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(56) Documents Cited
US 5435395 A US 4523645 A US 4509605 A
US 4469179 A US 3962943 A

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INT CL[7] E21B
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(54) Abstract Title
Control line locating apparatus

(57) A control line locating apparatus (50) is for positioning a control line (52) next to a drill string (54) so that a control line protector (10, fig. 1) can be mounted on the drill string (54). The apparatus comprises: a body (60,62) a hydraulic ram (66) mounted to the body (60,62), and a sheave (68) mounted on the hydraulic ram (66) for receiving the control line (52). In operation the control line (52) is fed to the sheave from storage drum (72) via the spring tensioner (74), the hydraulic ram moves the sheave (68) away from the body (60, 62) positioning the control line (52) adjacent the drill string (54). A control line protector (10, fig. 1) which comprises flexible webbing with hook and loop fasteners, is mounted on the drill string (54) and protects the control line (52) from damage.

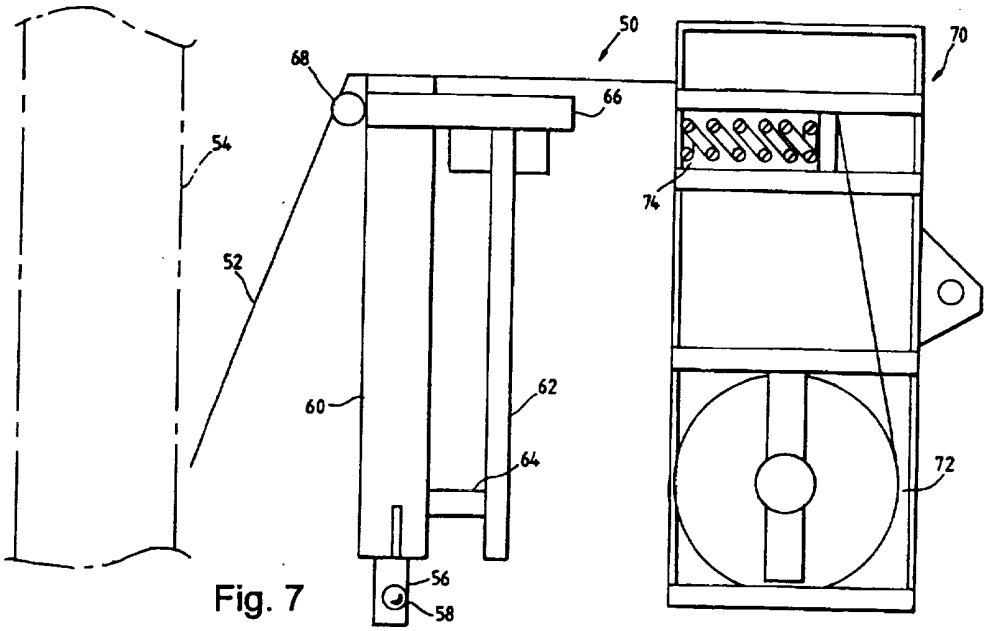

Fig. 7

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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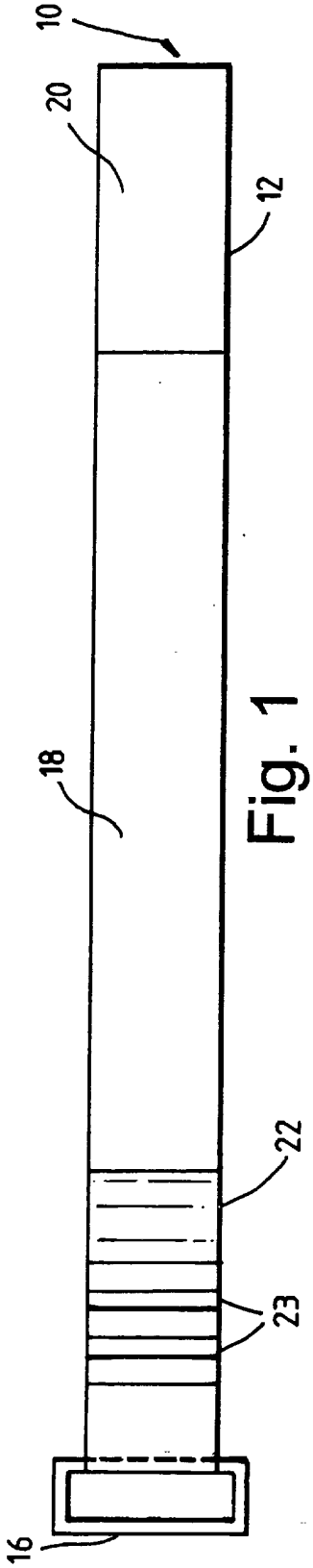

