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WELL TOOL FOR PLACING TUBULAR ELEMENT IN WELL

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Fig. 1

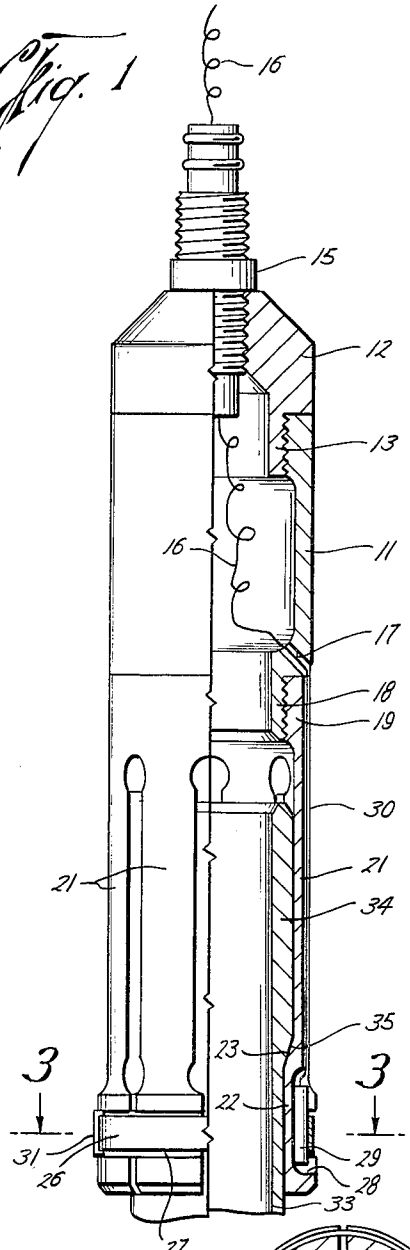


Fig. 2

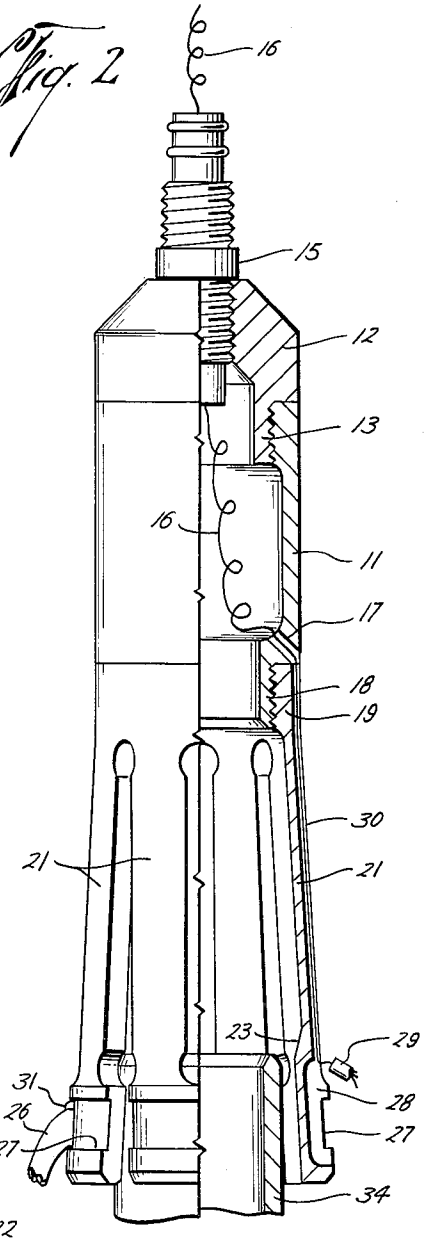
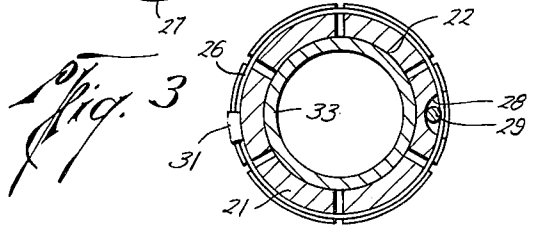


Fig. 3



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WELL TOOL FOR PLACING TUBULAR ELEMENT IN WELL

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This invention relates to a well tool for placing a tubular element in a well bore, well casing or the like. More particularly, the invention relates to a cable or wire line supporting well tool for attaching to the upper portion of a tubular element, such as a well screen, and having means for supporting said tubular element during letting-in and an explosive charge for releasing the tubular element at a predetermined time.

