Aug. 28, 1951 J. H. McCARVELL 2,565,736

WELL TOOL

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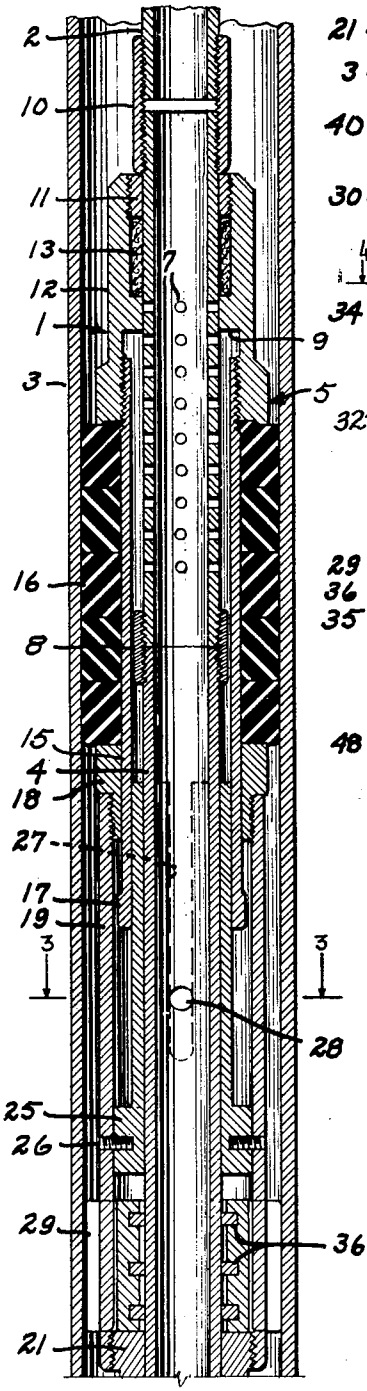


Fig. 1

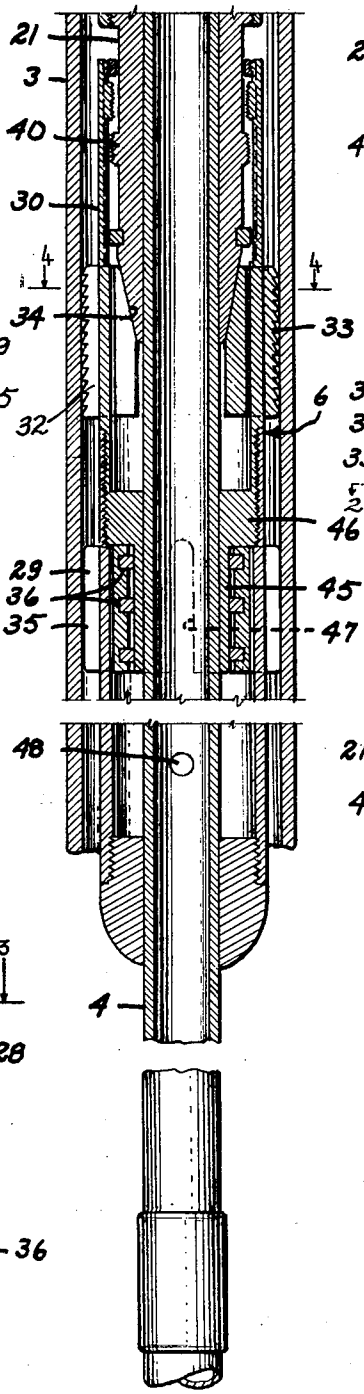


Fig. 2

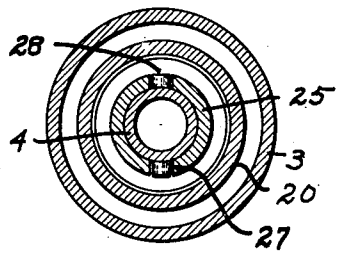


Fig. 3

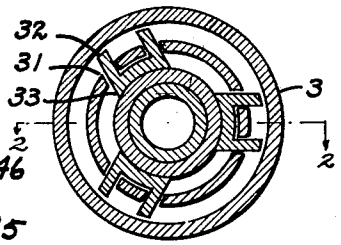


Fig. 4

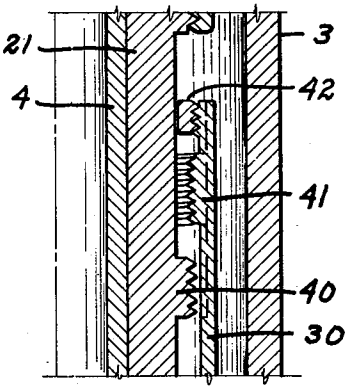


Fig. 5

JOHN H. McCARVELL
INVENTOR
BY Lester B. Clark
Ray L. Smith
ATTORNEYS

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WELL TOOL

John H. McCarvell, Houston, Tex.

