes a central mandrel 92 connected to the upper end of the body 83 of the valve. A locking dog carrier 94 is slidably disposed on a tubular fishing neck 95 which is threaded into the upper end of the mandrel. The fishing neck is provided with an external fishing flange 96 adjacent its upper end which limits upward movement of the dog carrier and provides a means for connection to a suitable running tool for installing the valve in the pocket. A plurality of elongate locking dogs 97 are swingably retained at their upper ends in the dog carrier, and the depending shanks of the dogs extend downwardly through suitable slots 98 in an external annular flange 99 on the mandrel. The lower end of the flange 99 on the mandrel engages the upper end of the sleeve 83 to limit downward movement of the valve in the pocket, and a dog retaining band 100 is disposed around the flange to limit the outward movement of the dogs in the slots of the flange.

The lower ends of the dogs are provided with outwardly extending locking lugs 101 which are engageable in the locking recess 90 of the sleeve when the dogs are moved laterally outwardly. The mandrel has a downwardly and outwardly tapered dog expander surface 102 which moves the lower ends of the dogs outwardly to move the lugs into locking position when said mandrel is moved upwardly relative to the dogs.

Manifestly the gas lift valve may be installed in the offset bore 89 of the sleeve and in the pocket, the engagement of the flange 99 on the mandrel of the valve with the upper end of the sleeve 83 limiting downward movement of the valve therein. As the valve is lowered into the pocket, the dogs and dog carrier are moved upwardly relative to the mandrel so that the lower ends of the dogs move upwardly on the tapered expander surface to such position that the locking lugs are retracted sufficiently to permit entry of the dogs into the offset bore 89. When the downward movement of the valve in the sleeve is stopped by the engagement of the flange 99 with the sleeve 83, the dog carrier and the locking dogs move downwardly on the mandrel, the locking dogs being moved laterally outwardly into the locking recess. The valve is thus locked in position in the sleeve and in the pocket, and the valve is then movable longitudinally in the pocket by movement of the sleeve between its upper and lower positions.

An annular shifting recess 103 is provided in the bore 86 of the sleeve for engagement by a suitable shifting tool (not shown) of the type shown in the patent to Middleton et al., No. 2,723,677, and includes a guide recess 104 disposed below an upwardly facing abrupt shoulder 105.

A pair of plungers 106 are installed in lateral recesses or bores 107 in external surface of the sleeve and are urged outwardly into engagement with the inner wall of the landing nipple by means of the plunger springs 108 installed in the lateral bores behind the plungers. A pair of annular plunger grooves or recesses 109 and 110 are provided in the inner wall of the landing nipple and are so positioned in said nipple that, when the sleeve is in the upper position in said nipple (FIGURE 6) the plungers 106 enter the upper recess 109; and when said sleeve is in the lower position (FIGURE 7), said plungers enter the lower recess 110. The upper and lower shoulders of the recesses 109 and 110 are beveled as are the outer surfaces of the plungers so that the plungers are cammed inwardly from their engagement in either of the grooves as the sleeve is moved toward the other of the grooves.

The plungers and the plunger grooves thus coact as a detent mechanism to releasably hold the sleeve in either the upper position of FIGURE 6 or the lower position of FIGURE 7 so that the sleeve is movable longitudinally in the nipple only on the application of a force of a certain magnitude thereto. The sleeve, and therefore the gas lift valve, is thus held against inadvertent movement in the landing nipple.

In operation the gas lift valve is lowered through the tubing string by means of the customary flexible line and is moved laterally in the landing nipple by means

of a deflecting tool (not shown) incorporated in the usual string of flexible line operated tools by which the valve is lowered. The valve is installed in the pocket and is locked in position in the locking recess of the sleeve.

It is noteworthy that the customary running tool (not shown) is releasably secured to the fishing flange **96** by means of shearable pins (not shown) and is released from the valve by exerting an upward pull on the running tool relative to the valve. Thus, when the valve is locked in position in the sleeve by means of the locking dogs, an upward pull on the fishing neck exerted by the running tool moves the valve and the sleeve to the upper position (FIGURE 6) wherein any flow through the ports **15** of the pocket is directed through the gas lift valve to the port **15***a* and thence to the nipple flow passage **82***a*. A further upward pull on the running tool shears the pins attaching the running tool to the valve and allows the running tool to be removed from the well.