In placing a tubular element, such as a screen in the bottom of the well bore, it is desirable to have a tool which can accomplish this result with a minimum of time and effort and in a positive and controllable operation. When operating in a well bore, there is limited room for maneuvering a tool to accomplish the desired result. Moreover, the tool will generally be operated by remote control because of the depth of most well bores.

The prior art is prolix with examples of various letting-in tools, none of which are as satisfactory as the present invention for a number of reasons. Some of those reasons include: (1) the letting-in tool must be supported and lowered by attachment to a string of tubing requiring, in many instances, several hours to run into and bring out of the well on the return trip; (2) the letting-in tool is manipulated by various up and down, and/or rotational movements, all of which are difficult to control from a remote position; (3) the tool is operated by fluid pressure which is difficult to accurately control; (4) spring and detent ball arrangements may be used which may be subject to easy malfunction; and (5) various other deficiencies.

It is therefore an object of this invention to provide an improved well tool for placing a tubular element in a well, which tool is easily operated by remote control and which utilizes an explosive charge to release the tubular element.

It is another object of this invention to provide an improved well tool which can easily and quickly be run into and out of the well by means of a cable or wire line.

It is a further object of this invention to provide an improved well tool for placing a tubular element in a well, which tool may be easily attached to the top portion of the setting in the assembled condition and which can be operated to release the tubular element by detonating an explosive charge at a predetermined time.

These and other objects of the invention will be obvious from the description herein.

Broadly stated, the invention comprises a well tool for placing a tubular element, such as a well screen, in a well bore or well casing. The element with which the instant tool operates has a generally tubular upper portion with a downwardly facing external shoulder. The well tool is generally formed with a body member sufficiently small in diameter to clear the well bore or casing. Means are provided at the upper end of the body member for securing a cable or wire line.

On the lower end of the body member, a plurality of flexible segments or fingers are attached thereto and extend downwardly therefrom, forming an internal bore for axially receiving therein the upper portion of the tubular element.

At least one, and preferably all, of the fingers have radially inwardly extending portions or projections which form a lower internal bore of reduced size. The

inwardly extending portions are arranged to engage with and support the external shoulder of the tubular element when in the assembled condition.

Retaining means are provided for restraining the radially outward movement of the fingers, thus keeping the tool in the assembled condition and thereby connected to and supporting the tubular element, until a predetermined time.

An explosive charge is positioned adjacent to the retaining means so that upon detonation of the explosive charge, the retaining means will be severed, thereby permitting the radially outward movement of the fingers when the tool is then raised. Thus, the fingers ride upon and over the external shoulder of the tubular element, whereby the element is released and the letting-in tool may be removed from the well.

Means are also provided for detonating the explosive charge at a predetermined time so that the operation may be accurately timed and positively controlled.

The invention may be further understood by reference to the drawings, wherein:

FIG. 1 is a vertical side elevation view, partially in central section, showing the assembled condition or attached phase of operation of one embodiment of the tool.

FIG. 2 is a view similar to FIG. 1 but showing the release phase after the explosive charge has been detonated and the tubular element released.

FIG. 3 is a cross-section view taken at line 3—3 of FIG. 1 and shows in greater detail certain portions of the lower ends of the flexible fingers and associated elements.

The body of the tool is generally annular and is of a size to clear the internal diameter of the well bore or casing in which the tubular element is to be placed. Referring to FIG. 1, the body member is conveniently shown as comprising sub **11**, which is tubular in shape and having an internally threaded upper portion which is secured to cap **12** having a reduced size externally threaded lower portion **13** and a radially inwardly tapering upper portion having an axial opening with internal threads which engage the threads of connector **15**, the upper end of which is connected to a cable or wire line (not shown) having an electrical conductor, diagrammatically shown as lead **16**. Lead **16** passes down through connector **15**, cap **12** and out through port **17** near the bottom of sub **11**, to the outside of the tool.

Sub **11** has lower end **18** with a reduced diameter and threads thereon, which engage with an annular body member or collar **19**. Circumferentially spaced apart and connected to the lower end of collar **19** is a plurality of flexible segments or fingers **21** which extend generally downwardly therefrom. Thus the internal surfaces of fingers **21** form an enlarged internal bore. At least one, and preferably all, of the fingers **21** have a radially inwardly extending lower projection **22**, forming an upwardly facing shoulder **23**, hence forming a lower internal bore with a reduced diameter.

Retaining means conveniently shown in the form of a retaining band or member such as steel strap **26** is secured circumferentially around the lower ends of fingers **21**, and is conveniently positioned in circumferential grooves **27** formed on the outside surfaces of the lower ends of fingers **21**. Strap **26** restricts the radially outward movement of fingers **21**.

