

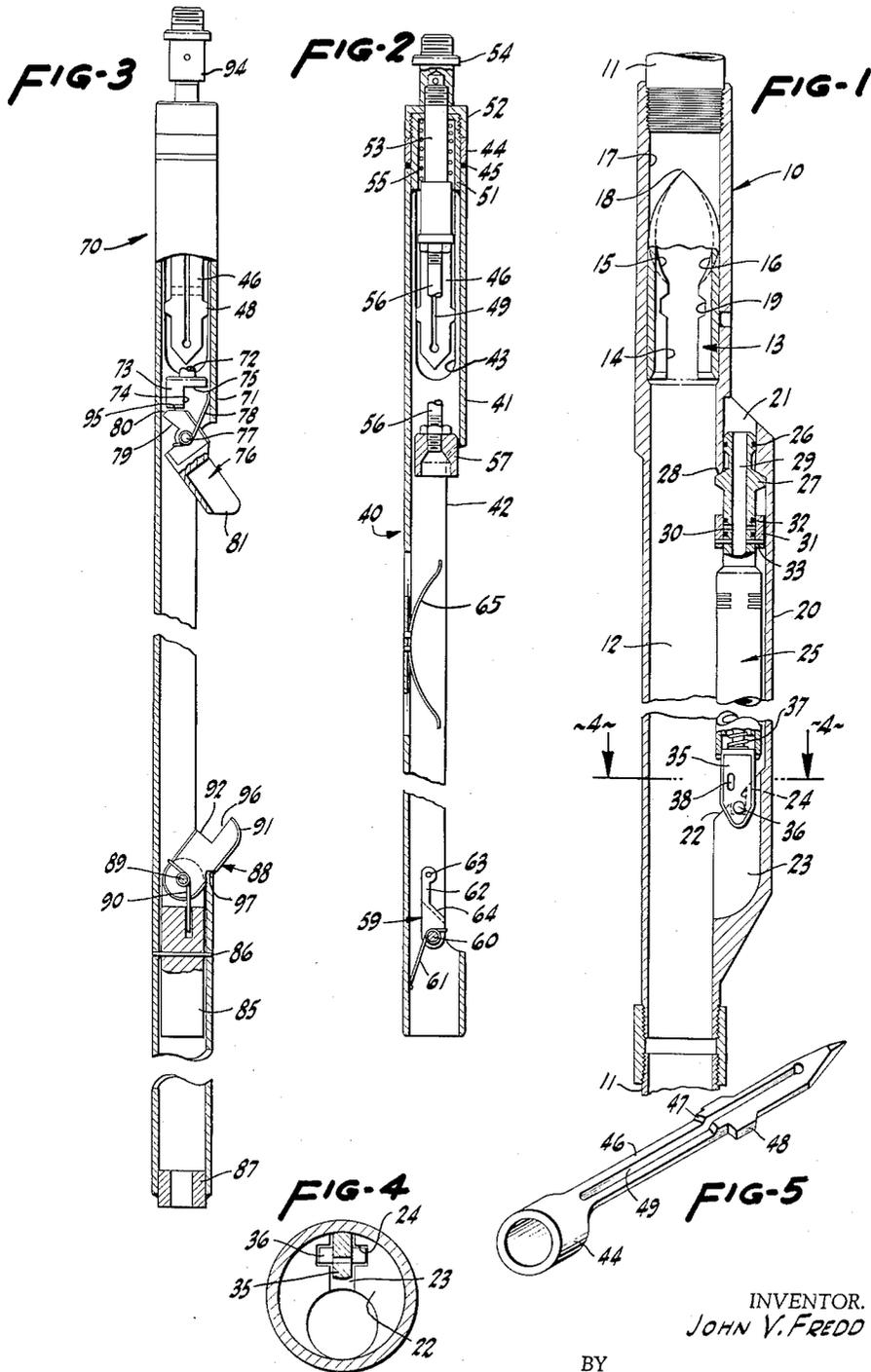
June 13, 1961

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2,988,146

OFFSET MANDREL AND TOOLS

Filed June 2, 1958



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1

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OFFSET MANDREL AND TOOLS

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 Filed June 2, 1958, Ser. No. 739,231
 30 Claims. (Cl. 166—117.5)

This invention relates to oil well equipment and, more particularly, to equipment for installing and removing oil well tools from an offset mandrel made up in a well tubing string.

One of the objects of the invention is to provide an improved offset mandrel, adapted to be connected in a well tubing string, having a well tool receiving pocket laterally offset from the main bore thereof with means for seating a well tool therein, and having a guide shoe for orienting running and pulling tools with respect to the offset pocket.

Another object of the invention is to provide an improved well tool, such as a gas lift valve or the like, which may be removably installed and removed from the above mentioned offset mandrel.

Another object of the invention is to provide a running tool cooperable with the above mentioned offset mandrel for running the above mentioned well tool into the offset mandrel pocket.

Still another object of the invention is to provide a pulling tool cooperable with the above mentioned offset mandrel for removing the above mentioned well tool from the offset mandrel pocket.

A still further object is to provide running and pulling tools as set forth above which may be remotely operable without the necessity of any equipment other than a conventional wire line and associated tools.

Another object is to provide means for running and pulling the above well tool to and from the offset pocket of the above offset mandrel which are preset at the surface of the well so that they will install or remove the well tool in or from a preselected offset mandrel of a plurality of such mandrels connected in a tubing string.

Other objects and advantages will become apparent in the course of the following detailed description.

In the drawings, forming a part of this application, and in which like parts are designated by like reference numerals throughout the same,

FIG. 1 is an elevational view in section of an offset mandrel with a gas lift valve shown in elevation, and partly in section, installed therein.

FIG. 2 is an elevational sectional view of a running tool for installing a gas lift valve in the offset mandrel of FIG. 1.

FIG. 3 is an elevational view, partly in section, of a pulling tool for removing the gas lift valve shown in FIG. 1.

FIG. 4 is a sectional view taken on the line 4—4 of FIG. 1.

FIG. 5 is a perspective view of the orienting guide member used in the tools shown in FIGS. 2 and 3.