When it is desired to move the valve to the lower position of FIGURE 7 (or subsequently to return it to the upper position) a suitable shifting tool of the type shown in the patent to Middleton, No. 2,723,677, is lowered into the bore **86** of the nipple to move the sleeve and consequently the valve to the desired position. As previously noted, the detent mechanism of the plungers **106** and the grooves or recesses **109** and **110** holds the sleeve and consequentiy the valve in either of the upper or lower positions against inadvertent movement therefrom.

When it is desired to remove the valve, a suitable retrieving tool is lowered into the landing nipple and is deflected to deliver a downward blow to the upper end of the fishing neck at the same time grasping the external flange **111** at the upper end of the dog carrier. An upward pull on the dog carrier removes the dogs from locked position in the sleeve, the dogs moving inwardly as they move upwardly along the tapered expander surface of the mandrel. Further upward movement of the dog carrier moves the mandrel and the gas lift valve itself upwardly from position in the landing nipple.

It will be seen that with this modified form of the invention, a ported landing nipple and a gas lift valve have been shown and described wherein the valve is removably installable in the nipple and in wherein the nipple is provided with a sliding sleeve means to move the valve between a first position in which flow through the ports of the nipple is directed into and through the gas lift valve to the nipple flow passage and a second position in which flow through the ports is not restricted by the valve.

It will be seen that the valve is releasably locked in the sliding sleeve means and that the sleeve means is movable longitudinally in the nipple by means of any suitable shifting tool to move the valve between the first and second positions in the nipple. It will also be seen that the sliding sleeve is releasably held in position against inadvertent movement by other well tools being passed therethrough.

Referring now to FIGURES 10 and 11, a still further modified form of landing nipple and gas lift valve are shown. The landing nipple **120** is provided with a laterally offset longitudinal pocket **121**, the offset pocket having an elongated internal annular locking groove or recess **122** near its upper end.

A gas lift valve **123** of construction generally similar to that of the valve of FIGURES 6 through 9 is removably installed in the pocket of the nipple and is movable longitudinally therein between an upper position as shown in FIGURE 10 and a lower position as shown in FIGURE 11. When the valve is in the upper position, the packing means **17** and **18** seal on either side of the lateral ports **15** of the pocket to direct any flow from the ports through the valve. When the valve is lowered to the position of FIGURE 11, the upper packing **17** no longer seals above the ports, and flow through said ports proceeds upwardly around the valve and emerges from the pocket into bore or flow passage **123***a* of the landing nipple through the internal ports or windows **124** in the inner wall of the pocket.

A locking means **91** similar to the locking means of the form of valve shown in FIGURES 6 through 9 is engageable in the locking recess **122** of the pocket. The external annular flange **99** on the mandrel is reduced in diameter in its lower part to enter the upper part of the pocket when the valve is in its lower position in the pocket, and an enlarged portion **125** at the upper end of the flange **99** engages the upper end of said pocket to limit downward movement of the valve as shown in FIGURE 11.

The locking recess **122** of the pocket is elongated so that the locking lugs **101** may remain in expanded locking position on the expander surface **102** of the mandrel.

A pair of snap wires or rings **126** and **127** are disposed on the mandrel **92** below the expander surface for cooperation with a snap ring groove **128** in the inner surface of the pocket. The snap rings are of a free size such that they resiliently enter the ring groove when they are positioned adjacent the groove. The snap ring groove is provided with beveled upper and lower shoulders or faces so that the snap rings are cammed inwardly from engagement with the groove on longitudinal movement of the valve in the pocket.

