United States Patent

Current

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[54] SLIDING SLEEVE ASSEMBLY FOR A HYDRAULICALLY SET WELL PACKER

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[52] **U.S. Cl.** **166/179,** 166/120

[51] **Int. Cl.** **E21b 23/00**

[58] **Field of Search** 166/120, 122, 212, 179

[56] **References Cited**

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[57] **ABSTRACT**

A sliding sleeve assembly for opening the setting port of a hydraulically set well packer which may be reversibly positioned for actuation in either an upwardly or downwardly direction. A shearable plug initially blocking the setting port and positioned in an elongate recess in the packer which extends equal distances on either side of the setting port with a shoulder at each end of the recess and a sliding sleeve telescopically positioned in the recess and in engagement with the plug whereby when the sleeve is longitudinally moved the plug is sheared. One end of the sleeve extending from the axis of the port a distance equal to one-half the length of the recess whereby the one end will engage one of the shoulders at the end of the recess and said sleeve may be positioned in the recess for actuation in either the upwardly or downwardly direction. The sleeve including an actuation shoulder positioned on one side of the plug when the sleeve is in engagement with the plug and including a wedge-shaped shoulder on the second side of the plug protecting the plug but allowing passage of a setting tool. The shoulders at the ends of the recess being tapered for retracting a setting tool after the sleeve is shifted in the recess.