Referring now to the drawings, the elongated offset mandrel 10 shown in FIG. 1 is made up in a tubing string 11 so that its main bore 12 is in alignment with and forms a continuation of the main bore of the tubing string.

A tubular guide shoe 13 is fixedly secured in the upper end of the main bore of the mandrel 10 coaxially therewith. As shown in FIG. 1, the guide shoe 13 has a slot 14 therethrough extending longitudinally of the shoe. The shoe has the upper surfaces 15 and 16 thereof extending upwardly from each side of slot 14 and helically around the inner wall 17 of the mandrel to the apex 18 of the guide shoe. Thus, when any tool having a portion thereof engaging the mandrel wall 17 passes downwardly

2

through the mandrel 10, the wall engaging portion will contact either surface 15 or 16 of the guide shoe and will be rotated thereby so that it will pass through the slot 14. The guide shoe 13 is also provided with horizontal notches 19 extending laterally from the sides of slot 14, for a purpose to be described.

One end of the well tool receiving pocket 20 of the mandrel, which is offset laterally from the main bore thereof, communicates with the exterior of the mandrel by passageway 21, which passageway is above and in alignment with the offset pocket. The lower end of the offset pocket of the mandrel is solid, with an upwardly and outwardly inclined upper surface 22, and is formed with a longitudinal groove 23 open at its inner side to the main bore 12 of the mandrel. Notches 24 extend downwardly from the inclined surface 22 and outwardly from groove 23, as shown in FIGS. 1 and 4.

A conventional gas lift valve 25 is modified at its upper and lower ends for installation in the offset mandrel 10 as shown. The upper tubular neck portion of the valve is inserted in the passageway 21 and the surface therebetween sealed by O-ring 26. Upward displacement of the valve through the passageway 21 is limited by abutment of the flange 27 on the valve neck with the downwardly facing passageway shoulder 28. Communication between the passageway 21 and the interior of the valve is provided by a passageway 29 which also communicates with the radial ports 30 through the valve neck below flange 27. Sliding sleeve 31 and O-rings 32 on each side of the port 30 seal the ports. The sleeve is maintained in this position by shear pins 33.

The lower end of the valve 25 is provided with a spring pressed connector member 35 which is rectangular in cross section and which fits into the offset pocket groove 23. A transversely extending rod 36, secured to the connector member 35, seats within the upwardly facing notches 24 to limit the downward movement of the connector member in groove 23. The connector member 35 is mounted in the lower end of valve 25 for longitudinal movement relative thereto and, when seated in the notches 24, the spring 37 within the valve forces the valve upwardly to maintain the upper valve flange 27 against the mandrel shoulder 28. A longitudinally extending slot 38 is formed through the connector member for a purpose to be hereinafter described.

The primary structural member of the running tool 40 shown in Fig. 2 is the elongated tubular body 41 having an internal diameter at least as great as the external diameter of the gas lift valve 25 shown in Fig. 1 and having a longitudinally extending window 42 through which the gas lift valve can be ejected. The body has a second longitudinally extending window 43 which extends from the lower extremity shown to the upper end of the body. Tubular guide sleeve 44, shown perspectivevly in Fig. 5 and in effect forming a continuation of body 41, is secured thereto as by weld 45. As shown in Fig. 5, guide key 46 is an integral portion of the guide sleeve 44, and extends downwardly therefrom on one side of the guide sleeve, and has the same external diameter as the guide sleeve down to the point 47. The guide key extends outwardly beyond the guide sleeve from the point 47 down to its lower end. The guide key has a T-shaped portion 48 which matches and can fit in the notches 19 of the guide shoe 13 (Fig. 1) to secure the running tool in the offset mandrel. The longitudinal slot 49 in the guide key permits the guide key to be contracted for insertion in or removal from the guide shoe 13.

After spring cup 51 is inserted in and secured to the body 41 by welding, and the cap 52 is threadedly connected to the spring cup, plunger 53 is passed through openings in the upper end of the cap and spring cup and is threadedly connected to the sub 54. Spring 55, encircled

3

ing a portion of the plunger, bears against an internal flange of the spring cup and a shoulder on the lower portion of the plunger, forcing the plunger downwardly. Rod 56 (shown broken in Fig. 2 for clarity) is connected to plunger 53 and holder 57 at the opposite ends thereof. Holder 57, which can slide within the closed portion of body 41, is open at its lower end for releasably engaging the upper end of the gas lift valve 25.

A bifurcated, well tool inserting member 59 is connected to body 41 by and can pivot about pin 60. Spring 61 maintains the inserting member in the normal position shown except when the gas lift valve is being installed in the offset mandrel. The connector member 35 of the gas lift valve is disposed between the arms 62 of the inserting member and is maintained therein by a shear pin 63 which passes through the arms 62 and the slot 38 in the connector member 35. In this position, when the gas lift valve is being installed in the offset mandrel, the bottom surface of the connector member abuts the lower face of groove 64 in the inserting member 59. Leaf spring 65 is secured to the interior surface of the body 41 opposite the window 42.

In the following description, it is assumed that one or more offset mandrels 10 are made up in the oil well tubing string 11. Except for ascertaining the depth of the particular offset mandrel in which a valve is to be installed or removed, the method for installing or removing the valve in any one of them is identical to that for the others. In all cases, a wire line with jars and other associated equipment is connected to the sub 54 of the running or pulling tool.

Prior to being run into the well, the upper end of the gas lift valve 25 is inserted in the holder 57, and the connector member is secured between the arms 62 by pin 63 through the arms and the slot 38. When in this position, the gas lift valve compresses the leaf spring 65 against the body 41.