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This invention relates to new and useful improvements in well tools, and more particularly to a tool which is adapted to be lowered into a well upon an operating string and set within the well to enable conditioning or production operations to be carried out.

It is the primary object of the invention to provide a tool that may be readily set in a well and which may thereafter be released and reset or withdrawn from the well with equal facility.

Another and important object is to provide a tool that may be set and released by rotation of the operating string, the tool being so constructed that unidirectional rotation of the string may be used, and hence the hazards incident to reverse rotation of such a string are avoided.

A further object is to provide in one form of the invention a tool which comprises packer and anchor sections and means for interconnecting and disconnecting such sections so that the packer may be set and released as desired.

A still further object is to provide a well tool which includes means for restraining the rotation of the respective sections thereof within a casing in which the tool is to be set or released.

Still another object is to provide a tool having means for freely by-passing fluids within the well, and to permit forced circulation of fluids while the tool is being lowered or lifted within the well.

The foregoing are the principal objects, which together with further objects and advantages of the invention, will be more fully apparent from the following description considered in connection with the accompanying drawings in which:

Fig. 1 is a vertical sectional view of the upper portion of a tool embodying the invention;

Fig. 2 is a similar view showing the lower portion of the tool and is a continuation of the structure shown in Fig. 1;

Fig. 3 is a sectional view taken on line 3—3 in Fig. 1;

Fig. 4 is a sectional view taken on line 4—4 in Fig. 2;

Fig. 5 is an enlarged detail showing the manner of providing a threaded connection between the upper and lower sections of the tool.

The invention as shown in the embodiment of the drawings comprises a tool 1 which may be lowered and operated by the operating string 2 within the casing 3. The tool includes a tubular body 4 connected into the operating string 2 as a part thereof, surrounded by the upper packer section or assembly 5 and the lower slip or anchor section or assembly 6.

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The body 4 is attached to the operating string 2 by coupling or collar 10 which also serves as a pressure member by engagement with the jamb nut 11 in the upper end of the head 12 with which the coupling makes engagement. The nut 11 also serves as a gland to hold the packing 13 in sealing relation with the body 4. A packer sleeve 15 is threadedly attached to the head 12 and extends downwardly therefrom to complete the upper member of the upper assembly 5. One or more packing rings 16 are positioned upon this sleeve and are adapted to be expanded to form a seal with the casing 3, as will be more fully apparent.

The lower end of the sleeve 15 has a peripheral shoulder 17 to determine the limit of downward movement of the top collar 18 which slidably surrounds the sleeve and which, together with the head 12, is instrumental in effecting desired expansion of the rings 16. This collar is attached to the top of the tubular extension 19 which is in turn threadedly connected to the upper end of a mandrel 21.

A drive sleeve 25 slidably surrounds the body 4 and is attached to the extension 19 in any suitable manner, as by the screws 26. The collar 18, extension 19, drive sleeve 25, and mandrel 21 thus comprise the lower member of the upper assembly 5, so that the upper end of the sleeve 25 moves telescopically between the body 4 and the packer sleeve 15, and has axially extending slots 27 which are adapted to receive projections 28 on the body 4 when the tool parts are in the relative positions shown in the drawings, and as best seen in Fig. 3. The mandrel 21 extends downwardly into the lower assembly, which may be termed the slip or anchor section 6 which section includes a tubular member or sleeve 30 having radial openings 31 to receive the jaw portion 32 of slips or jaws 33 which are U-shaped in cross section. These slips have inner tapered surfaces 34 which are engageable by a complementary tapered surface at the lower end of the mandrel 21 so that relative axial movement of the sections 5 and 6 will cause the slips 33 to move outwardly into engagement with the casing 2.