Fig. 1

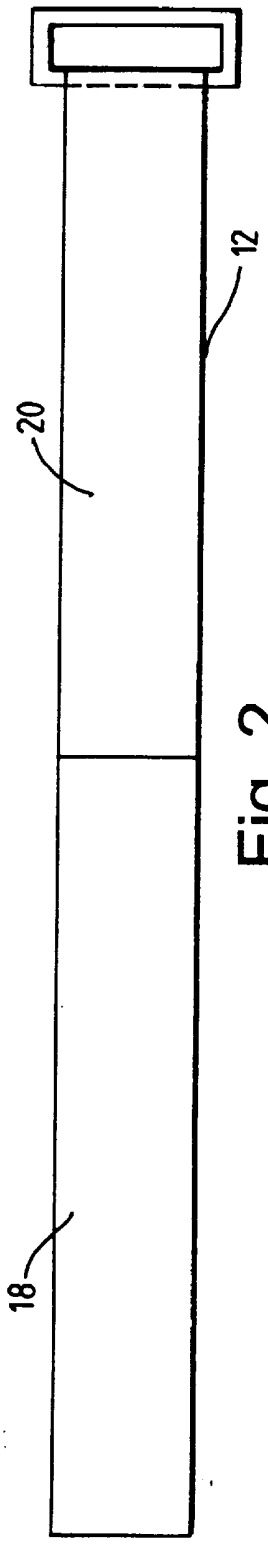

Fig. 2

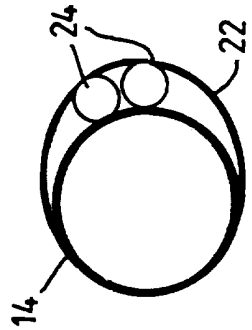

Fig. 4

Fig. 3

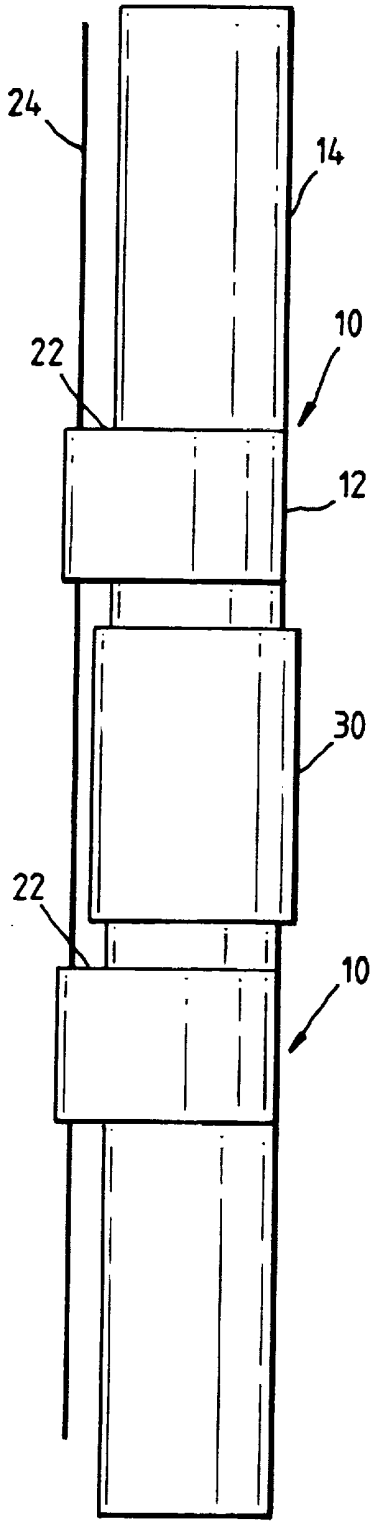

Fig. 5

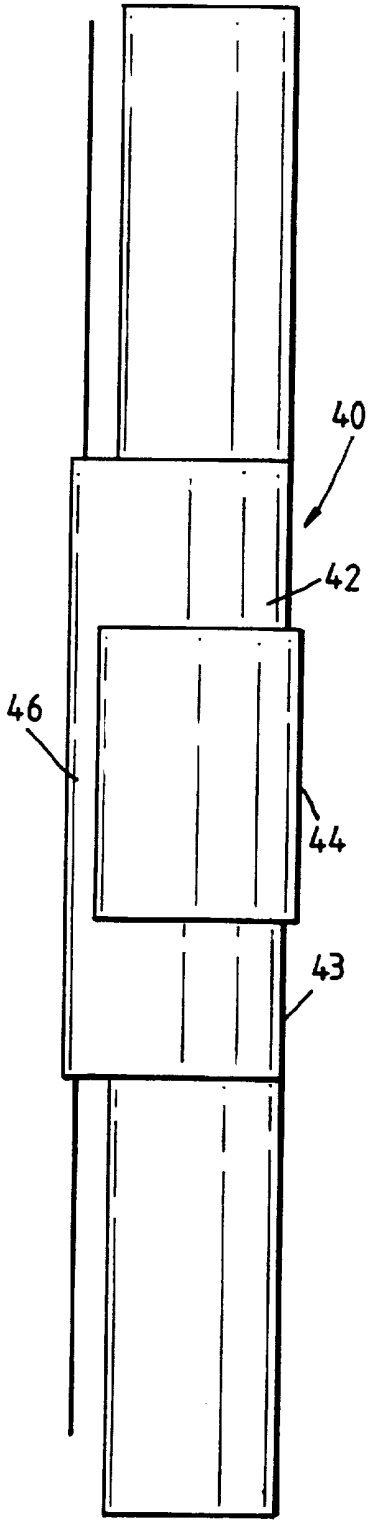

Fig. 6

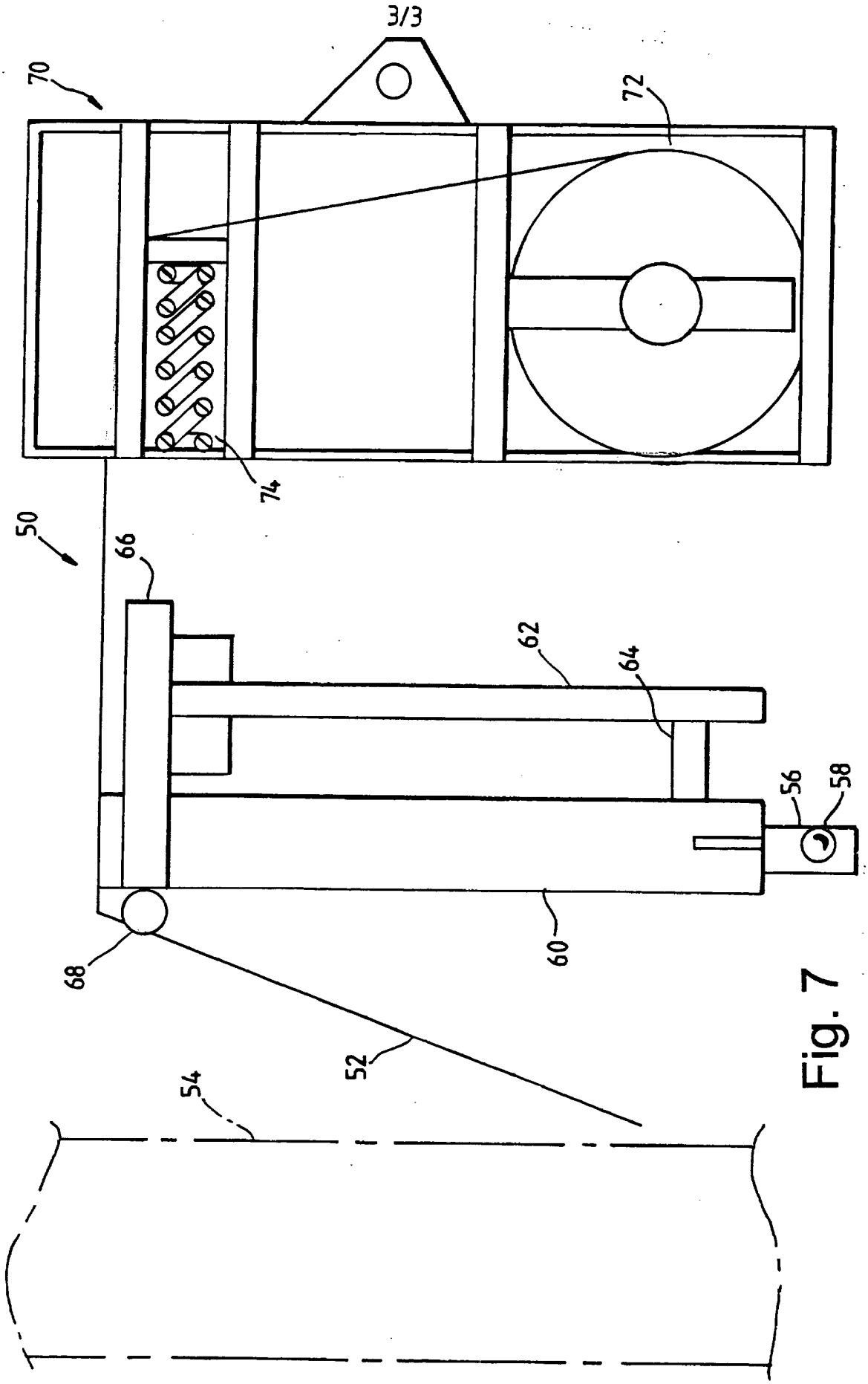

Fig. 7

CONTROL LINE

This invention relates to control line, and in particular to a method and apparatus for mounting control line to a downhole string, and also to a control line protector.

Control line or cable is often attached to tubing strings utilised in downhole operations, particularly in oil and gas exploration and production. The control line or cable may be utilised to, for example, carry control signals or power to a downhole tool or device mounted in or on the tubing.

The control line is attached at intervals to the outside of the tubing by control line protectors. Conventional control line protectors consist of cast iron, steel or rubber clamps held in place around the tubing by bolts or pins. These protectors are relatively expensive to manufacture, and as hundreds of protectors will be provided on a typical tubing string the purchase or rental of the protectors represents a significant outlay