May 2, 1967 J. R. BROWN 3,316,971

SAND TRAP FOR USE IN WELL BORES

Filed Feb. 12, 1965 2 Sheets-Sheet 1

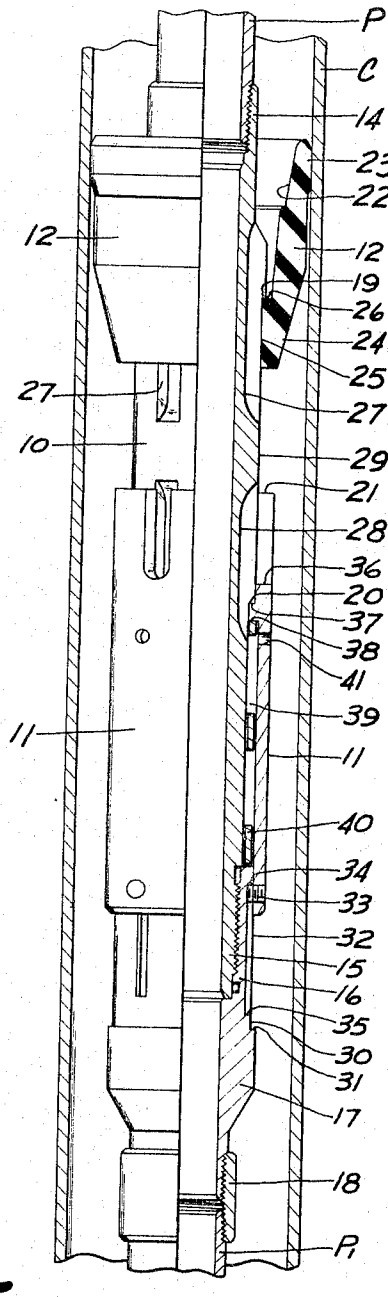

Fig. 1

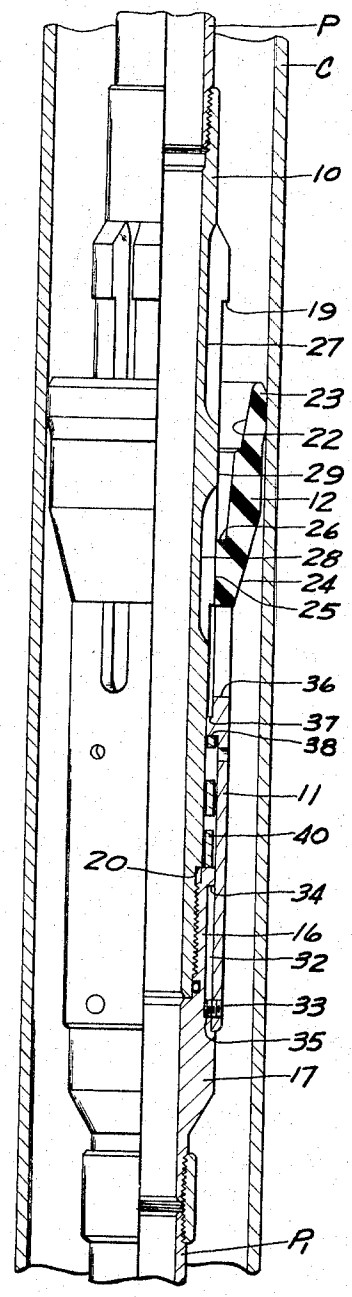

Fig. 2

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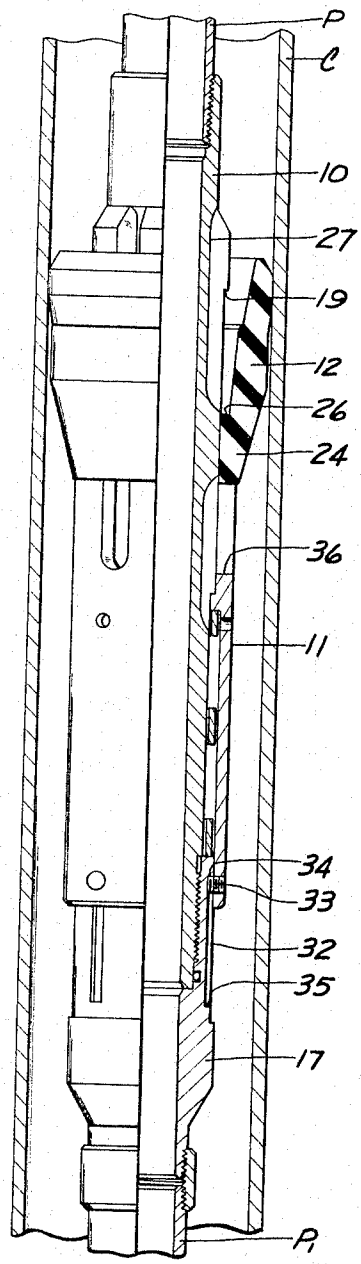