The running tool is then lowered into the tubing string until the raised portion 47 of the guide key enters and is secured within the slot 14 and notches 19 of the guide shoe 13. In this position, the gas lift valve in the running tool is directly opposite the offset pocket of the offset mandrel 10. With the body 41 thus secured, the sub 54 and hence the plunger 53 and holder 57 are raised upwardly, removing the valve from holder 57. Spring 65 now forces the upper portion of the gas lift valve outwardly through the window 42. The entire running tool is now jarred upwardly, thus freeing the guide key 46 from the guide shoe and executing the following operations in order: First, the upper end of the gas lift valve enters the mandrel passageway 21 until stopped by abutment of the flange 27 and shoulder 28. Secondly, the lower surface of the connector member presses downwardly against groove 64, causing the inserting member 59 to pivot about the pin 60, so that the connector member moves into the mandrel groove 23, with the rod 36 entering the notches 24. The running tool is now jarred downwardly, causing the pin 63 to shear. The gas lift valve is now fully installed in the offset mandrel, as shown in Fig. 1. Also, the inserting member has returned to the position shown in Fig. 2 by spring 61, and the running tool can now be retracted from the tubing string.

The upper enclosed portion and body 71 of the pulling tool 70 illustrated in Fig. 3 are identical in every respect to the running tool 40 shown in Fig. 2 and are provided with the same guide key 46. Otherwise, these tools differ as described hereinbelow. Rod 72 is fixedly secured to the upper end of an L-shaped cylindrical equalizing arm holder 73 which has a surface 74 parallel to its longitudinal axis and a surface 75 perpendicular thereto. A generally cylindrical equalizing arm 76 is secured to body 71 by and pivots about pin 77. Spring 78, secured to pin 77, tends to pivot the equalizing arm outwardly about the pin. When being run into the tubing string, the surfaces 79 and 80 of the equalizing arm abut the surfaces 74 and

4

75, respectively, of the equalizing arm holder. In this manner, the longitudinal axis of the equalizing arm is maintained parallel to the longitudinal axis of the pulling tool. The lower portion 81 of the equalizing arm is tubular, the external upper portion of this lower portion having been removed so as to form a scoop.

Cylindrical shaft 85 is slidably disposed within body 71 and is secured in the position shown by shear pin 86. When the pin is sheared, the shaft can move downwardly in the body until its lower end abuts the plug 87 which is fixedly secured to the body. The lower portion of unlatching arm 88 is inserted in the bifurcated upper section of shaft 85 and is secured thereto by pin 89. The unlatching arm can pivot about the pin and is maintained, unless otherwise forced therefrom, in the position shown by spring 90. Should sufficiently large forces be applied at surfaces 91 and 92, the unlatching arm will be forced inwardly such that its longitudinal axis is parallel to that of the pulling tool, and the unlatching arm and spring shaft will move downwardly within the body 71 after the pin 86 had been sheared.

When the pulling tool is being run into the tubing string, equalizing arm 76 is within body 71 such that its longitudinal axis is parallel to that of the pulling tool, and the surfaces 79 and 80 abut surfaces 74 and 75 of the equalizing arm holder as previously mentioned. Also, although the unlatching arm 88 is biased outwardly as shown in FIG. 3, it will be forced inwardly as obstructions are encountered and will pivot about pin 89 without forcing the shaft 85 downwardly. It is to be noted at this point that a guide key 46, once secured in a particular guide shoe 13, can be forced downwardly therethrough in the same manner that it is retracted therefrom.

Once the pulling tool is locked in the desired offset mandrel by engagement of the guide key 46 with the guide shoe 13, equalizing arm holder 73 is raised upwardly by an upward pull on the top sub 94 and rod 72 connected thereto. When the surfaces 74 and 79 are cleared, spring 78 causes the equalizing arm 76 to pivot about pin 77, and surface 95 of the equalizing arm abuts the lower end of equalizing arm holder 73. The lower end 81 of the equalizing arm now engages the gas lift valve below the flange 27 and abuts the upper end of sleeve 31.

The pulling tool is now jarred downwardly to shear the pins 33 and to force sleeve 31 below the ports 30 in order to equalize the pressures within and without the offset mandrel. During this downward jarring operation, the gas lift valve cannot move downwardly due to engagement of the rod 36 with the bottoms of the notches 24; however, when sleeve 31 is forced downwardly, the pulling tool moves downwardly sufficiently to permit surfaces 92 and 96 of the unlatching arm 88 (which has been pivoted outwardly by spring 90) to abut the lower end of connector member 35. The pulling tool now is jarred upwardly, causing unlatching arm 88 to force the connector member 35 upwardly and inwardly, compressing spring 37. Now, with the rod 36 free from the notches 24, and bearing against the sloping surface 22, the pulling tool is again jarred downwardly, causing the upper portion of the gas lift valve to be forced downwardly and out of the passageway 21 and rod 36 to move inwardly in the mandrel along surface 22. This movement of rod 36 and connector member 35 cams the unlatching arm 88 inwardly until the unlatching arm shoulder 97 is clear of the adjacent portion of the body 71. Pin 86 is now sheared by further downward jarring, and the shaft 85, unlatching arm 88, and the gas lift valve move downwardly within the enclosed lower portion of the body 71. The pulling tool is now jarred upwardly to remove the guide key 46 from the guide shoe 13, and the entire assembly of wire line, pulling tool, and gas lift valve is removed from the well. Equalizing arm 76 is cammed inwardly as obstructions are encountered during this removal operation.

Orienting key 46, due to its resiliency, flexes inwardly

in window 43 when meeting obstructions such as the lower ends of other guide shoes 13 while the pulling tool is lifted through the well tubing.

In the above description, a well installation has been described in which a plurality of identical offset mandrels 10 have been connected in a tubing string. In this case, the same running tool 40 may be used to insert a valve in any one of the mandrels 10, and the same pulling tool 70 may be used to remove a valve from any desired one of the mandrels. However, it is within the purview of the invention to provide for automatic selectivity by constructing the mandrels in such way that it will require a different running and pulling tool for each mandrel, or, conversely stated, a particular running or pulling tool can insert or remove a valve from only one of the installed mandrels.

Such selectivity can easily be accomplished by rotating the guide shoe 13 in the upper end of mandrel 10 for each mandrel, so that a different angular relation is had between the guide shoe slot 14 and the offset pocket 20 of each mandrel. Thus, if the guide shoe 13 were rotated 180° in FIG. 1, and the running tool of FIG. 2 were run into the mandrel, the valve installing window 42 of the running tool would be facing away from, instead of towards, the offset pocket 20, and the valve could not be installed in this mandrel. However, if the guide key 46 on the running tool were also rotated 180° with respect to window 42, the running tool would then be positioned in the mandrel to enable a valve to be installed in the mandrel.