The lower snap ring **127** is so disposed on the mandrel that, when the valve is in the upper position of FIGURE 10, the snap ring enters the groove **128**. Similarly, when the valve is in the lower position of FIGURE 11, the lower snap ring is moved below the groove **128** while the upper snap ring **126** enters said groove. The snap rings and the groove thus constitute a detent mechanism to releasably hold the gas lift valve in either its upper or its lower position, the valve being movable from one position to the other only on the application of a certain force to the valve.

In operation, the gas lift valve is installed in the pocket by means of a deflecting tool in a string of flexible line operated tools (not shown), the locking dogs moving upwardly on the expander surface **102** of the mandrel to permit their entry into the pocket and subsequently moving downward on the expander surface to project into the locking recess and thus lock the valve in the pocket. An upward pull on the running tool (not shown) attached to the flange **96** of the fishing neck moves the valve upwardly to the position of FIGURE 10, the lower snap ring **127** entering the groove **128** to prevent accidental lowering of the valve in the pocket. At the same time the lugs of the locking dogs engage the upper face of the locking groove to positively prevent removal of the valve from the pocket. A further upward pull on the running tool causes the shearable pins (not shown) attaching the running tool to the valve to be fractured, whereupon the running tool is removed from the well.

The valve is moved downwardly to its lower position in the pocket by the delivery of blows by means of suitable tool (not shown) lowered into the landing nipple by means of a customary flexible line and deflected in the nipple by means of a usual deflecting tool to alignment with the gas lift valve. As the valve moves downwardly, the lower snap wire is cammed inwardly from engagement with the groove **128**, and the upper snap wire enters the groove at the same time that the enlarged portion **125** of the flange **99** stops downward movement of said valve in the pocket. The valve is thus releasably held in its lower position.

The valve is moved upwardly to its upper position by means of a suitable gripping or grasping tool (not shown) which engages and grips the flange **96** of the fishing neck. An upward pull on the fishing neck moves the valve upwardly to the upper position, the upper snap ring being inwardly cammed for removal from the groove **128** and

the lower ring re-entering the groove. The gripping tool is disengaged from the flange 96 by an upward pull of a magnitude greater than that necessary to move the valve to its upper position in the pocket.

When it is desired to remove the gas lift valve from the pocket, a suitable fishing tool is lowered into the nipple and is deflected into alignment with the upper end of said valve. The fishing tool engages the flange 111 on the dog carrier and at the same time delivers a downward blow to the fishing neck to move the mandrel downwardly relative to the dogs to unlock the dogs for inward movement to retracted position. An upward pull on the flange 111 then removes the valve from the pocket and is then removed upwardly from the well.

It is noteworthy that, if the valve is in its lower position in the pocket (FIGURE 11), the dogs and dog carrier are already moved upwardly toward unlocked position by virtue of the engagement of the lower faces of the locking lugs with the upwardly facing shoulder at the lower end of the locking groove. In this event, it is unnecessary for the pulling tool to move the mandrel downwardly relative to the dogs (and such movement would indeed by prevented by the engagement of the enlarged portion 125 of the flange 99 with the upper end of the mandrel), and the valve is removed by a direct upward pull on the dog carrier.

With this form of the invention it is obvious that a blind or dummy valve (not shown) could be substituted for the gas lift valve 123 in which case, when the dummy valve is in the upper position as shown in FIGURE 10, the flow through the ports 15 of the pocket is simply closed off, while when the dummy valve is in the lower position of FIGURE 11, flow is permitted through the ports 15 in the same manner as when the gas lift valve 123 is in the lower position.

It will be seen that, with this form of the invention, a landing nipple and a gas lift valve therefor have been shown and described wherein the valve is removably installed in said landing nipple, the valve being movable between a first position in which any flow through the ports of the nipple is directed through the valve and a second position in which unrestricted flow is permitted through the ports without being confined to flow through the valve. It will be seen that the valve is releasably held in either of the two positions described; and it will further be seen that the valve, when installed in the landing nipple, is locked against inadvertent removal therefrom.