A vertical slot or recess **28** is formed or provided in the outside surface of the lower end of one of the fingers **21** so that the recess **28** lies under and across strap **26**. An explosive means or charge such as detonator cap **29** is positioned in recess **28**, and is thus adjacent to and under strap **26** where it is there held. Lead **16** passes down

the outside of the finger 21 via external longitudinal channel 30 and is connected to detonator cap 29 positioned in recess 28. Thus, at a predetermined time, detonator cap 29 may be detonated by passing an electrical impulse or current down lead 16 from a control station above surface.

One of the fingers 21 is also provided with a band or strap retaining means such as a U-shaped clamp 31 which bridges across strap 26 and is secured to the outside of the finger 21 to which attached. Thus, when strap 26 has been severed, it will still be retained on the tool in severed condition by claimp 31, thus preventing it from dropping into the well.

The tubular element, such as a well screen for example, is made up with a guide plug or set shoe (not shown) on the bottom of the screen (not shown) and a suitable section of blank line or tubing 33 thereabove with a collar or upset 34 forming a downwardly facing annular external shoulder 35. In the assembled condition or attached phase, shoulder 35 will be engaged and supported by upwardly facing shoulders 23 of fingers 21.

The letting-in tool is attached to upset 34 by expanding fingers 21 thereover, as upset 34 is moved axially into the upper internal recess formed by fingers 21. When upset 34 is positioned such that downwardly facing shoulder 35 engages upwardly facing shoulders 23, then strap 26 is secured about thel ower ends of fingers 21 by conventional means, such as by rivets, a buckle or the like. It is to be understood that downwardly facing external shoulder 35 may take many different forms, such as an annular recess in the upper end of tubing 33, or an otherwise reduced portion, with a larger portion thereabove. Similarly, upwardly facing shoulders 35 may take other forms, such as lugs or projections, but which function in the same manner.

In operation, the tool as shown in the assembled condition in FIG. 1, is let down into the well bore by a wire line to the desired location, such as the bottom of the well. With the tubular element lowered to the desired position, detonator cap 29 is then exploded by an electrical current, controlled from the surface and via lead 16. Upon detonation of cap 29, strap 26 is broken or severed, thereby releasing fingers 21 so that they may move radially outward.

Then, by taking up on the wire line, the well tool is raised relative to tubing 33 and upset 34. As a result, shoulders 23 of expanded fingers 21 ride upwardly and outwardly over downwardly facing external shoulder 35 of upset 34. At this point, the tubular element will be released, as is shown in FIG. 2. Detonator cap 29 is shown ruptured, strap 26 is shown in severed condition and is being retainably supported by clamp 31. The well tool may then be withdrawn from the well and reassembled for another operation.

The entire procedure of placing the tubular element in the well by the use of this novel wire line well tool can be completed in a matter of minutes, compared to hours using other tools. It is easily operated and accurately controlled by use of a wire line. The tubular element may be readily released at a predetermined time by a simple electrical impulse or signal.

There are, of course, many alternatives available with this apparatus, which still fall within the scope of the invention. For example, detonating means other than an electrical current from above ground may be used, as is well known to those skilled in the art of remote detonation of explosive charges, such as a timing device and battery attached to the tool.

Moreover, steel strap 26 could take other forms, such as a steel cable, and be of other material, and still function in the same restraining manner. Also, rather than encircling fingers 21, strap 26 could be threaded through an opening through the fingers.

Other modifications may be made in the invention as particularly described without departing from the scope

of the invention. Accordingly, the foregoing description is to be construed illustratively only and is not to be construed as a limitation upon the invention as defined in the following claims.

What is claimed is:

1. A well tool for placing a tubular element in a well, said tubular element having a generally tubular upper portion with a downwardly facing external shoulder, said well tool comprising:
- a body member,
- means for attaching said body member to a lowering cable,
- a plurality of flexible segments attached to the lower end of said body member and extending generally downwardly therefrom and forming an upper internal bore for receiving said upper portion of said tubular element,
- at least one of said segments having a radially inwardly extending lower portion forming a reduced lower internal bore for engaging said external shoulder of said tubular element in the assembled condition,
- retaining means secured to said segments for restraining the radially outward movement of said segments, and
- an explosive charge positioned adjacent said retaining means for severing said retaining means upon detonation thereof.

2. A well tool for placing a tubular element in a well, said tubular element having an upper portion with a downwardly facing external shoulder, said well tool comprising:
- a generally annular body member,
- means for attaching said body member to a lowering cable,
- a plurality of flexible fingers attached to the lower end of said body member in a generally downwardly extending direction and forming an upper internal bore for receiving said upper portion of said tubular element therein,
- said fingers having radially inwardly extending lower portions forming a reduced lower internal bore for engaging said external shoulder of said tubular element in the assembled condition,
- retaining means secured to said fingers for restricting the radially outward movement of said fingers, and
- an explosive charge positioned adjacent said retaining means for severing said retaining means upon detonation thereof.