for the operator. Furthermore, as the protectors are sized to match a particular tubing diameter, a large range of protector sizes must be available to allow matching with the range of tubing diameters currently in use.

Conventionally, the protectors are manually mounted on the tubing by a team of deckhands as the tubing is run into the bore. In a typical operation, a stand of tubing will

be made up to the upper end of the tubing string protruding through the deck floor. The control line may be supplied from a skid-mounted storage drum on the deck, the line passing over appropriate tensioners and sheaves before passing through the deck floor with the tubing. As the control line sheave must be radially spaced from the tubing to prevent interference with the longitudinal movement of the tubing, the control line must first be pushed or pulled from the sheave into contact with the tubing before the tubing protector clamp is positioned around the control line and tubing, and the securing bolt or pin tightened using an appropriate power tool.

A control line protector is typically provided above and below each tubing or tool joint such that a pipe stand formed of three tubing sections will be provided with at least six protectors; the stand must be stopped at least six times as it is run in, to allow mounting of the control line protectors.

Similarly, when the tubing string is being withdrawn from the bore, each protector must be individually removed.

If a conventional control line protector breaks or becomes detached from the tubing string while downhole, the resulting debris may cause damage to the tubing, control line or casing, and may even jam the tubing in the bore.

It is among the objectives of embodiments of the present invention to obviate or mitigate these disadvantages.

According to one aspect of the present invention there

is provided a control line protector comprising: a flexible member for encircling a section of tubing and a control line to be attached thereto; and a fastener for securing the ends of the member.

The present invention also relates to a method of mounting control line on tubing using such a protector.

The term control line as used herein is intended to encompass cable, conduit, and indeed any signal or fluid carrying line which might be mounted externally of a downhole support member.