5 Claims, 6 Drawing Figures

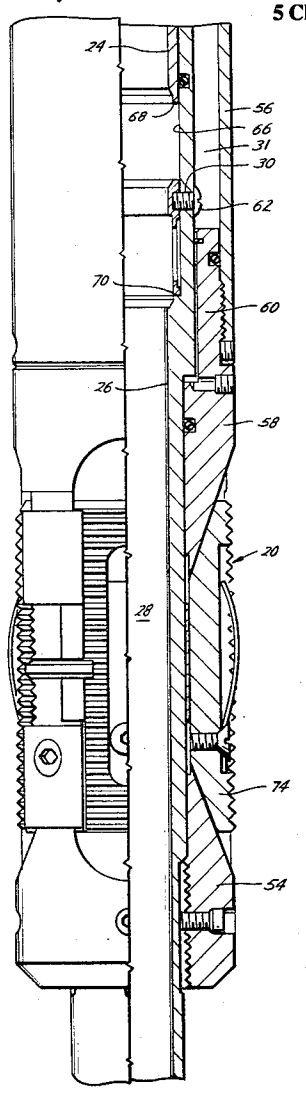

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Fig. 1A

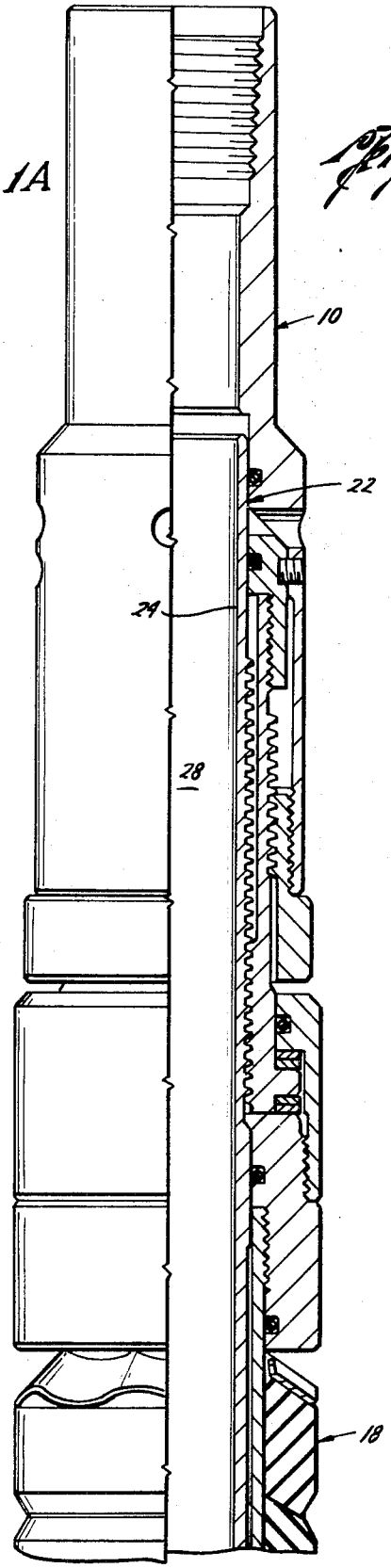
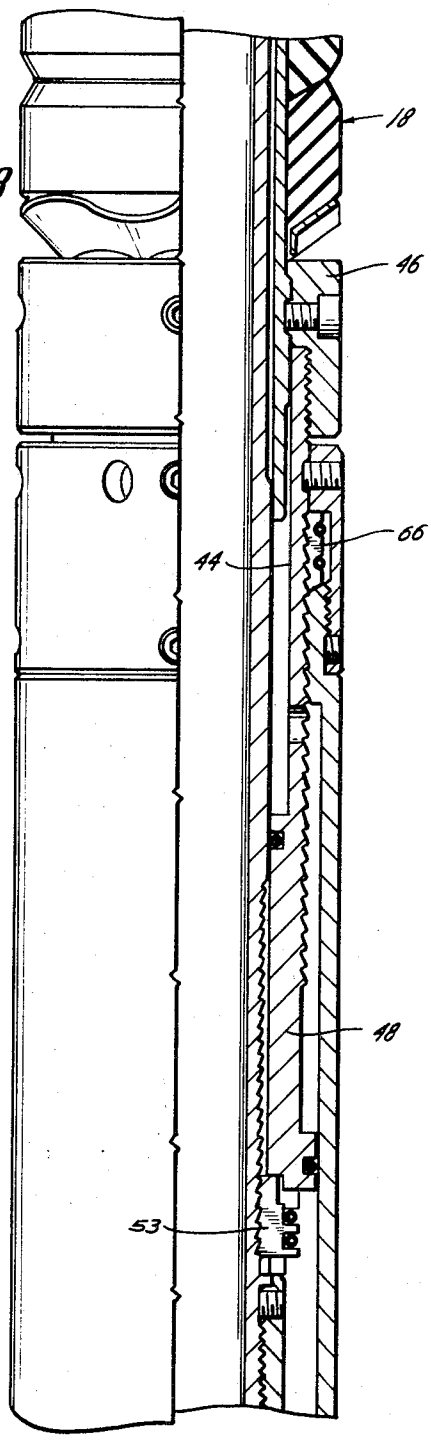


Fig. 1B



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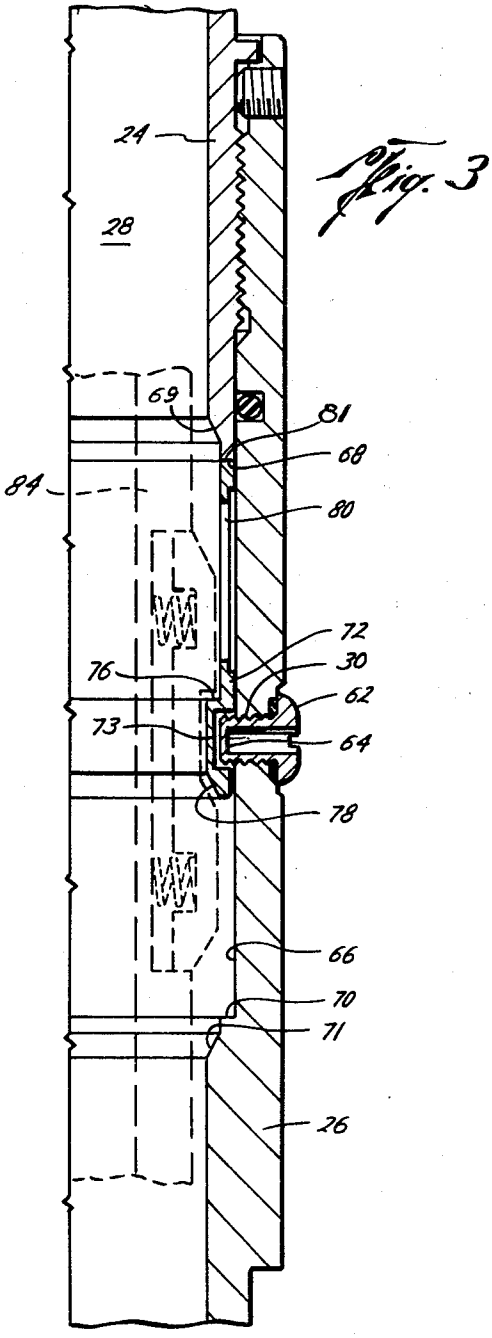