It will be seen that the valve is movable between the first and second positions by a direct force in the appropriate direction on the fishing neck of the valve. Inasmuch as the application of a force to the valve is impossible without the use of a deflecting tool to move the force-applying instrumentality to the proximity of the valve, it is apparent that the passage of other well tools through the landing nipple will not inadvertently move the gas lift valve from the selected position to the non-selected position. It is also apparent that the gas lift valve can easily be removed from the landing nipple without regard to which of the two positions in the pocket the valve happens to occupy.

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: a landing nipple provided with a lateral port; a gas lift valve removably installed in said nipple, said gas lift valve having a flow passage therethrough with a lateral opening intermediate the ends of said valve, and external seal means thereon spaced longitudinally on opposite sides of said lateral opening, said seal means being disposed to engage said landing nipple; and means on said housing and said gas lift valve co-engageable to position said gas lift valve in said nipple at a first position in which said seal means on said gas lift valve are positioned on opposite sides of said port in said nipple for directing flow from said port into said nipple through said valve, and a second position in which said seal means are disposed on the same side of said port in said nipple opening said port to permit flow of fluids directly into said nipple without passing through said flow passage of said valve.

2. A well tool including: a landing nipple having a bore therethrough and means at each end of said nipple aligned with said bore to connect said nipple to a string of well pipe; a valve pocket in said nipple laterally offset from the bore of said nipple, said pocket having a port opening to the exterior of said nipple; a valve removably positioned in said pocket; said valve having a flow passage therethrough with a lateral opening intermediate the ends of said valve and external seal means on said valve on opposite sides of said lateral opening, said seal means being disposed to engage said valve pocket on opposite sides of said port when in a first position for sealing between said valve and said pocket whereby said port and said lateral opening are disposed in sealed communication for flow of fluids therethrough; operating means in said nipple slidable longitudinally therein between a first and a second position; and latch means on said operating means and said valve cooperatingly engageable to releasably connect said valve to said operating means; said operating means moving said valve between a first position in which said seal means on said valve are disposed on opposite sides of the port of said pocket for directing flow from the port of said pocket through the flow passage of said valve when said operating means is moved to said first position; said operating means moving said valve to a second position in which said seal means on said valve are disposed on the same side of said port of said pocket opening said port for flow into said nipple without passage through said flow passage of said valve when said operating means is moved to said second position.

3. A well tool including: a landing nipple having a bore therethrough and means at each end of said nipple aligned with said bore to connect said nipple to a string of well pipe; a valve pocket in said nipple laterally offset from the bore of said nipple, said pocket having a port opening to the exterior of said nipple; a valve removably positioned in said pocket; said valve having a flow passage therethrough with a lateral opening intermediate the ends of said valve; a pair of longitudinally spaced annular seal means on the exterior of said valve on opposite sides of said lateral opening and engageable with the bore wall of said pocket for sealing between said valve and said pocket; a sleeve in said bore of said nipple slidable longitudinally therein between a first and a second position; latch means on said sleeve and said valve cooperatingly engageable to releasably connect said valve to said sleeve means; said sleeve moving said valve to a first position in which said seal means on said valve are disposed on opposite sides of said port of said pocket for directing flow through the port of said pocket through said flow passage of said valve when said sleeve is moved to said first position; said sleeve moving said valve to a second position in which said seal means are disposed on the same side of said port of said pocket for opening said port for flow into said nipple without passage through said flow passage of said valve when said sleeve is moved to said second position; and means on said sleeve and said nipple restraining said sleeve from movement from either of said first and second positions.

4. A well tool including: a landing nipple having a bore therethrough and having means at each end aligned with said bore to connect said nipple to a string of well pipe; a valve pocket in said nipple laterally offset from the bore through said nipple, said pocket having a port opening to the exterior thereof; a gas lift valve having a flow pas-

sage therethrough with a lateral opening intermediate the ends thereof removably positionable in said pocket; a pair of longitudinally spaced sealing means on said valve on opposite sides of said lateral opening and sealingly engageable with the walls of said pocket; and means on said valve and said pocket releasably locking said valve in said pocket; said means on said valve and said pocket locking said valve in said pocket permitting said valve when locked in said pocket to be moved longitudinally therein between a first and a second position; said sealing means sealing on either side of said port in said pocket when said valve is in said first position to confine any flow from said port to said bore to said lateral opening of said passage through said valve; said sealing means being moved to a position sealing only on one side of said port when said valve is in said second position to permit flow through said port and said pocket to said bore without passage through the flow passage of said valve.