Thus, selectivity can be provided by constructing each mandrel 10 with a different angular relation between the guide shoe slot 14 and the offset pocket 20 and by providing a running tool for each mandrel with the same angular relation between the guide key 46 and the windows 42. In the same manner, a different pulling tool would be provided for each mandrel.

It is to be realized that the forms of the invention herewith shown and described are to be taken as a preferred embodiment of the same and that various changes in the shapes, sizes and arrangements of parts may be resorted to without departing from the spirit of the invention or the scope of the attached claims.

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

1. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, an upwardly facing notch formed in said lower surface; a well tool comprising an elongated body member having an upper tubular neck sealingly fitting within said offset mandrel passage, a connector member mounted in the lower end of said body member for longitudinal movement relative thereto, a rod projecting outwardly from the lower end of said connector member and received within said upwardly facing notch, and means biasing said connector member downwardly relative to said body member.

2. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, a downwardly facing shoulder in said mandrel adjacent said passage, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, and an upwardly facing notch formed in said

lower surface, said notch being open towards said groove; a well tool comprising an elongated body member having an upper tubular neck sealingly fitting within said offset mandrel passage and an external flange on said neck engaging said offset mandrel shoulder, a connector member mounted in the lower end of said body member for longitudinal movement relative thereto and having its lower end received within said longitudinal groove, a rod projecting outwardly from the lower end of said connector member and received within said upwardly facing notch, and means biasing said connector member downwardly relative to said body member.

3. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, an upwardly facing notch formed in said lower surface, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; a well tool comprising an elongated body member having an upper tubular neck sealingly fitting within said offset mandrel passage, a connector member mounted in the lower end of said body member for longitudinal movement relative thereto, a rod projecting outwardly from the lower end of said connector member and received within said upwardly facing notch, and means biasing said connector member downwardly relative to said body member.

4. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, a downwardly facing shoulder in said mandrel adjacent said passage, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, an upwardly facing notch formed in said lower surface, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; a well tool comprising an elongated body member having an upper tubular neck sealingly fitting within said offset mandrel passage and an external flange on said neck engaging said offset mandrel shoulder, a connector member mounted in the lower end of said body member for longitudinal movement relative thereto, a rod projecting outwardly from the lower end of said connector member and received within said upwardly facing notch, and spring means biasing said connector member downwardly relative to said body member.

5. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, a downwardly facing shoulder in said mandrel adjacent said passage, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, an upwardly facing notch formed in said lower sur-

face, said notch being open towards said groove, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof and having its upper surface extending helically upwardly from each side of said slot, said guide shoe having horizontally extending notches formed in each side of said slot, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; a well tool comprising an elongated body member having an upper tubular neck sealingly fitting within said offset mandrel passage and an external flange on said neck engaging said offset mandrel shoulder, a radial port through said neck below said flange, a slide valve surrounding said neck and sealed thereto to prevent flow through said port, shear pin means connecting said slide valve to said neck to prevent relative longitudinal movement therebetween, a connector member mounted in the lower end of said body member for longitudinal movement relative thereto and having its lower end received within said longitudinal groove, a rod projecting outwardly from the lower end of said connector member and received within said upwardly facing notch, and means biasing said connector member downwardly relative to said body member.

6. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; a running tool comprising an elongated tubular body member adapted to pass longitudinally through said offset mandrel guide shoe and having a longitudinally extending window therethrough, a guide key carried by said body member and projecting outwardly therefrom, said guide key portion having a width approximately equal to the width of said guide shoe slot, means on said guide shoe and guide key for restraining relative longitudinal movement therebetween when said guide key is disposed within said guide shoe slot, a plunger mounted coaxially in said body member for longitudinal movement relative thereto, means on the lower end of said plunger for releasably engaging the upper end of a well tool, spring means for biasing said plunger downwardly into said body member, means connected to the lower portion of said body member adjacent the lower end of said window for releasably engaging the lower end of a well tool, and second spring means carried by said body member for biasing a released well tool carried therein outwardly through said window, the vertical plane determined by the axis of said body member and the vertical axis of said guide key being angularly related to the vertical plane determined by said body member axis and the vertical axis of said window by a predetermined angle equal to the predetermined angle of said offset mandrel.

7. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof and having its upper surface extending helically upwardly from each side of said slot, the vertical plane determined by the central axis of said main bore and said slot being angu-

larly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; a running tool comprising an elongated tubular body member adapted to pass longitudinally through said offset mandrel guide shoe and having a longitudinally extending window therethrough, a guide key carried by said body member and projecting outwardly therefrom, said guide key portion having a width approximately equal to the width of said guide shoe slot, means on said guide shoe and guide key for restraining upward movement of said guide key relative to said guide shoe when said guide key is disposed within said guide shoe slot, a plunger mounted coaxially in said body member for longitudinal movement relative thereto, means on the lower end of said plunger for releasably engaging the upper end of a well tool, spring means for biasing said plunger downwardly into said body member, a well tool inserting member connected to the lower portion of said body member for pivotal movement of the upper end thereof into and out of said window, means on the upper end of said inserting member for releasably engaging the lower end of a well tool, and second spring means carried by said body member for biasing a released well tool carried therein outwardly through said window, the vertical plane determined by the axis of said body member and the vertical axis of said guide key being angularly related to the vertical plane determined by said body member axis and the vertical axis of said window by a predetermined angle equal to the predetermined angle of said offset mandrel.

8. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, a downwardly facing shoulder in said mandrel adjacent said passage, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, an upwardly facing notch formed in said lower surface, said notch being open towards said groove, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof and having its upper surface extending helically upwardly from each side of said slot, said guide shoe having horizontally extending notches formed in each side of said slot, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; a running tool comprising an elongated tubular body member adapted to pass longitudinally through said offset mandrel guide shoe and having first and second longitudinally extending windows therethrough, a guide key carried by said body member and having an outwardly projecting portion mounted for movement radially of the axis of said body member in and out of said first window, said guide key portion normally projecting outwardly from said body member, said guide key portion having a width approximately equal to the width of said guide shoe slot, laterally extending projections formed on said guide key portion receivable within said guide shoe notches, said guide key portion having a longitudinal slot therethrough to enable said guide key projections to be moved towards one another, a plunger mounted coaxially in said body member for longitudinal movement relative thereto, means on the lower end of said plunger for releasably engaging the upper end of a well tool, spring means for biasing said plunger downwardly into said body member, a well tool inserting member connected to the lower portion of said body member

for pivotal movement of the upper end thereof into and out of said second window, means on the upper end of said inserting member for releasably engaging the lower end of a well tool, and second spring means carried by said body member for biasing a well tool carried therein outwardly through said second window, the vertical plane determined by the axis of said body member and the central axis of said first window being angularly related to the vertical plane determined by said body member axis and the central axis of said second window by a predetermined angle equal to the predetermined angle of said offset mandrel.

9. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, an upwardly facing notch formed in said lower surface, and a tubular guide shoe mounted in the upper end of said bore co-axially therewith, said guide shoe having a slot extending from the top to the bottom thereof, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; a well tool comprising an elongated body member having an upper tubular neck sealingly fitting within said offset mandrel passage, a radial port through said neck, a slide valve surrounding said neck and sealed thereto to prevent flow through said port, shear pin means connecting said slide valve to said neck to prevent relative longitudinal movement therebetween, a connector member mounted in the lower end of said body member for longitudinal movement relative thereto, a rod projecting outwardly from the lower end of said connector member received within said upwardly facing notch, and means biasing said connector member downwardly relative to said body member; and a pulling tool comprising an elongated tubular body member adapted to pass longitudinally through said offset mandrel guide shoe and having a longitudinally extending window therethrough, a guide key carried by said body member and projecting outwardly therefrom, said guide key portion having a width approximately equal to the width of said guide shoe slot, means on said guide shoe and guide key for restraining relative longitudinal movement therebetween when said guide key is disposed within said guide shoe slot, a plunger mounted coaxially in said body member for longitudinal movement between upper and lower positions relative thereto, spring means biasing said plunger to said lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into and out of said window, second spring means normally biasing the lower end of the equalizing member outwardly through said window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the bias of said second spring when said plunger is in its lower position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in its upper position, said equalizing member having means at its lower end for engaging the upper end of the slide valve on said well tool seated in the offset pocket of said mandrel, an unlatching arm mounted in the lower end of said body member for pivotal movement of the upper end thereof into and out of said window, and third spring means normally biasing said unlatching arm upper end outwardly through said window, said arm being adapted to pivot inwardly through said window upon upward engagement with said well tool, the vertical plane determined by the axis of said body member and the vertical axis of said guide key being angularly related to the

vertical plane determined by said body member axis and the vertical axis of said window by a predetermined angle equal to the predetermined angle of said offset mandrel.

10. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, an upwardly facing notch formed in said lower surface, said notch being open towards said groove, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; a well tool comprising an elongated body member having an upper tubular neck sealingly fitting within said offset mandrel passage, a radial port through said neck, a slide valve surrounding said neck and sealed thereto to prevent flow through said port, shear pin means connecting said slide valve to said neck to prevent relative longitudinal movement therebetween, a connector member mounted in the lower end of said body member for longitudinal movement relative thereto and having its lower end received within said longitudinal groove, a rod projecting outwardly from the lower end of said connector member received within said upwardly facing notch, and means biasing said connector member downwardly relative to said body member; and a pulling tool comprising an elongated tubular body member adapted to pass longitudinally through said offset mandrel guide shoe and having a longitudinally extending window therethrough, a guide key carried by said body member and normally projecting outwardly therefrom, said guide key portion having a width approximately equal to the width of said guide shoe slot, means on said guide shoe and guide key for restraining relative longitudinal movement therebetween when said guide key is disposed within said guide shoe slot, a plunger mounted coaxially in said body member for longitudinal movement between upper and lower positions relative thereto, spring means biasing said plunger to said lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into and out of said window, second spring means normally biasing the lower end of the equalizing member outwardly through said window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the bias of said second spring when said plunger is in its lower position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in its upper position, said equalizing member having means at its lower end for engaging the upper end of the slide valve on said well tool seated in the offset pocket of said mandrel, a shaft mounted in the lower portion of said body member for longitudinal movement therein, a shear pin connecting said shaft and body member against relative movement, an unlatching arm mounted on said shaft for pivotal movement of the upper end thereof into and out of said window, and third spring means normally biasing said unlatching arm upper end outwardly through said window, said arm having a width approximately equal to the width of said offset mandrel groove and being adapted to pivot inwardly through said window upon upward engagement thereof with said well tool, the vertical plane determined by the axis of said body member and the vertical axis of said guide key being angularly

11

related to the vertical plane determined by said body member axis and the vertical axis of said window by a predetermined angle equal to the predetermined angle of said offset mandrel.

11. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, a downwardly facing shoulder in said mandrel adjacent said passage, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, an upwardly facing notch formed in said lower surface, said notch being open towards said groove, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof and having its upper surface extending helically upwardly from each side of said slot, said guide shoe having horizontally extending notches formed in each side of said slot, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; a well tool comprising an elongated body member having an upper tubular neck sealingly fitting within said offset mandrel passage and an external flange on said neck engaging said offset mandrel shoulder, a radial port through said neck below said flange, a slide valve surrounding said neck and sealed thereto to prevent flow through said port, shear pin means connecting said slide valve to said neck to prevent relative longitudinal movement therebetween, a connector member mounted in the lower end of said body member for longitudinal movement relative thereto and having its lower end received within said longitudinal groove, a rod projecting outwardly from the lower end of said connector member received within said upwardly facing notch, and means biasing said connector member downwardly relative to said body member; and a pulling tool comprising an elongated tubular body member adapted to pass longitudinally through said offset mandrel guide shoe and having first and second longitudinally extending windows therethrough, a guide key carried by said body member and having an outwardly projecting portion mounted for movement radially of the axis of said body member in and out of said first window, said guide key portion normally projecting outwardly from said body member, said guide key portion having a width approximately equal to the width of said guide shoe slot, laterally extending projections formed on said guide key portion receivable within said guide shoe notches, said guide key portion having a longitudinal slot therethrough to enable said guide key projections to be moved towards one another, a plunger mounted coaxially in said body member for longitudinal movement between upper and lower positions relative thereto, spring means biasing said plunger to said lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into and out of said second window, second spring means normally biasing the lower end of the equalizing member outwardly through said second window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the bias of said second spring when said plunger is in its lower position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in its upper position, said equalizing member having means at its lower end for engaging the upper end of the slide valve on said well tool seated in the offset pocket of said mandrel, a shaft mounted in the lower portion of said