The provision of a flexible member allows a single protector to be utilised on tubing of a variety of forms and sizes.

The flexible member may be of webbing, tape or the like and is typically formed of a plastics material. Of course, the material will be selected to withstand the temperatures, pressure and fluids which will be encountered in use.

Preferably also, the fastener comprises an pressure sensitive securing arrangement, for example, a hook and loop fastener such as VELCRO ®. Alternatively, or in addition, other forms of securing arrangement may be provided, for example, a pressure sensitive adhesive.

The fastener may comprise a loop for mounting on one end of the member for facilitating tightening of the protector around the tubing and control line. The loop may incorporate means for securing or retaining the other end of the member, such as a ratchet arrangement or friction

buckle.

It will be apparent that these forms of fastener facilitate rapid mounting of the protector on the tubing, with the result that the tubing may be run in significantly more rapidly than tubing being fitted with conventional control line protectors.

Preferably also, the control line protector includes portions for locating the control line. These portions may be mounted on or located by the member. Preferably, the locating portions are of a depth corresponding to the control line diameter, and thus provide protection for the control line from contact with the bore wall as the tubing and the control line is run in to a bore. The portions may be of any suitable structural material, and may be rigid or resilient. The portions may define walls dimensioned to grip the control line and may be adapted to locate a plurality of control lines.

The protector may be adapted to extend over a tubing or tool joint, such a protector comprising two flexible members, one for location above the joint and the other below, and a protector portion for extending over the tool joint externally of the control line.

According to another aspect of the present invention there is provided a control line locating apparatus for positioning adjacent a control line protector mounting location, the apparatus comprising: a body; an extendable and retractable member mounted to the body and having a portion for receiving control line being fed from a control

line storage arrangement to be run downhole with a tubing string, in use, the member being extendable to locate the receiving portion and the control line therein adjacent the tubing to facilitate location of a control line protector around the tubing and control line.

Conventionally, tensioned control line is pushed or pulled from a sheave to a position adjacent the tubing by one or more deck hands, a control line protector then being mounted around the tubing and the control line and fixed in place by one or more other deck hands. Clearly this operation is labour intensive, difficult and potentially dangerous. The apparatus of this aspect of the invention overcomes many of these problems by locating the control line adjacent the tubing with little or no manual intervention, thus reducing the number of operators required to carry out the control line protector mounting operation.

The control line receiving portion may be a sheave.

The extendable and retractable member may incorporate a hydraulic ram.

These and other aspects of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a view from one side of a control line protector in accordance with an embodiment of a first aspect of the present invention;

Figure 2 is a view from the other side of the control line protector of Figure 1;

Figure 3 is a side view of a part of the control line protector of Figure 1;

Figure 4 is a schematic sectional view of the protector of Figure 1 shown locating two control lines on a section of tubing;

Figure 5 is a schematic representation of two of the protectors as illustrated in Figure 1 mounted on a tubing section;

Figure 6 is a schematic representation of a protector in accordance with a further embodiment of the invention mounted on a tubing section; and

Figure 7 is a schematic representation of a control line location apparatus in accordance with a preferred embodiment of another aspect of the present invention.

Reference is first made to Figures 1, 2 and 3 of the drawings, which show a control line protector 10 in accordance with a preferred embodiment of the present invention. The protector 10 comprises a flexible member in the form of length of webbing 12, around 15cm (6") wide and of length in excess of the circumference of the tubing 14 (Figures 4 & 5) on which the protector 10 is to be mounted.

A loop 16 is mounted on one end of the webbing 12. Each face of the webbing 12 carries alternating sections of hook and loop fastener 18, 20, such as VELCRO ®, and the loop 16 is mounted in a loop 21 formed in the webbing 12 and maintained by overlapping hook and loop-carrying portions of the end of the webbing 12.

Provided adjacent the loop 16 are plastics locating

portions 22 extending across the width of the webbing 12, the portions 22 defining recesses 23 to locate two control lines 24 to be mounted on the tubing 14, as illustrated in Figure 4 of the drawings. The rear faces of the locating portions 22 are provided with a loop surface for engaging a portion of the webbing 12 carrying a hook surface 18.