Fig. 3

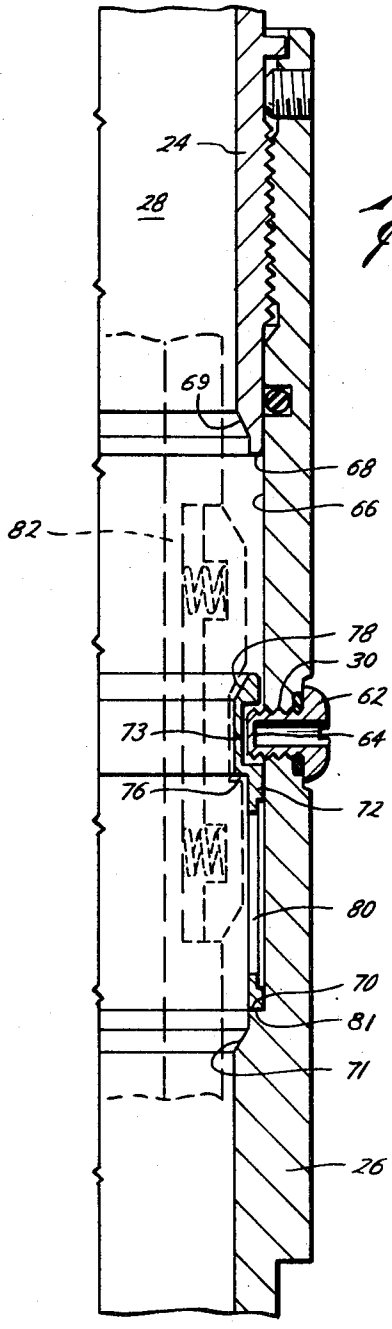

Fig. 2

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Fig. 1C

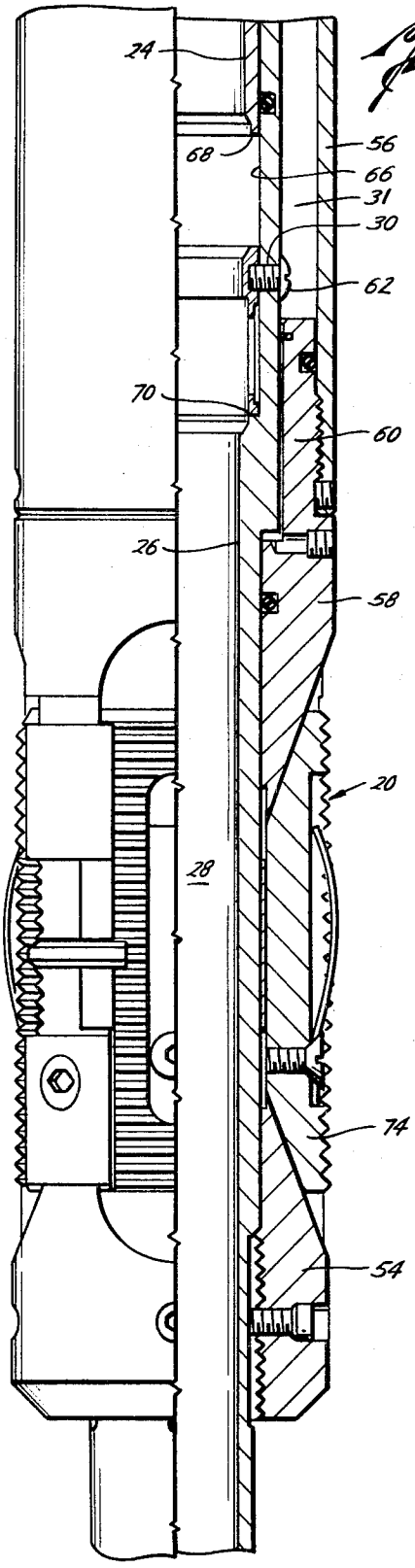
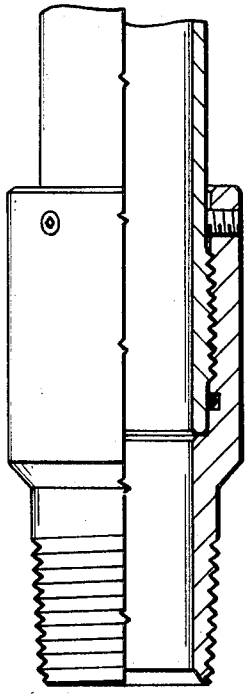


Fig. 1D



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SLIDING SLEEVE ASSEMBLY FOR A HYDRAULICALLY SET WELL PACKER

BACKGROUND OF THE INVENTION

Hydraulically set well packers, such as shown in U.S. Pat. No. 3,456,723, are old. And the use of sliding sleeves initially covering the setting port in order to prevent premature setting of the packer, such as when packers are used in tandem spaced one below another, is old. However, for various reasons, it may be preferred to actuate the sliding sleeve by either an upward movement or a downward movement. In the past this has required separate packers depending upon the mode of actuation desired.