Fig. 3

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SAND TRAP FOR USE IN WELL BORES

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6 Claims. (Cl. 166—99)

This invention relates to improvements in sand traps, junk catchers or the like, for use in well bores.

In the operation of wells, such as oil and gas wells, which employ pipe strings carrying various types of tools positioned inside a well casing, the accumulation of sand and other detritus settling down on top of the well tools in the well bore frequently creates a severe problem in connection with the removal of well strings and the tools carried thereon.

To meet this problem, various types of sand traps, junk catchers or the like have been designed for installation in the pipe string above the tools, which are more commonly well packers, anchors, down-well pumps, and the like. These prior art traps have generally been rather complicated in construction, frequently requiring varied manipulations of the pipe strings in order to release them for removal and have been generally inefficient in their primary purpose of trapping sand settlings and other detritus while permitting the pipe string and attached tools to be removed from the well when necessary.

Accordingly, it is a primary object of this invention to provide a greatly simplified, economical design of trap which obviates the disadvantages of prior designs and which is highly effective both for preventing accumulation of settlings and detritus on the well tools and for ready release when it is necessary to remove the pipe string and the tool supported thereon.

An important object is the provision of a trap construction which is operated entirely by longitudinal movements of the supporting pipe string.

A more specific object is the provision of a trap structure employing an upwardly facing, flexible cup-type catcher element slidably disposed for relative longitudinal movement on a mandrel having by-pass passages and effective, in response to said longitudinal movement, to open and close said by-pass passages, the catcher element being operative in the closed position of the passages to seal the annular space between the pipe string and the well bore wall.

Other and more specific objects of this invention will become more readily apparent from the following detailed description when read in conjunction with the accompanying drawing which illustrates a useful embodiment in accordance with this invention.

In the drawing:

FIG. 1 is a longitudinal, quarter sectional view of the trap apparatus illustrating the positions occupied by the parts as the device is being run into a well;

FIG. 2 is a view similar to FIG. 1 showing the positions of the parts when the device is being withdrawn from the well; and

FIG. 3 is a view similar to FIGS. 1 and 2 showing the parts in the position occupied when the catcher element is in sealing position in the well.

Referring to the drawing, the device comprises a tubular mandrel **10**, a positioning sleeve **11** slidably mounted about the mandrel, and an upwardly facing cup-type trap or catcher element **12** slidably mounted on the upper portion of mandrel **10** above positioning sleeve **11**.

Mandrel **10** is adapted to be installed between upper and lower sections P and P', respectively, of a tubing string which extends into the bore of a well casing C. The upper end of mandrel **10** has a threaded socket **14** for receiving the lower end of upper pipe section P and has an externally threaded lower end portion **15** receivable in the upper portion **16** of a tubular sub or adapter **17**, the lower end of which is threaded for connection to lower pipe section P' by a conventional collar **18**, or the like.

The exterior of mandrel **10** is reduced in diameter in a series of steps beginning at a point near the upper end thereof where the first reduction defines the annular, downwardly facing shoulder **19**; the second reduction in diameter is at an intermediate point along the mandrel and defines the downwardly facing annular shoulder **20** (best seen in FIG. 2); and the third reduction in diameter occurs near the lower end of the mandrel defining the exteriorly threaded lower pin portion **15**.

Catcher element **12** is slidably disposed on the portion of mandrel **10** below shoulder **19** and above upper end face **21** of positioning sleeve **11**. Shoulders **19** and **21** thus provide the limits for relative longitudinal travel between the mandrel and catcher element **12**.