In use, the protectors 10 may be supplied in disassembled form, the webbing 12 being provided as a continuous length, stored on a drum or the like, and which may be cut into lengths as required. The loops 16 and locating portions 22 may be supplied separately and mounted on the cut webbing lengths as required.

As the tubing 14 and control lines 24 are fed together in to the bore, deck hands locate the lines 24 relative to the tubing 14 by positioning the control lines 24 between the locating portions 22, wrapping the webbing 12 around the tubing 14, passing the webbing end through the loop 16, pulling the webbing tight around the tubing 14, and then wrapping the free end of the webbing around the tubing 14 and over the inner webbing portion. The alternating sections of hook and loop fastener 18,20 ensure that a substantial area of the overlapping webbing is securely fastened in place. Further, an area of adhesive, such as a section of double-sided pressure sensitive adhesive tape, may be provided beneath the webbing free end, to further secure the webbing 12 on the tubing 14.

Typically, at least two protectors 10 will be provided on each tubing section, one above and one below each tool

joint 30, as illustrated in Figure 5 of the drawings. It will be noted that the orientation of the protectors 10 is the same, that is the locating portions 22 are aligned, such that the control lines 24 are held in parallel to the longitudinal axis of the tubing. The location of the portions 22 also serves to project the control lines 24 from damage which would otherwise occur if the tool joint 30 came into contact with the bore wall where the control lines pass over the joint 30.

An arrangement providing further protection at a tool joint is illustrated in Figure 6 of the drawings. The illustrated control line protector 40 is H-shaped, comprising two webbing portions 42, 43, similar to the webbing portion 12 described above, for location one on either side of a tool joint 44, and an elongate control line locating portion 46 which extends across the tool joint 44 between the webbing portions 42, 43.

The webbing portions 42, 43 may be supplied as a continuous length on a drum or the like, to be cut to the desired length, and the locating portions 46 may be an extrusion of rigid material, such as plastics or a foamed material, which is cut to length as required. As with the first embodiment, one or both of the webbing portions 42, 43 and the locating portions 46 may be provided with a pressure sensitive fastener or adhesive to facilitate assembly of the protector 40.

Reference is now made to Figure 7 of the drawings, which is a schematic illustration of a control line

locating apparatus 50 to assist in positioning control line 52 adjacent a section of tubing 54, and to facilitate mounting of a control line protector on the tubing 54. The apparatus 50 may be used in conjunction with the protectors as described above, or may equally be used in conjunction with control line protectors of conventional construction.

The apparatus 50 is located on the rotary table (which remains stationary during this operation) of the drilling deck, conveniently being secured in position by a pin 56 engaging one of the rotary table wear bushing pin holes, and being locked in the hole by a ball bearing grab 58.

The apparatus 50 comprises a vertical static post 60, from which the pin 56 extends, and a smaller diameter vertical post 62 coupled to the lower end of the post 60 by a cross-piece 64. The upper ends of the posts 60, 62 support a hydraulic ram 66 having a sheave 68 mounted on the free end of the ram piston rod. Appropriate hydraulic fluid supply lines, accumulators and controls (not shown) are provided to permit an operator to extend and retract the ram 66 and thus move the sheave towards and away from the tubing 54.

The apparatus 50 is located between the tubing 54 and a skid-mounted control line deployment arrangement 70 comprising a control line storage drum 72 driven by a pneumatic motor, and a spring tensioner 74 which maintains the control line under substantially constant tension and accommodates application of sudden loads to the control line 52, which might otherwise break or damage the line.

From the storage drum 72, the control line 52 passes around the tensioner 74, over the ram-mounted sheave 68, and then through the rotary table with the tubing 54.

When a control line protector is to be mounted on the tubing 54, the ram 66 is extended, pushing the sheave 68 and the control line 52 towards the tubing 54. The control line protector is then positioned around the tubing 54 and the control line 52 below the sheave 68 and secured in place. The ram 66 is then retracted and the tubing 54 and control line 52 run in until the next control line protector location is positioned level with the ram 66. The tubing is then stopped and the operation repeated.

Thus, the control line protectors may be mounted on the tubing 54 with minimal physical effort, and the operation may be carried out by only one or two deck hands.