The present invention is directed to the improvement in a sliding sleeve assembly which may be reversibly positioned in the packer for actuation in either an upwardly or downwardly position as desired whereby a single packer model may be used regardless of the mode of actuation.

SUMMARY

The present invention is directed to an improvement in a sliding sleeve assembly for opening of the setting port of a hydraulically set well packer which may be positioned in the packer for actuation in either an upwardly or downwardly position.

Another object of the present invention is the provision of a reversible sliding sleeve assembly having a shearable plug initially blocking the setting port and an elongate recess in the packer body extending an equal distance on either side of the setting port with a shoulder at each end of the recess with a sliding sleeve telescopically positioned in the recess and in engagement with the plug whereby when the sleeve is longitudinally shifted the plug is sheared opening the setting port. One end of the sleeve extends from the axis of the port a distance equal to one-half the length of the recess whereby said one end of the sleeve is in engagement with one of the shoulders at the end of the recess so that the sleeve may be positioned in the recess for actuation in either the upwardly or downwardly direction, but the sleeve and abutting shoulder will prevent accidental shearing of the setting plug in the opposite direction.

A still further object of the present invention is the improvement of a reversible sliding sleeve assembly wherein the sleeve includes an actuating shoulder positioned on one side of the setting plug when the sleeve is in engagement with the plug and includes a wedge-shaped shoulder on the second side of the plug protecting the plug from, but allowing easy passage of, a setting tool through the sleeve.

A further object of the present invention is the improvement of a reversible setting sleeve assembly wherein the shoulders at the end of the recess include tapered surfaces retracting the setting sleeve after the sleeve has been shifted and the plug sheared.

Other and further features and advantages will be apparent from the description of the structure and operation of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A, 1B, 1C and 1D are fragmentary elevational views, partly in cross section, illustrating one type of hydraulically set well packer utilizing the present invention which drawings are a continuation of each other,

FIG. 2 is an enlarged fragmentary elevational view, in cross section, showing the reversible sliding sleeve assembly of the present invention in position for actuation by upward movement, and

FIG. 3 is an enlarged fragmentary cross-sectional view of the reversible sliding sleeve assembly of the present invention in position for actuation in a downward direction.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will be described, for convenience only, as applied to the hydraulic set packer described in U.S. Pat. No. 3,456,723 although it is to be understood that the present invention may be utilized in any suitable hydraulic set-type packer.

Referring now to the drawings, and particularly to FIGS. 1A through 1D, the packer of the present invention is generally indicated by the numeral **10**. The packer **10** includes the usual packer seal means generally indicated by the numeral **18** and a slip assembly generally indicated by the numeral **20**, both of which are shown in their retracted positions. The packer **10** also includes a mandrel **22**, which for convenience includes an upper portion **24** and a lower portion **26** secured together, and internal passageway **28** in communication with a running in string (not shown) for receiving hydraulic fluid to set the packer and includes at least one setting port **30** for passage of the hydraulic pressure for setting the slip assembly **20** and the packer seal means **18**.

A lower slip cone **54** is provided secured to the mandrel **26** and positioned against the lower end of the slips **74** of the slip assembly **20**. A hydraulically actuated slip expanding means which includes slip setting sleeve **56** is provided above the slip assembly **20** and includes an upper movable slip cone **58** and a piston **60** which is exposed to hydraulic pressure in a chamber **31** which communicates with port **30** for actuation of the piston **60** for expanding the slip assembly outwardly and into engagement with a well casing (not shown).

A hydraulically actuated packer seal expanding means includes packer seal setting sleeve **44**, the upper end **46** of which is positioned adjacent the bottom of the seal means **18**, and the lower end of which is provided with a piston **48** and which is exposed to hydraulic pressure in the chamber **31** for movement upwardly against the packer seal means **18** for setting the seal **18**.

A one-way clutch **66** is provided between the slip setting sleeve **56** and sleeve **44** and a one-way clutch **53** is provided between the sleeve **44** and the mandrel **24** allowing the slip assembly **20** to be expanded and locked in position and to allow the packer seal means **18** to be expanded and locked in the expanded position.