5. A well tool including: a landing nipple having a bore therethrough and having means at each end aligned with said bore to connect said nipple to a string of well pipe; a valve pocket in said nipple laterally offset from the bore through said nipple, said pocket having port opening to the exterior thereof; a flow control valve having a flow passage therethrough with a lateral opening intermediate the ends thereof and removably positionable in said pocket; a pair of longitudinally spaced external sealing means on said valve on opposite sides of said lateral opening and sealingly engageable with the walls of said pocket; means on said valve and said pocket releasably locking said valve in said pocket; said means on said valve and said pocket releasably locking said valve in said pocket permitting said valve when locked in said pocket to be moved longitudinally therein between a first and a second position; said sealing means sealing on either side of the port in said pocket when said valve is in said first position to confine any flow from said port to said bore through said lateral opening and said passage of said valve; said sealing means being moved to a position sealing only on one side of said port when said valve is in said second position to permit flow from said port to said bore without passing through said flow passage of said valve; and holding means on said valve and said pocket releasably holding said valve in said first and second positions.

6. A well tool including: a landing nipple having a bore therethrough and having means at each end aligned with said bore to connect said nipple to a string of well pipe; a valve pocket in said nipple laterally offset from the bore through said nipple, said pocket having a port opening to the exterior thereof; a flow control valve having a flow passage therethrough with a lateral opening intermediate the ends thereof and removably positionable in said pocket; a pair of longitudinally spaced external sealing means on said valve on opposite sides of said lateral opening and sealingly engageable with the walls of said pocket; means on said valve and said pocket releasably locking said valve in said pocket; said means on said valve and said pocket releasably locking said valve in said pocket permitting said valve when locked in said pocket to be moved longitudinally therein between a first and a second position; said sealing means sealing on either side of said port in said pocket when said valve is in said first position to confine any flow from said port through said lateral opening and said passage of said valve and into said bore, said sealing means being moved to a position sealing only on one side of said port when said valve is in said second position to permit flow from said port into said bore without passage through said flow passage of said valve; and holding means on said valve and said pocket releasably holding said valve in said first and second positions; the bore through said nipple providing an unobstructed opening therethrough of a minimum dimension approximating the diameter of the string of well pipe.

7. As a sub-combination in a well tool of the character described, a landing nipple having a longitudinal through bore for use in a string of well pipe, said nipple including: a valve-receiving pocket laterally offset from said bore; said pocket having a port opening to the exterior of said nipple; a sleeve disposed in said nipple and slidable longitudinally therein between a first and a second position and having a bore therethrough aligned with the bore through said nipple; restraining means on said sleeve and said nipple cooperatively engageable to releasably hold said sleeve in each of said positions against undesired movement therefrom; and latch means on said sleeve engageable by cooperating latch means on a gas lift valve installable in said pocket to link said valve to said sleeve for movement therewith.

8. As a sub-combination in a well tool of the character described, a landing nipple having a longitudinal through bore for use in a string of well pipe, said nipple including: a valve-receiving pocket laterally offset from said bore; said pocket having a port opening to the exterior of said nipple; a sleeve disposed in said nipple and slidable longitudinally therein between a first and a second position and having a bore therethrough aligned with the bore through said nipple; restraining means on said sleeve and said nipple cooperatively engageable to releasably hold said sleeve in each of said positions against undesired movement therefrom; latch means on said sleeve engageable by cooperating latch means on a gas lift valve installable in said pocket to link said valve to said sleeve for movement therewith; and means on said sleeve and said nipple maintaining said latch means on said sleeve in engaging alignment with said valve.