The upper section or packer assembly 5 and the lower section or anchor assembly 6 are provided with drag assemblies which are referred to as 29. Each of these assemblies comprises segmented drag members 35 which are likewise U-shaped in cross section, similar to the slips 32, and have the leg portions thereof extending through openings in the members 19 and 30 respectively. These members are constantly urged outwardly into frictional engagement with

the casing 3 by means of a plurality of spring rings 36 positioned in complementary annular grooves within the members 35. It seems aparent that the engagement of the drag members 35 with the interior of the casing 3 tends to resist rotation of the respective tool sections 5 and 6 within the casing, thereby serving a purpose that will more fully appear in the description of the operation of the device.

In order to provide the desired connection between the sections 5 and 6, the mandrel 21 is provided with threaded area 40 which is adapted to engage complementary threads on the interior of the member 30 of the lower section 6. To facilitate the making up of this connection, the member 30 is provided with a splined nut 41 at its upper end, such nut being held within the member by means of a jamb nut 42.

Below the slip assembly the lower section 6 is provided with a drive sleeve 45 which is secured to the member 30 by a threaded connection with the flanged portion 46 thereof. This sleeve is slotted at 47 to receive projections 48 on the body 4 so that a driving connection may be had between the body and the tool section 6.

The operation of the construction described is believed apparent. By way of summary it will be assumed that the parts of the device are in desired relative positions when lowering the tool into a well bore. At such time the projections 28 on the body 4 are at the upper end of the upper drive sleeve 25. At such time it is to be noted that the openings 7 in the body 4 are above the head 12, and in this manner any fluid trapped below the tool may pass upwardly through the bore of the body 4, and thence outwardly into the casing 3. During such lowering operation the threaded areas upon the mandrel 21, and the member 30 are interconnected so that the mandrel and the slips 33 are held in spaced relation, and engagement of the slips with the casing 3 is prevented.

When the tool has been lowered to the desired position, the body 4 is rotated by means of the operating string 2 until the projections 28 enter the slots 27 on the sleeve 25. Thereupon the operating string is rotated in a clockwise direction to disconnect the threaded connection between the upper and lower sections 5 and 6. The operating string is then moved downwardly until the collar 10 engages the upper end of the packer assembly 5. Further downward movement then causes the tapered surface 34 of the mandrel 21 to force the slips 33 outwardly into engagement with the casing 3. Continued lowering of the operating string 2 and the application of weight thereof to the head 12 effects desired expansion of the packer rings 16 whereby the tool is set at the desired position.

It is to be noted that the lowering of the operating string 2 in the manner just indicated, to the position shown in the drawings, moves the openings 7 in the body 4 to a location below the packing 13 in the head 12. Hence the tool is effective in closing the passage through the casing 3 except for the continuous bore through the body 4 and the operating string 2.

In event it is necessary to change the location of the tool 1, or to remove the tool from the well bore, the operating string 2 is lifted until the projections 48 on the body enter the slot 47 in the driving sleeve 45. During this lifting step the lift collar 8 on the body 4 engages the shoulder 9 within the head 12 whereby the upper section 5 is lifted, and the threaded areas on the mandrel 21 and the member 30 are moved to a position to be reconnected. Further rotation of the operating string 2 in a clockwise direction will effect such reconnection, whereupon the tool may be either lifted or lowered to a desired position, and reset or, if desired, may be withdrawn from the well.

While the invention has been described in detail as embodied in a combination packer and anchor tool, it is to be understood that the invention is not confined thereto, but is applicable in other types of tool in which assemblies are to be interconnected or disconnected at will by unidirectional rotation of the operating string to which the tool is attached.

Broadly the invention comprehends a well tool which may be lowered into a well, and readily set at a desired position therein, such tool being so constructed that it may with equal facility be released and reset or withdrawn from the well as desired.

The invention claimed is:

1. In a device of the class described, a jaw carrying member, there being spaced slots in said member, a jaw of U-shaped cross section having the legs thereof extending through said slots, and means for urging said jaw radially of said member so that the jaw surfaces extending beyond the member are moved outwardly for engagement with a proximate surface.

2. In a device of the class described, a jaw carrying member having paired slots therein, a plurality of jaws of U-shaped cross section each having the legs thereof passing through the slots of a pair, and means urging the jaws toward the member so that the portion of the jaws protruding through the member are moved into engagement with a proximate surface, said means comprising expansible rings resiliently engaging the bottoms of said jaws.

3. In a device of the class described, a drag assembly including a tubular member having paired slots therein, a drag jaw of U-shaped cross section mounted in each of said pairs of slots with their drag surfaces extending beyond the surface of the member, and means engaging the inner surfaces of said jaws to urge the jaws into dragging contact with a sourrounding surface.