Thus, hydraulic pressure may be applied through the passageway **28** and through the setting port **30** and against both of the pistons **48** and **60** for allowing the slip setting sleeve **56** to move downwardly carrying the upper slip cone **58** to expand the slip assembly **20** into setting engagement and after which the seal setting sleeve **44** is moved upwardly to compress and expand the packer seal means **18** outwardly into a sealing relationship. The above named description and operation is more fully described in U.S. Pat. No. 3,456,723.

While, of course, the setting port **30** may be opened at all times if desired, a sliding sleeve means for initially blocking the port **30** may be provided to initially close the setting port **30** and after the packer is placed in position a setting or shifting tool is passed to the packer to shift the sliding sleeve to uncover the port for setting the packer. Sometimes it is desirous to move the sliding sleeve in a particular direction. For example, a stronger upward jar may be obtained for moving the sleeve upwardly than downwardly. However, if all of the sliding sleeves in a tandem installation are set for upwardly movement and the lower most packer is set first and fails to obtain a good seal, which requires the entire tandem installation to be removed, the upwardly setting shifting tool will open the ports of all of the upper packers as it is withdrawn from the tubing string, and necessitate redressing all the packers which is undesirable. This can be avoided by providing packer setting port sliding sleeves in a tandem installation which are actuated by a downward movement.

But since the prime purpose of a packer of the type described in this invention when used in tandem installations is to provide means to set and test the lowermost packer first and then set and test the second lowermost packer, etc., up

the hole, a shifting tool such as an Otis Model B retractable shifting tool assembly may be utilized and provided with means to allow the tool to be initially passed downwardly through the upper packers without shifting the sliding sleeves downward but upon manipulation of the shifting tool lowering in means will activate the shifting tool into the downwardly shifting configuration. In this case, should one of the lowermost packers not set properly, the shifting tool may be withdrawn from the tubing string without disturbing the packer setting port sliding sleeves in the upper packers. However, it can be appreciated that the shifting tool for operating more than one packer sliding sleeve in a downward direction in a sequence from the lowermost packer upward is complicated to operate. Therefore, it is desirable to have hydraulically set packers with sliding sleeves that may be actuated downwardly and some packers that are actuated by an upward shifting movement of the sleeve. In the past, it has been necessary for an operator to carry one inventory of packers which will be operable by downward movement and a second inventory of packers which will be operable by an upwardly releasing sliding sleeve in order to provide packers which will be operable in the desired direction. Patent application entitled Sliding Sleeve Assembly for a Hydraulically Set Well Packer filed concurrently herewith by James H. Current and Marion D. Kilgore, discloses one type of sliding sleeve assembly which may be positioned in a packer for shifting to an open position by either upward or downward actuation.

The present invention is directed to providing a sliding sleeve assembly which may be reversibly positioned in the packer for shifting to an open position by either upward or downward actuation.

Referring now to FIGS. 1C, 2 and 3, a shearable plug **62** may be provided in the setting port **30**. The plug **62** is preferably hollow and thus when the plug end **64** is sheared the fluid may flow from the internal passageway **28** in the packer into the chamber **31** for actuating the packer. The internal passageway **28** of the packer includes an elongate tubular recess **66** which may be formed between the ends of mandrel sections **24** and **26**. A shoulder **68** and **70** are provided at opposite ends of the recess **66** and a sliding sleeve **72** is telescopically positioned in the recess **66** for movement therein. Initially, the sliding sleeve **72** is in engagement with the shearable setting plug **62**, here shown as the plug **62** being in an annular groove **73** in the sleeve **72**. Thus, as the sliding sleeve **72** is shifted longitudinally, the end **64** of the setting plug **62** is sheared to open the port **30** to set the packer.

It is to be noted that the shoulders **68** and **70** at the ends of the recess **66** are both equal distance from the axis of the setting port **30** and that one end **81** of the setting sleeve **72** extends from the axis of the setting port **30** a distance equal to one-half of the length of the recess **66** thereby engaging one of the shoulders **68** or **70** at the ends of the recess **66** when the sleeve **72** is in engagement with the setting plug **62**. Thus, and referring to FIGS. **2** and **3**, the setting sleeve **72** may be positioned for a sliding movement in the recess **66** in a longitudinal direction, either upwardly or downwardly as desired, without requiring any change in the remainder of the packer **10**.