9. As a sub-combination in a well tool of the character describer, a landing nipple having a longitudinal through bore for use in a string of well pipe, said nipple including: a valve-receiving pocket laterally offset from said bore; said pocket having a port opening to the exterior of said nipple; a sleeve disposed in said nipple and slidable longitudinally therein between a first and a second position and having a bore therethrough aligned with the bore through said nipple; restraining means on said sleeve and said nipple cooperatively engageable to releasably hold said sleeve in each of said positions against undesired movement therefrom; latch means on said sleeve engageable by cooperating latch means on a gas lift valve installable in said pocket to link said valve to said sleeve for movement therewith; means on said sleeve engageable by a shifting tool whereby said shifting tool may selectively move said sleeve between said first and second positions.

10. A landing nipple of the character set forth in claim 7 wherein the restraining means comprises a detent mechanism.

11. As a sub-combination in a well tool of the characted described, a landing nipple having a longitudinal bore therethrough for use in a string of well pipe, said nipple including: a valve-receiving pocket laterally offset from said bore; said pocket having a port opening to the exterior of said nipple; a sleeve member disposed in said nipple and slidable longitudinally therein between a first and a second position and having a first bore therethrough aligned with the bore through said nipple and a second bore aligned with said pocket; means on said sleeve member and said nipple engaging one another to maintain said second bore aligned with said pocket; a locking recess in said second bore engageable by a locking means on a gas lift valve on insertion of said valve into said second bore and said pocket to hold said valve in said pocket; said valve being movable longitudinally in said pocket with said sleeve when said sleeve member is moved in said nipple; and holding means on said sleeve member and said nipple releasably holding said sleeve in each of said first and second positions.

12. As a sub-combination in a well tool of the character described, a landing nipple having a longitudinal

bore therethrough for use in a string of well pipe, said nipple including: a valve-receiving pocket laterally offset from said bore; said pocket having a port opening to the exterior of said nipple; a sleeve member disposed in said nipple and slidable longitudinally therein between a first and a second position and having a first bore therethrough aligned with the bore through said nipple and a second bore aligned with said pocket; means on said sleeve member and said nipple engaging one another to maintain said second bore aligned with said pocket; a locking recess in said second bore engageable by a locking means on a gas lift valve on insertion of said valve into said second bore and said pocket to hold said valve in said pocket; said valve being movable longitudinally in said pocket with said sleeve when said sleeve member is moved in said nipple; holding means on said sleeve member and said nipple releasably holding said sleeve in each of said first and second positions; and a groove in said first bore means engageable by a shifting tool whereby said sleeve may be moved selectively between said first and said second positions.

13. In combination, a landing nipple having a longitudinal bore therethrough for use in a string of well pipe, and a gas lift valve, said nipple including: an open-ended valve-receiving pocket laterally offset from said bore; said pocket having a port opening to the exterior of said nipple; a sleeve disposed in said nipple below the lower end of said pocket and slidable longitudinally in said nipple between a first and a second position and having a bore therethrough aligned with the bore through said nipple; and a resilient latch means on said sleeve engaging said gas lift valve on insertion of said valve into said pocket to releasably hold said valve in said pocket; said sleeve being selectively movable to said first or second position by a suitable shifting tool, said valve being moved in said pocket by movement of said sleeve; said valve having a flow passage thereon and external seal means surrounding said flow passage and engaging the bore wall of said pocket for directing flow from said port through the flow passage of said valve when said sleeve is moved to said first position; said external seal means on said valve being moved to a position permitting flow from said port to said bore without passage through the flow passage of said valve when said sleeve is moved to said second position.

14. In combination, a landing nipple having a longitudinal bore therethrough for use in a string of well pipe, and a gas lift valve, said nipple including: an open-ended valve-receiving pocket laterally offset from said bore; said pocket having a port opening to the exterior of said nipple; a sleeve disposed in said nipple below the lower end of said pocket and slidable longitudinally in said nipple between a first and a second position and having a bore therethrough aligned with the bore through said nipple; a resilient latch means on said sleeve for engaging said gas lift valve on insertion of said valve into said pocket to releasably hold said valve in said pocket; said sleeve being selectively movable to said first and second positions by a suitable shifting tool, said valve being moved in said pocket by movement of said sleeve; said valve having a flow passage thereon and external seal means surrounding said flow passage and engaging the bore wall of said pocket for confining flow through said port to flow through the flow passage of said valve when said sleeve is moved to said first position; said external seal means on said valve being moved to a position permitting unrestricted flow through said port when said sleeve is moved to said second position; and means on said sleeve and said nipple maintaining said latch means in engaging alignment with said valve.