Catcher element **12** is of a generally conventional cup-shaped configuration having its mouth portion **22** opening upwardly and defined by the flexible lip **23** which is dimensioned to normally be in slidable engagement with the bore wall of casing C. The lower end portion of catcher element **12** comprises the base section **24** having an axial bore **25** dimensioned to slidably fit closely about the exterior of mandrel **10** extending between shoulders **19** and **20**. The upper face of base section **24** defines an upwardly facing annular shoulder **26** adapted to abut shoulder **19** for limiting upward movement of ctacher element **12** relative to the mandrel.

Mandrel **10** has a series of angularly spaced longitudinal grooves **27** in the outer periphery thereof which open to the exterior of the mandrel above shoulder **19** and to a point which will be below the lower end of catcher element **12** when the latter is in its uppermost position, shown in FIG. 1. A second series of angularly spaced, longitudinal grooves **28** are provided in the exterior of mandrel **10** extending from a point spaced below the lower ends of grooves **27** to a point a short distance below shoulder **20**. The portion of mandrel **10** extending between the lower ends of grooves **27** and the upper ends of grooves **28** constitutes a cylindrical sealing area **29** adapted to provide a non-slotted surface which is disposed for sealing engagement by base portion **24** of the catcher element, as will appear subsequently.

The lower end of positioning sleeve **11** is slidably disposed over the upper reduced diameter portion **30** of adapter **17** which defines the upwardly facing shoulder **31** adapted to form a stop for the lower end of sleeve **11** in its longitudinal movements relative to the mandrel. Reduced portion **30** is provided with a series of angularly spaced, longitudinally extending grooves **32** adapted to receive guide pins **33** projecting inwardly from the lower end of sleeve **11**. The upper and lower ends of grooves **32** are defined by walls forming shoulders **34** and **35**, respectively, and are adapted to be engaged by guide pins **33** to limit the relative longitudinal travel of sleeve **11**. The upper end of sleeve **11** is provided with a plurality of angularly spaced, vertically extending slots **36**

which open through the upper end of the sleeve and are angularly positioned to be substantially in register with grooves **28** in the mandrel. Sleeve **11** is provided at a point just below the lower ends of slots **36** with an inwardly extending annular enlargement defining an upwardly facing shoulder **37** and a downwardly facing shoulder **38**. Upwardly facing shoulder **37** is adapted to be engaged by shoulder **20** on the exterior of the mandrel for limiting upward movement of sleeve **11** relative to the mandrel. The radial dimensions of mandrel **10** and sleeve **11** are made such as to define an annular space **39** between the sleeve and the mandrel between shoulder **38** and the upper end of adapter portion **16**. A coil spring **40** is disposed in compression in annular space **39**, having its opposite ends bearing, respectively, against shoulder **38** and the upper end of adapter portion **16**, whereby to normally bias sleeve **11** upwardly relative to mandrel **10**. Sleeve **11** is provided with a plurality of vent or relief ports **41** through the wall thereof below shoulder **38** to prevent trapping of fluid in the annular space during relative movement of the sleeve.

In operation, the device will be installed between pipe sections P and P', as shown in FIG. 1, and will be run into a well bore. It will be understood that other tools, such as packers, anchors, down-well pumps, and and the like will be mounted below the trap device on pipe section P'. When the pipe string is run into the well carrying the trap structure, the friction between lip **23** of the catcher element and the well wall, as represented by casing C, will restrain the catcher element sufficiently to allow shoulder **19** on the mandrel to engage shoulder **26** of the catcher element, pushing the latter downwardly with the pipe string. The force of spring **40** will hold sleeve **11** in its upward position, also as shown in FIG. 1. With the parts in the position shown in FIG. 1, it will be seen that grooves **27** will extend from below catcher element **12** to points above base **24** of the latter so as to provide a plurality of by-pass passageways through the catcher element for fluid encountered in lowering the tools into the well bore.

When the tool string has attained its desired position in the well, catcher element **12** will settle down along the mandrel under its own weight and the weight of any fluid thereabove until the lower end of base section **24** comes into contact with end face **21** of the sealing sleeve. At this point, it will be seen that base **24** will be opposite and surrounding the non-slotted section **29** of the mandrel and will form a seal therewith, as best seen in FIG. 3. Thus, any sand or other detritus settling down from above will be trapped in catcher element **12**, since the latter will have sealed off between portion **29** and the wall of casing C. Thus, no such settlings or detritus can pass below the catcher element and will thereby be kept off of the equipment or tools in the well below the catcher element.