The sliding sleeve **72** includes an actuating shoulder **76** which is preferably positioned on a first side of the setting plug **62** and a wedge-shaped or tapered shoulder **78** on the second side of the plug **62** which protects the plug from accidental shearing by a setting tool and aids in guiding the setting tool through the sleeve **72**.

It is to be noted that since the shoulder **81** of the setting sleeve engages one of the shoulders **68** and **70**, the sleeve **72** is prevented from movement in the nonsetting direction and thus avoids any accidental shearing of the setting plug by the passage of the tools through the setting sleeve **72**.

The shoulders **68** and **70** at the end of the recess **66** may also include tapered surfaces **69** and **71**, respectively, which act on the setting tool and assist in disengaging the setting tool from the sliding sleeve **72** after the sleeve **72** has been shifted. The sleeve **72** may also include an opening **80** through the wall which is positioned to be aligned with the port **30** when the sleeve **72** is shifted to its new position for more easily allowing the flow of hydraulic fluid into the port **30**.

In use, the setting sleeve **72** may be assembled when the packer **10** is assembled either in the position shown in FIG. **2** in which the setting sleeve is actuated by a sliding upward movement, or as shown in FIG. **3**, in which the setting sleeve **72** is actuated by a downward movement.

Referring now to FIG. **2**, a conventional shifting tool, such as Otis Model B, is shown in dotted outline as **82** which may be passed downwardly through the setting sleeve **72** and thereafter released as is conventional so that on upward movement the shifting tool **82** will engage shoulder **76** and on an upward jar will shear shearable plug **62** and the sleeve **72** will be moved upwardly allowing opening **80** to be aligned with the port **30**. Upon upward shifting of the sleeve **72** fluid from the internal passageway **28** in the packer **10** will flow through the sheared plug **62** and set the packer **10**. It is to be noted that when the shifting tool moves downwardly through the sleeve **72** it will engage the tapered shoulder **78** which prevents the setting plug **62** from being accidentally sheared by downward movement of the setting tool **82**.

Furthermore, since the setting sleeve **72** is in abutment with one of the shoulders **68** and **70** at the end of the recess **66**, the sleeve **72** will not be accidentally moved downwardly by the shifting tool **82** to accidentally shear plug **62**. After the sleeve **72** shifts to an upward position, the tapered shoulder **69** will contact and retract the shifting tool **82** thereby releasing the tool **82** from the shoulder **76** on the setting sleeve **72**.

The downwardly moving setting sleeve **72**, as best seen in FIG. **3**, is actuated by a shifting tool **84** shown in dotted outline, which may be a conventional shifting tool such as an Otis Model B, or a modification thereof, which on downward movement through passageway **28** will engage the actuating shoulder **76** on sleeve **72** and upon jarring the tool **84** the sleeve **72** will shear the setting plug **62** allowing hydraulic fluid pressure to flow from the passageway **28** through port **30** to actuate and set the packer.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned as well as others inherent therein.

What is claimed is:

1. In a hydraulically set well packer having a setting port in communication with an internal passageway the improvement in a sliding sleeve assembly for opening the port comprising,

means initially blocking the setting port,

said internal passageway including an elongate recess extending equidistance on either side of the setting port,

a shoulder at each end of the recess,

a sliding sleeve telescopically positioned in the recess and in engagement with the initially blocking means whereby when the sleeve is longitudinally moved the initially blocking means is opened,

said sleeve including an actuating shoulder facing in one direction for engagement by a shifting tool for moving the sleeve in the second direction,

one end of the sleeve extending from the axis of the port a distance equal to one-half the length of recess whereby said end will engage one of the shoulders at the end of the recess when the sleeve is in engagement with the initially blocking means and said sleeve may be positioned in the recess for actuation of the sleeve in either the first or second direction.

2. The apparatus of claim **1** wherein the sleeve includes an opening through the wall positioned to be aligned with the port when the sleeve is actuated.

3. The apparatus of claim **1** wherein the shoulders at the ends of the recess include tapered surfaces retracting a setting tool after the sleeve has been shifted.

4. The apparatus of claim **1** wherein said initially blocking means is a shearable plug.

5. The apparatus of claim **4** wherein the actuating shoulder on the sleeve is positioned on one side of the plug when the sleeve is in engagement with the plug and including,

a wedge-shaped shoulder on the second side of the plug protecting the plug from but allowing easy passage of a setting tool in said one direction.

* * * * *