15. A landing nipple of the character set forth in claim 14 including: a resilient holding means on said sleeve and said nipple releasably holding said sleeve in each of said first and second positions against inadvertent movement therefrom.

16. In combination, a landing nipple having a bore therethrough for use in a string of well pipe, and a gas lift valve, said landing nipple including: a valve-receiving pocket having an open upper end and lateral offset from said bore; said pocket having a port opening to the exterior of said nipple; an elongate locking recess in said pocket; said valve including a central mandrel; a locking dog carrier mounted on said mandrel for limited longitudinal movement thereon; a plurality of elongate locking dogs swingably suspended from said carrier; a tapered expander section on said mandrel moving the lower ends of said dogs laterally outwardly to expanded position on downward movement of said carrier relative to said mandrel; locking lugs on said dogs protruding outwardly therefrom; said locking lugs entering said locking recess to limit upward movement of said valve in said pocket when said dogs are moved to expanded position; stop means on said valve engageable with said pocket to limit downward movement of said valve in said pocket; said valve being movable through a limited distance between the upper position limited by said locking lugs and the lower position limited by said stop means on said valve; said valve being removable from said pocket by upward movement of said carrier and said dogs relative to said mandrel to release said dogs for inward lateral movement; said valve having a flow passage therethrough with a lateral opening; and external sealing means on opposite sides of said lateral opening of said valve engaging said pocket; said sealing means directing flow from the port of said pocket through the lateral opening and flow passage of said valve when said valve is in one of said upper and lower positions in said nipple; said sealing means being moved to a position uncovering said port for allowing flow from said port to said bore when said valve is in the other of said upper and lower positions.

17. In combination, a landing nipple having a bore therethrough for use in a string of well pipe, and a gas lift valve, said landing nipple including: a valve-receiving pocket having an open upper end and laterally offset from said bore; said pocket having a port opening to the exterior of said nipple; an elongate locking recess in said pocket; said valve including a central mandrel; a locking dog carrier mounted on said mandrel for limited longitudinal movement thereon; a plurality of elongate locking dogs swingably suspended from said carrier; a tapered expander section on said mandrel moving the lower ends of said dogs laterally outwardly to expanded position on downward movement of said carrier relative to said mandrel; locking lugs on said dogs protruding outwardly therefrom; said locking lugs entering said locking recess to limit upward movement of said valve in said pocket when said dogs are moved to expanded position; stop means on said valve engageable with said pocket to limit downward movement of said valve in said pocket; said valve being movable in said pocket through a limited distance between the upper position limited by said locking lugs and the lower position limited by said stop means on said valve; said valve being removable from said pocket by upward movement of said carrier and said dogs relative to said mandrel to release said dogs for inward lateral movement; said valve having a flow passage therethrough with a lateral opening; external sealing means on opposite sides of said lateral opening of said valve engaging said pocket; said sealing means confining any flow through the port of said pocket to flow through the lateral opening and flow passage of said valve to said bore when said valve is in one of said upper and lower positions in said nipple; said sealing means being moved to a position uncovering said port for flow therethrough to said bore unhampered by said valve when said valve is in the other of said upper and lower positions; said valve being movable between said upper and lower positions by the application of a direct force to said mandrel.