12

body member for longitudinal movement therein, a shear pin connecting said shaft and body member against relative movement, an unlatching arm mounted on said shaft for pivotal movement of the upper end thereof into and out of said second window, and third spring means normally biasing said unlatching arm upper end outwardly through said second window, said arm having a width approximately equal to the width of said offset mandrel groove and being adapted to pivot inwardly through said second window upon upward engagement thereof with said well tool, the vertical plane determined by the axis of said body member and the central axis of said first window being angularly related to the vertical plane determined by said body member axis and the central axis of said second window by a predetermined angle equal to the predetermined angle of said offset mandrel.

12. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; and a pulling tool for removing a well tool seated in said offset pocket comprising an elongated tubular body member adapted to pass longitudinally through said offset mandrel guide shoe and having a longitudinally extending window therethrough, a guide key carried by said body member and projecting outwardly therefrom, said guide key portion having a width approximately equal to the width of said guide shoe slot, means on said guide shoe and guide key for restraining relative longitudinal movement therebetween when said guide key is disposed within said guide shoe slot, a plunger mounted coaxially in said body member for longitudinal movement between upper and lower positions relative thereto, spring means biasing said plunger to said lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into and out of said window, second spring means normally biasing the lower end of the equalizing member outwardly through said window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the bias of said second spring when said plunger is in its lower position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in its upper position, an unlatching arm mounted in the lower end of said body member for pivotal movement of the upper end thereof and out of said window, third spring means normally biasing said unlatching arm upper end outwardly through said window, said arm having a width approximately equal to the width of said offset mandrel groove and being adapted to pivot inwardly through said window upon upward engagement with a well tool seated in the offset pocket of said mandrel, the vertical plane determined by the axis of said body member and the vertical axis of said guide shoe being angularly related to the vertical plane determined by said body member axis and the vertical axis of said window by a predetermined angle equal to the predetermined angle of said offset mandrel.

13. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket

in said mandrel offset from said main bore, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof and having its upper surface extending helically upwardly from each side of said slot, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; and a pulling tool for removing a well tool seated in said offset pocket comprising an elongated tubular body member adapted to pass longitudinally through said offset mandrel guide shoe and having a longitudinally extending window there-through, a guide key carried by said body member and projecting outwardly from said body member, said guide key portion having a width approximately equal to the width of said guide shoe slot, means on said guide shoe and guide key for restraining relative longitudinal movement therebetween when said guide key is disposed within said guide shoe slot, a plunger mounted coaxially in said body member for longitudinal movement between upper and lower positions relative thereto, spring means biasing said plunger to said lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into and out of said window, second spring means normally biasing the lower end of the equalizing member outwardly through said window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the bias of said second spring when said plunger is in its lower position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in its upper position, said equalizing member having means at its lower end for engaging the upper end of a slide valve on a well tool seated in the offset pocket of said mandrel, a shaft mounted in the lower portion of said body member for longitudinal movement therein, a shear pin connecting said shaft and body member against relative movement, an unlatching arm mounted on said shaft for pivotal movement of the upper end thereof into and out of said window, third spring means normally biasing said unlatching arm upper end outwardly through said window, said arm having a width approximately equal to the width of said offset mandrel groove and being adapted to pivot inwardly through said window upon upward engagement with a well tool seated in the offset pocket of said mandrel, the vertical plane determined by the axis of said body member and the vertical axis of said guide key being angularly related to the vertical plane determined by said body member axis and the vertical axis of said window by a predetermined angle equal to the predetermined angle of said offset mandrel.

14. Apparatus of the character described, comprising: an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, an upwardly facing notch formed in said lower surface, said notch being open towards said groove, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof and having its upper surface extending helically upwardly from each side of said slot, said guide shoe having horizontally extending notches formed in each

side of said slot, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle; and a pulling tool for removing a well tool seated in said offset pocket comprising an elongated tubular body member adapted to pass longitudinally through said offset mandrel guide shoe and having first and second longitudinally extending windows therethrough, a guide key carried by said body member and having an outwardly projecting portion mounted for movement radially of the axis of said body member in and out of said first window, said guide key portion normally projecting outwardly from said body member, said guide key portion having a width approximately equal to the width of said guide shoe slot, laterally extending projections formed on said guide key portion receivable within said guide shoe notches, said guide key portion having a longitudinal slot therethrough to enable said guide key projections to be moved towards one another, a plunger mounted coaxially in said body member for longitudinal movement between upper and lower positions relative thereto, spring means biasing said plunger to said lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into and out of said second window, second spring means normally biasing the lower end of the equalizing member outwardly through said second window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the biasing said second spring when said plunger is in its lower position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in its upper position, said equalizing member having means at its lower end for engaging the upper end of a slide valve on a well tool seated in the offset pocket of said mandrel, a shaft mounted in the lower portion of said body member for longitudinal movement therein, a shear pin connecting said shaft and body member against relative movement, an unlatching arm mounted on said shaft for pivotal movement of the upper end thereof into and out of said second window, third spring means normally biasing said unlatching arm upper end outwardly through said second window, said arm having a width approximately equal to the width of said offset mandrel groove and being adapted to pivot inwardly through said second window upon upward engagement with a well tool seated in the offset pocket of said mandrel, the vertical plane determined by the axis of said body member and the central axis of said first window being angularly related to the vertical plane determined by said body member axis and the central axis of said second window by a predetermined angle equal to the predetermined angle of said offset mandrel.