It will be clear to those of skill in the art that the above-described aspects of the invention greatly facilitate location of control line on tubing, whether this be in the form of completion tubing or test stem tubing.

It will also be apparent to those of skill in the art that the above-described embodiments are merely exemplary of the present invention and that various modifications and improvements may be made thereto without departing from the scope of the invention.

CLAIMS

1. A control line locating apparatus for positioning adjacent a control line protector mounting location, the apparatus comprising: a body; an extendable and retractable member mounted to the body and having a portion for receiving control line being fed from a control line storage arrangement to be run downhole with a tubing string, in use, the member being extendable to locate the receiving portion and the control line therein adjacent the tubing to facilitate location of a control line protector around the tubing and control line.

2. The apparatus of claim 1, wherein the control line receiving portion is a sheave.

3. The apparatus of claim 1 or 2, wherein the extendable and retractable member incorporates a hydraulic ram.

4. The apparatus of claim 1, 2 or 3, wherein the body is adapted for mounting on a drilling deck.

5. The apparatus of any of claims 1 to 4, in combination with a control line protector comprising: a flexible member for encircling a section of tubing and a control line to be attached thereto; and a fastener for securing the ends of the member.

6. A control line protector comprising: a flexible member for encircling a section of tubing and a control line to be attached thereto; and a fastener for securing the ends of the member.

7. The apparatus or protector of claim 5 or 6, wherein and the flexible member is of webbing, tape or the like.

8. The apparatus or protector of claim 7, wherein the flexible member is formed of a plastics material.

9. The apparatus or protector of any of claims 5 to 8, wherein the fastener comprises a pressure sensitive securing arrangement.

10. The apparatus or protector of claim 9, wherein the fastener comprises a hook and loop fastening arrangement.

11. The apparatus or protector of any of claim 5 to 10, wherein the fastener comprises a loop for mounting on one end of the member for facilitating tightening of the protector around the tubing and control line.

12. The apparatus of claim 11, wherein the loop incorporates means for securing or retaining the other end of the member.

13. The apparatus or protector of claim 12, wherein the

control line protector includes portions for locating the control line.

14. The apparatus or protector of claim 13, wherein said locating portions are of a depth corresponding to the control line diameter, and thus provide protection for the control line from contact with the bore wall as the tubing and the control line is run in to a bore.

15. The apparatus or protector of any of claims 5 to 14, wherein the protector is adapted to extend over a tubing or tool joint, the protector comprising two flexible members, one for location above the joint and the other below, and a protector portion for extending over the tool joint externally of the control line.

16. A method of positioning control line to facilitate control line protector mounting, the method comprising the steps: mounting an extendable and retractable member adjacent a control line protector mounting location; feeding control line from a storage arrangement over a receiving portion of the member and running the control line downhole with a tubing string; extending the member to locate the receiving portion and the control line therein adjacent the tubing to facilitate location of a control line protector around the tubing and control line; and retracting the member to space the receiving portion and the control line therein from the tubing to facilitate

running the control line and tubing downhole.

17. The method of claim 16, further comprising locating a control line protector on the tubing by encircling a section of tubing and control line with a flexible member and securing the ends of the member.

18. The method of claim 17, wherein the ends of the flexible member are secured by a pressure sensitive securing arrangement.

19. A control line locating apparatus substantially as described herein and as illustrated in Figure 7 of the accompanying drawings.

The Patent Office
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Application No:	GB 9929443.1	**Examiner:**	Barnaby Wright
Claims searched:	1-5, 16-19	**Date of search:**	9 May 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): E1F (FGR, FAC)

Int Cl (Ed.7): E21B

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 1,558,160	BEALL See figs 1 & 2, and page 1, ln 31-45.	-
A	US 5,435,395	CONNELL See figs, and col 5, ln 15-42	-
A	US 4,523,645	MOORE See figs, and col 4, ln 43 to col 5, ln 5.	-
A	US 4,509,605	TULLOS See fig 3, and col 2, ln 52-57, and col 6, ln 33-43	-
A	US 4,469,179	MINE See fig 3, and col 2, ln 47 to col 3, ln 6.	-
A	US 3,962,943	ALLEN See fig 1, and col 2, ln 56-66	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.