18. In combination a landing nipple having a bore therethrough for use in a string of well pipe, and a gas

lift valve, said landing nipple including: a valve-receiving pocket having an open upper end and laterally offset from said bore; a port in said pocket opening to the exterior of said nipple; an elongate locking recess in said pocket; said valve including a central mandrel; a locking dog carrier mounted on said mandrel for limiting longitudinal movement thereon; a plurality of elongate locking dogs swingably suspended from said carrier; a tapered expander section on said mandrel moving the lower ends of said dogs laterally outwardly to expanded position on downward movement of said carrier relative to said mandrel; locking lugs on said dogs protruding outwardly therefrom; said locking lugs entering said locking recess to limit upward movement of said valve in said pocket when said dogs are moved to expanded position; stop means on said valve engageable with said pocket to limit downward movement of said valve in said pocket; said valve being movable in said pocket through a limited distance between the upper position limited by said locking lugs and the lower position limited by said stop means on said valve; said valve being removable from said pocket by upward movement of said carrier and said dogs relative to said mandrel to release said dogs for inward lateral movement; said valve having a flow passage therethrough with a lateral opening external sealing means on opposite sides of said lateral opening of said valve engaging said pocket; said sealing means confining any flow through the lateral opening and flow passage of the port of said pocket to flow through said valve when said valve is in one of said upper and lower positions in said nipple; said sealing means being in a position uncovering said port for flow therethrough unhampered by said valve when said valve is in the other of said upper and lower positions; and holding means on said valve and said pocket engageable to releasably hold said valve in said upper and lower positions in said pocket.

19. In combination, a landing nipple having a bore therethrough for use in a string of well pipe, and a gas lift valve, said landing nipple including: a valve-receiving pocket having an open upper end and laterally offset from said bore; a port in said pocket opening to the exterior of said nipple; an elongate locking recess in said pocket; said valve including a central mandrel; a locking dog carrier mounted on said mandrel for limited longitudinal movement thereon; a plurality of elongate locking dogs swingably suspended from said carrier; a tapered expander section on said mandrel moving the lower ends of said dogs laterally outwardly to expanded position on downward movement of said carrier relative to said mandrel; locking lugs on said dogs protruding outwardly therefrom; said locking lugs entering said locking recess to limit upward movement of said valve in said pocket when said dogs are moved to expanded position; stop means on said valve engageable with said pocket to limit downward movement of said valve in said pocket; said valve being movable in said pocket through a limited distance between the upper position limited by said locking lugs and the lower position limited by said stop means on said valve; said valve being removable from said pocket by upward movement of said carrier and said dogs relative to said mandrel to release said dogs for inward lateral movement; said valve having a flow passage therethrough with a lateral opening; external sealing means on opposite sides of said lateral opening of said valve engaging said pocket; said sealing means confining any flow through the port of said pocket to flow through the lateral opening and flow passage of said valve when said valve is in one of said upper and lower positions in said nipple; said sealing means being in a position uncovering said port for flow therethrough unhampered by said valve when said valve is in the other of said upper and lower positions; and holding means on said valve and said pocket engageable to releasably hold said valve in said upper and lower positions in said pocket; said holding means including a groove means in one of said valve and pocket and a resilient means on the other of said valve and pocket, said resilient means being urged into holding engagement in said groove means; said groove means and said resilient means including cam means to disengage said resilient means from said groove means on application of the longitudinal force to said valve of a certain magnitude.

20. A device of the type described including: a landing nipple connectable in a pipe string and having a flow passage aligned with the bore of said pipe string; said landing nipple having means providing a valve-receiving pocket having a lateral port providing communication between the exterior of said nipple and said pocket, said pocket means being laterally offset from said flow passage; a valve having a flow passage therethrough with a lateral opening intermediate the ends thereof and external sealing means surrounding said lateral opening, said valve means being insertable in said pocket means, said valve means having locking and releasable restraining means thereon; means on said pocket cooperable with said locking and restraining means of said valve receivable in said pocket for locking said valve in said pocket while permitting limited movement of said valve between said first and second positions in said pocket; said external seal means on said valve being disposed in engagement with the bore wall of said pocket to connect the lateral opening of the flow passage of said valve in flow communication with the lateral port of said pocket when said valve is in one of said first and second positions, said external seal means on said valve being in a position permitting flow of fluid through said lateral port of said pocket means without flowing through the passage of said valve means when said valve is in the other of said first and second positions.

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