15. Apparatus of the character described comprising an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, a downwardly facing shoulder in said mandrel adjacent said passage, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, and an upwardly facing notch formed in said lower surface, said notch being open towards said groove.

16. Apparatus of the character described comprising an elongated offset mandrel adapted to be connected in a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, a downwardly facing shoulder in said man-

15

drel adjacent said passage, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, and a tubular guide shoe mounted in the upper end of said main bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof and having its upper surface extending helically upwardly from each side of said slot, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle.

17. Apparatus of the character described comprising an elongated offset mandrel adapted to be connected to a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, a downwardly facing shoulder in said mandrel adjacent said passage, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, an upwardly facing notch formed in said lower surface, said notch being open towards said groove, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof, the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle.

18. Apparatus of the character described comprising an elongated offset mandrel adapted to be connected to a tubing string, said mandrel having a vertical main bore therethrough, means forming a well tool receiving pocket in said mandrel offset from said main bore, a passage through said mandrel above and in alignment with said offset pocket, a downwardly facing shoulder in said mandrel adjacent said passage, said pocket having its lower surface sloping upwardly and outwardly from the main bore of said mandrel, a longitudinal groove formed in said lower pocket surface, said groove being open to said main bore, an upwardly facing notch formed in said lower surface, said notch being open towards said groove, and a tubular guide shoe mounted in the upper end of said bore coaxially therewith, said guide shoe having a slot extending from the top to the bottom thereof and having its upper surface extending helically upwardly from each side of said slot, said guide shoe having horizontally extending notches formed in each side of said slot, and the vertical plane determined by the central axis of said main bore and said slot being angularly related to the vertical plane determined by said central axis and said offset pocket by a predetermined angle.

19. A well tool comprising an elongated body member having an upper tubular neck and an external flange on said neck, a connector member mounted in the lower end of said body member for longitudinal movement relative thereto, a rod projecting outwardly from the lower end of said connector member, and spring means biasing said connector member downwardly relative to said body member.

20. A well tool comprising an elongated body member having an upper tubular neck and an external flange on said neck, a radial port through said neck below said flange, a slide valve surrounding said neck and sealed thereto to prevent flow through said port, shear pin means connecting said slide valve to said neck to prevent relative longitudinal movement therebetween, a connector member mounted in the lower end of said body member for longitudinal movement relative thereto, a rod projecting outwardly from the lower end of said connector member, and spring means biasing said connector member downwardly relative to said body member.

16

21. A running tool for installing a well tool within the offset pocket of an offset mandrel comprising an elongated tubular body member having a longitudinally extending window therethrough, means mounted on said body member adapted to orient said body member in said mandrel with said window adjacent said offset pocket, a plunger mounted coaxially in said body member for longitudinal movement relative thereto, means on the lower end of said plunger for releasably engaging the upper end of a well tool, spring means for biasing said plunger downwardly into said body member, means connected to the lower portion of said body member adjacent the lower end of said window for releasably engaging the lower end of a well tool, and second spring means carried by said body member for biasing a released well tool carried therein outwardly through said window.

22. A running tool for installing a well tool within the offset pocket of an offset mandrel comprising an elongated tubular body member having a longitudinally extending window, means mounted on said body member adapted to orient said body member in said mandrel with said window adjacent said offset pocket, a plunger mounted in said body member for longitudinal movement relative thereto, means on the lower end of said plunger for releasably engaging the upper end of a well tool, spring means for biasing said plunger downwardly into said body member, a well tool inserting member connected to the lower portion of said body member for pivotal movement of the upper end thereof into and out of said window, means on the upper end of said inserting member for releasably engaging the lower end of a well tool, and second spring means carried by said body member for biasing a well tool carried therein outwardly through said window when released by upward movement of said plunger.

23. A running tool for installing a well tool within the offset pocket of an offset mandrel comprising an elongated tubular body member having first and second longitudinally extending windows therethrough, a guide key carried by said body member and having an outwardly projecting portion mounted for movement radially of the axis of said body member in and out of said first window, said guide key portion normally projecting outwardly from said body member, laterally extending projections formed on said guide key portion, a plunger mounted coaxially in said body member for longitudinal movement relative thereto, means on the lower end of said plunger for releasably engaging the upper end of a well tool, spring means for biasing said plunger downwardly into said body member, means connected to the lower portion of said body member adjacent the lower end of said second window for releasably engaging the lower end of a well tool, and second spring means carried by said body member for biasing a released well tool carried therein outwardly through said second window, the vertical plane determined by the axis of said body member and the central axis of said first window being angularly related to the vertical plane determined by said body member axis and the central axis of said second window by a predetermined angle.

24. A running tool for installing a well tool within the offset pocket of an offset mandrel comprising an elongated tubular body member having a longitudinally extending window therethrough, a guide key carried by said body member and projecting outwardly therefrom, a plunger mounted in said body member for longitudinal movement relative thereto, means on the lower end of said plunger for releasably engaging the upper end of a well tool, spring means for biasing said plunger downwardly into said body member, a well tool inserting member connected to the lower portion of said body member for pivotal movement of the upper end thereof into and out of said window, means on the upper end of said inserting member for releasably engaging the lower end of a well tool, and second spring means carried by said body member for biasing a released well

tool carried therein outwardly through said window, the vertical plane determined by the axis of said body member and the vertical axis of said guide key being angularly related to the vertical plane determined by said body member axis and the central axis of said window by a predetermined angle.