4. In a device of the class described, a drag assembly including a tubular member having paired slots therein, a drag jaw of U-shaped cross section mounted in each of said pairs of slots, annular groove segments on the inner faces of said jaws, and resiliently expansible rings in said groove segments and urging the jaws outwardly for engagement with a surface exteriorly of said member.

5. In a well tool, the combination of a tubular body adapted for connection to the well operating string, said body having a top collar and spaced successively therebelow on its exterior, a lift collar and vertically spaced apart projections, a tubular upper assembly slidable on said body including, a lower, externally slotted tubular member having a top collar with an internal shoulder and successively spaced therebelow on said member, an outwardly urged friction means engageable with the well bore wall, an externally threaded area, and a downwardly tapered lower end, the slots in said lower member extending longitudinally of and opening upwardly through the upper end of the member, and an internally shouldered upper member terminating downwardly in a peripherally shoul-

dered lower end within and slidably connecting said upper member with said lower member, said upper member having packer means therearound above said lower member, and a tubular, slotted lower assembly slidable on said body and extending below said upper assembly and including a tubular structure having an internally threaded area threadedly engageable with said externally threaded area on said lower member of said upper assembly, and spaced successively therebelow in said tubular structure, radial openings and slips slidably extending through said openings and internally tapered to coincide with said tapered lower end, and outwardly urged friction means on said tubular structure engageable with the well bore wall, slots in said tubular structure opening downwardly thereof, said internal shoulder on said upper member being engaged on the top collar on said tubular body and said lower member top collar resting on said peripheral shoulder on said upper member as said tool is lowered with said operating string into the well with said threaded areas in engagement, the rotation of said operating string and body in one direction relative to said upper assembly positioning said upper projections for engagement within said lower member slots upon lowering of said tubular string and body, further rotation of said operating string, body, and lower member in the same direction disengaging said threaded areas as said lower friction means contacts the well bore to resist rotation of said lower assembly, downward motion of said operating string and said body bringing said body top collar against said upper member to force said upper member downwardly so that said lower tapered end forces said slips outwardly to grasp said well bore to anchor said tool, and further downward motion of said string and body forcing said packer means outwardly between said upper member and said lower member to seal the well bore, the lifting of said string and said body bringing said lift collar against said internal shoulder on said upper member to lift said upper assembly to release said packer means and said slips from well bore contact and to position said lower projections for engagement within said lower assembly slots, and lifting and rotation of said operating string, said body, and said lower assembly in the same direction engaging and threadedly connecting said threaded areas as said upper friction means contacts the well bore wall to resist rotation of said upper assembly.

6. A well tool including a tubular body adapted for connection as part of the well operating string, a tubular upper assembly slidably mounted on said body including a lower member having a downwardly tapered lower end and an upper member slidably connected with said lower member and having packer means therearound above said lower member, means on said upper and lower members to engage and expand said packer means, a tubular lower assembly slidably mounted on said body below said upper assembly and including a tubular element having radial openings therethrough and slips movably extending through said openings and having rear faces inclined downwardly and inwardly to slidably engage said tapered lower end, outwardly urged friction means on said lower member and on said lower assembly to frictionally engage the surrounding well wall and to oppose rotation of said lower member and said lower assembly, disengageable interconnection means on said lower member and lower assembly operable when connected to support said lower assembly and position said tapered lower end out of slip engaging position, and disconnectable means on said lower member and body coengaging upon lowering said body relative to said lower member to connect said lower member with said body for rotation together as said body rotates within said lower assembly, dismountable means on said body and said lower assembly connectable upon lifting said body relative to said lower assembly and to connect said lower assembly and said body for rotation together while said body rotates within said upper assembly to again connect said interconnection means, said body having an external shoulder engageable with and supporting said upper assembly and interconnected lower assembly with the packer means unexpanded, said body being adapted to be lowered with said interconnection means disengaged to engage and force said upper assembly downwardly relative to the lower assembly to extend said slips to grasp said well wall, and to expand said packer means to seal, said well bore, said body having means engageable with and operable to lift said upper assembly upwardly relative to said lower assembly to release well wall contact of said slips and said packer means, there being openings through said body wall to permit fluid communication with said well bore above said upper member before said slips are extended, said openings communicating with the upper member interior when said slips are extended.

JOHN H. McCARVELL.

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