3. A well tool for placing a tubular element in a well, said tubular element having a tubular upper portion with a downwardly facing external shoulder, said well tool comprising:
- a generally annular body member,
- means for attaching said body member to a wire line,
- a plurality of flexible fingers attached to the lower end of said body member in a generally downwardly extending direction and forming an upper internal bore for receiving said upper portion of said tubular element therein,
- said fingers having radially inwardly extending lower portions with upwardly facing shoulders forming a reduced lower internal bore for engaging said external shoulder of said tubular element in the assembled condition,
- retaining means secured around the lower ends of said fingers for restricting the radially outward movement of said fingers, and
- an explosive charge positioned adjacent said retaining means for severing said retaining means upon detonation thereof.

4. A well tool for placing a tubular element in a well, said tubular element having a tubular upper portion with a downwardly facing annular external shoulder, said well tool comprising:
- a generally annular body member,

means for attaching said body member to a lowering wire line,

said wire line having conductor means for transmitting an electrical impulse,

a plurality of flexible fingers attached to the lower end of said body member in a generally downwardly extending direction and forming an upper internal bore for receiving said upper portion of said tubular element therein,

said fingers having radially inwardly extending lower portions with upwardly facing shoulders forming a reduced lower internal bore for engaging said external shoulder of said tubular element in the assembled condition,

a retaining band secured around the lower ends of said fingers for restricting the radially outward movement of said fingers,

an explosive charge positioned under said band for severing said band upon detonation thereof by said electrical impulse transmitted through said conductor means.

5. A well tool for placing a tubular element in a well, said tubular element having a tubular upper portion with a downwardly facing annular external shoulder, said well tool comprising:

a generally annular body member,

means for attaching said body member to a lowering wire line,

said wire line having conductor means for transmitting an electrical impulse,

a plurality of flexible fingers attached to the lower end of said body member and extending downwardly therefrom and forming an upper internal bore for axially receiving said upper portion of said tubular element therein,

said fingers having

radially inwardly extending lower portions with upwardly facing shoulders forming a reduced lower internal bore for engaging said external shoulder of said tubular element in the assembled condition, and

a circumferential groove around the outside of said lower portions,

a retaining band positioned in said circumferential groove and surrounding said fingers for restricting the radially outward movement of said fingers, and

an explosive charge positioned under said band for severing said band upon detonation thereof by transmission of said electrical impulse through said conductor means to said explosive charge.

6. A well tool for placing a tubular element in a well, said tubular element having a tubular upper portion with a downwardly facing annular external shoulder, said well tool comprising:

a generally annular body member,

means for attaching said body member to a lowering wire line,

said wire line having conductor means for transmitting an electrical signal,

a plurality of flexible fingers attached to the lower end of said body member in a generally downwardly extending direction and forming an upper internal bore for axially receiving said upper portion of said tubular element therein,

said fingers having radially inwardly extending lower portions with upwardly facing shoulders forming a reduced lower internal bore for engaging said external shoulder of said tubular element in the assembled condition,

one of said fingers formed with an external recess in the lower portion thereof for receiving an explosive charge,

said explosive charge being connected to said conductor means and detonated by said electrical signal received therefrom at a predetermined time, and

a retaining band secured around the lower ends of said fingers and overlying said explosive charge for restricting the radially outward movement of said fingers, whereby said band is severed upon detonation of said explosive charge.

7. A well tool for placing a tubular element in a well, said tubular element having a tubular upper portion with a downwardly facing annular external shoulder, said well tool comprising:

a generally tubular body member,

means for attaching said body member to a lowering wire line,

said wire line having an electrical conductor for transmitting an electrical signal,

a plurality of flexible fingers circumferentially spaced apart and attached to the lower end of said body member in a generally downwardly extending direction and forming an upper internal bore for axially receiving said upper portion of said tubular element therein,

said fingers having

radially inwardly extending lower portions forming a reduced lower internal bore and for engaging said external shoulder of said tubular element in the assembled condition, and

a circumferential groove around the outside of said lower portions,

one of said fingers being provided with an external recess in the lower portion thereof for receiving an explosive charge,

said explosive charge being connected to said conductor means and detonated by said electrical signal received therefrom at a predetermined time,

a retaining band positioned in said circumferential groove and overlying said explosive charge for restricting the radially outward movement of said fingers, whereby said band is severed upon detonation of said explosive charge, and

band retainer means for retaining said band after severance thereof.

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