25. A running tool for installing a well tool within the offset pocket of an offset mandrel comprising an elongated tubular body member having first and second longitudinally extending windows therethrough, a guide key carried by said body member and having an outwardly projecting portion mounted for movement radially of the axis of said body member in and out of said first window, said guide key portion normally projecting outwardly from said body member, laterally extending projections formed on said guide key portion, said guide key portion having a longitudinal slot therethrough to enable said guide key projections to be moved towards one another, a plunger mounted coaxially in said body member for longitudinal movement relative thereto, means on the lower end of said plunger for releasably engaging the upper end of a well tool, spring means for biasing said plunger downwardly into said body member, a well tool inserting member connected to the lower portion of said body member for pivotal movement of the upper end thereof into and out of said second window, means on the upper end of said inserting member for releasably engaging the lower end of a well tool, and second spring means carried by said body member for biasing a well tool carried therein outwardly through said second window, the vertical plane determined by the axis of said body member and the central axis of said first window being angularly related to the vertical plane determined by said body member axis and the central axis of said second window by a predetermined angle.

26. A pulling tool for removing a well tool seated within the offset pocket of an offset mandrel comprising an elongated tubular body member having a longitudinally extending window therethrough, a plunger mounted coaxially in said body member for longitudinal movement relative thereto, means carried by said body member for orienting said pulling tool in an offset mandrel so that said window is adjacent the offset pocket of said mandrel, first spring means biasing said plunger to a lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into and out of said window, cooperating surfaces on said plunger and lower end of the equalizing member outwardly through said window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the bias of said second spring when said plunger is in its lower position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in an upper position, an unlatching arm mounted in the lower end of said body member for pivotal movement of the upper end thereof into and out of said window, and third spring means normally biasing said unlatching arm upper end outwardly through said window, said arm being adapted to pivot inwardly through said window upon upward engagement with the bottom of a well tool therewith.

27. A pulling tool for removing a well tool seated within the offset pocket of an offset mandrel comprising an elongated tubular body member having a longitudinally extending window therethrough, means mounted on said body member adapted to orient said body member in said mandrel with said window adjacent said offset pocket, a plunger mounted coaxially in said body member for longitudinal movement between upper and lower positions relative thereto, first spring means biasing said plunger to said lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into

and out of said window, second spring means normally biasing the lower end of the equalizing member outwardly through said window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the bias of said second spring when said plunger is in its lower position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in its upper position, a shaft mounted in the lower portion of said body member for longitudinal movement therein, a shear pin connecting said shaft and body member against relative movement, an unlatching arm mounted on said shaft for pivotal movement of the upper end thereof into and out of said window, and third spring means normally biasing said unlatching arm upper end outwardly through said window, said arm being adapted to pivot inwardly through said window upon upward engagement with the bottom of a well tool therewith.

28. A pulling tool for removing a well tool seated within the offset pocket of an offset mandrel comprising an elongated tubular body member having a longitudinally extending window therethrough, a guide key carried by said body member and projecting outwardly therefrom, a plunger mounted coaxially in said body member for longitudinal movement between upper and lower positions relative thereto, first spring means biasing said plunger to said lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into and out of said window, second spring means normally biasing the lower end of the equalizing member outwardly through said window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the bias of said second spring when said plunger is in its lower position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in its upper position, said equalizing member having means at its lower end for engaging an equalizing slide valve on a well tool seated in said offset pocket, an unlatching arm mounted in the lower end of said body member for pivotal movement of the upper end thereof into and out of said window, and third spring means normally biasing said unlatching arm upper end outwardly through said window, said arm being adapted to pivot inwardly through said window upon upward engagement with the bottom of a well tool therewith, the vertical plane determined by the axis of said body member and the vertical axis of said guide key being angularly related to the vertical plane determined by said body member axis and the vertical axis of said window by a predetermined angle.

29. A pulling tool for removing a well tool seated within the offset pocket of an offset mandrel comprising an elongated tubular body member having a longitudinally extending window therethrough, a guide key carried by said body member and projecting outwardly therefrom, a plunger mounted coaxially in said body member for longitudinal movement between upper and lower positions relative thereto, first spring means biasing said plunger to said lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into and out of said window, second spring means normally biasing the lower end of the equalizing member outwardly through said window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the bias of said second spring when said plunger is in its lower position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in its upper position, said equalizing member having means at its lower end for

engaging an equalizing slide valve on a well tool seated in said offset pocket, a shaft mounted in the lower portion of said body member for longitudinal movement therein, a shear pin connecting said shaft and body member against relative movement, an unlatching arm mounted on said shaft for pivotal movement of the upper end thereof into and out of said window, and third spring means normally biasing said unlatching arm upper end outwardly through said window, said arm being adapted to pivot inwardly through said window upon upward engagement with the bottom of a well tool therewith, the vertical plane determined by the axis of said body member and the vertical axis of said guide key being angularly related to the vertical plane determined by said body member axis and the vertical axis of said window by a predetermined angle.

30. A pulling tool for removing a well tool seated within the offset pocket of an offset mandrel comprising an elongated tubular body member having first and second longitudinally extending windows therethrough, a guide key carried by said body member and having an outwardly projecting portion mounted for movement radially of the axis of said body member in and out of said first window, said guide key portion normally projecting outwardly from said body member, laterally extending projections formed on said guide key portion, said guide key portion having a longitudinal slot therethrough to enable said guide key projections to be moved towards one another, a plunger mounted coaxially in said body member for longitudinal movement between upper and lower positions relative thereto, first spring means biasing said plunger to said lower position, an equalizing member connected at the upper end thereof to said body member for pivotal movement of the lower end thereof into and out

of said second window, second spring means normally biasing the lower end of the equalizing member outwardly through said second window, cooperating surfaces on said plunger and equalizing member for holding the lower end of said equalizing member inwardly of the body member against the bias of said second spring when said plunger is in its second position and for releasing the lower end of said equalizing member for outward movement by said second spring when said plunger is in its upper position, said equalizing member having means at its lower end for engaging an equalizing slide valve on a well tool, a shaft mounted in the lower portion of said body member for longitudinal movement therein, a shear pin connecting said shaft and body member against relative movement, an unlatching arm mounted on said shaft for pivotal movement of the upper end thereof into and out of said second window, and third spring means normally biasing said unlatching arm upper end outwardly through said second window, said arm being adapted to pivot inwardly through said second window upon upward engagement with the bottom of a well tool therewith, the vertical plane determined by the axis of said body member and the central axis of said first window being angularly related to the vertical plane determined by said body member axis and the central axis of said second window by a predetermined angle.

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