When it is desired to pull the pipe string and its supported equipment from the well, an upward force applied to the pipe string will pull mandrel **10** upwardly relative to catcher element **12** which will be frictionally held against the wall of casing C by the load of settlings trapped therein. This relative upward movement of the mandrel will move the latter upwardly until upper end face **21** of positioning sleeve **11** abuts the lower end of the catcher element, as seen in FIG. 2. Continued upward movement of the pipe string will move the mandrel upwardly relative to sleeve **11** compressing spring **40** because of the resistance offered by catcher **12** seated on the upper end of the sleeve, until guide pins **33** engage bottom shoulders **35** of grooves **32**. This terminates upward movement of the mandrel relative to catcher element **12** and positioning sleeve **11**. At this point, it will be seen that grooves **28** now form by-pass passages around base portion **24** of the catcher element so that as the tool string is drawn upwardly through casing C fluid above catcher element **12** will by-pass the latter through grooves **28** to the annular space below the catcher element, the lower ends of grooves **28** being in communication with slots **36** in the upper end of sleeve **11**. While some very fine sand may pass downwardly through the by-pass passages when grooves **28** are thus opened, this will generally not be sufficient to interfere with the removal of the tool string as the slots will ordinarily be dimensioned to prevent the passage of larger fragments which might otherwise prevent release of the tool string.

From the foregoing, it will be seen that this device provides a comparatively simple, easily operated, and efficient sand trap or junk catcher having the various advantages noted previously.

It will be understood that various changes and modifications may be made in the details of the illustrative embodiment within the scope of the appended claims but without departing from the spirit of this invention.

What I claim and desire to secure by Letters Patent is:

1. A device for trapping detritus settling in a well bore, comprising, a tubular mandrel connectible into a well pipe string to form a part thereof, longitudinally spaced-apart upper and lower elongate groove means in the exterior of said mandrel, a non-grooved cylindrical sealing section separating said upper and lower groove means, an upwardly facing cup-shaped catcher element slidably disposed on the mandrel for relative longitudinal movement thereon between an upper by-pass position opposite said upper groove means, an intermediate position about said sealing section, and a lower by-pass position opposite said lower groove means, a positioning sleeve means longitudinally slidably disposed about said mandrel below said catcher element for movement between an upper position adapted to stop said catcher element at said intermediate position and a lower position permitting the catcher element to attain said lower by-pass position, means resiliently biasing said sleeve means toward said upper position, and means limiting relative upward movement of said catcher element to said upper by-pass position.

2. A device according to claim **1** wherein said catcher element includes a flexible lip portion about its upper end slidably engageable with a surrounding well wall, and a base portion having an axial bore adapted for close fitting engagement about said sealing section.

3. A device according to claim **1** wherein said last-mentioned means comprises cooperating shoulders on said mandrel and said catcher element abuttable upon attainment by the catcher element of said upper by-pass position.

4. A device for trapping detritus settling in a well bore, comprising, a tubular mandrel connectible into a well pipe string to form a part thereof, longitudinally spaced-apart upper and lower elongate groove means in the exterior of said mandrel, a non-grooved cylindrical sealing section separating said upper and lower groove means, an upwardly facing cup-shaped catcher element slidably disposed on the mandrel for relative longitudinal movement thereon between an upper by-pass position opposite said upper groove means, an intermediate position about said sealing section, and a lower by-pass position opposite said lower groove means, a positioning sleeve means longitudinally slidably disposed about said mandrel below said catcher element for movement between an upper position adapted to stop said catcher element at said intermediate position and a lower position permitting the catcher element to attain said lower by-pass position, means resiliently biasing said sleeve means toward said upper position, means limiting relative upward movement of said catcher element to said upper by-pass position, and means limiting the movement of said sleeve means to said upper and lower positions.

5. A device according to claim **4** wherein said catcher element includes an outwardly flaring flexible lip portion

about its upper end adapted to slidably engage a surrounding well wall, and a base portion having an axial bore adapted for close fitting engagement about said sealing section, said base portion having a length less than that of said upper grooves, and wherein said means limiting relative upward movement of said catcher element comprises cooperating shoulders on said mandrel and said catcher element abuttable upon attainment by the catcher element of said upper by-pass position.

6. A device according to claim 4 wherein the upper end portion of said sleeve means is provided with openings registering with said lower groove means at both said upper and lower positions.

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