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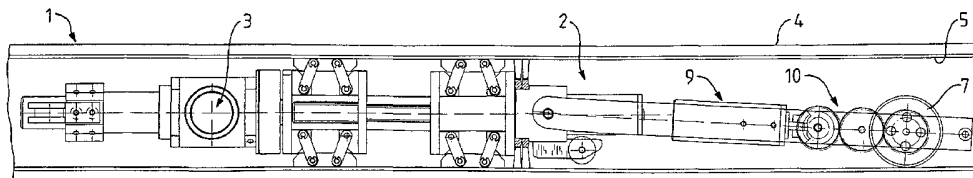
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: APPARATUS FOR TRANSPORTING EQUIPMENT ALONG A CONDUIT



(57) Abstract: The invention relates to apparatus (1) in the form of a tractor unit (2) for transporting equipment (3) along the interior of a conduit (4) such as a mains water pipe, the tractor unit (2) comprising a rotatable device by which the apparatus (1) is driven along the conduit, and which device (2) has enhanced frictional engagement with the conduit (4) whereby the apparatus (1) can be transported and positioned as desired in the conduit (4). The conduit (4) is usually an iron pipe, which may have a polyethylene liner (5) and the enhanced frictional engagement of the apparatus (1) with the conduit (4) or liner (5) is in the embodiment(s) achieved using a magnetic tractive unit (2). This comprises in the preferred embodiment a ring magnet (6), the most powerful being a permanent magnetic made of rare earth mixtures, mounted between two rotatable devices in the form of soft iron pole pieces or wheels (7), around the circumference of which is trained a cover element in the form of a rubber tyrelike element (8).



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APPARATUS FOR TRANSPORTING EQUIPMENT ALONG A CONDUIT

The invention relates to apparatus for passing along a conduit, and particularly to apparatus for transporting equipment along the interior of a conduit.

Conduits, pipes, tubes and the like particularly mains pipes for carrying water, all hereinafter termed conduits, are often of magnetic material, and have side or branch pipes, there being a ferrule connection or ferrule, between the conduit and branch pipe. Moreover, the conduits are often lined with a liner such as a polyethylene liner.

A robotic workstation is often used to prepare the bore of a ferrule prior to lining the conduit with a polyethylene liner and another robotic workstation is used to place a connector through the liner into the ferrule from within the liner after it has been installed in the conduit. The success of both these processes relies on accurate positioning of the work-heads by the robotic units. Conventional techniques for positioning the workstations, such as winching from the surface, cannot provide sufficient control. Another conventional technique is to use wheels or caterpillar tracks driven by on-board motors to position the units. The difficulty here is that the polyethylene presents a low coefficient of friction to the driving wheels which reduces the motive force available to move the workstation along the pipe.

It is an object of the invention to seek to mitigate these disadvantages.

According to the invention there is provided apparatus for transporting equipment along the interior of a conduit, comprising a rotatable device by which the apparatus is driven along the conduit, and which device has

enhanced frictional engagement with the conduit whereby the apparatus can be transported and positioned as desired in the conduit.

The conduit may have magnetic properties and the device may comprise a wheeled magnetic device. This provides the apparatus with an increased tractive effect so that accurate transport and positioning is achievable.

There may be a plurality of wheeled devices.

The or each wheeled device may comprise two circular members of magnetic material between which is mounted a magnet, suitably a permanent ring magnet, which may preferably comprise a rare earth magnet. This provides a powerful magnet.

The two circular members may comprise soft iron pole piece members. This provides for an enhanced magnetic, and hence tractive, effect.

Each pole piece member may have an external non-magnetic driving cover element. This provides for ease of movement, particularly when the driving cover element may comprise a rubber tyre-like member.

The apparatus may include an on-board motor, suitably an electric motor, connected to the rotatable device by a gear train. This provides for a self-contained apparatus with its own motive power.

The apparatus may mount equipment which may comprise means to prepare the bore of a ferrule of the conduit, suitably a ceramic cutter or alternatively an upstanding finger for penetrating a liner of a pre-lined conduit.

Apparatus for transporting equipment along the interior of a conduit, such as a mains water pipe, is hereinafter described, by way of example, with reference to the accompanying drawings.

Fig. 1 is a schematic elevational view of apparatus according to the invention;

Fig. 2 is a perspective view of part of a practical embodiment of the apparatus; and

Figs. 3 and 4 are respective side elevational and plan views of a further embodiment of apparatus according to the invention.

Referring to the drawings, in which like parts are referred to by like reference numerals, there is shown apparatus 1 in the form of a tractor unit 2 for transporting equipment 3 along the interior of a conduit 4 such as a mains water pipe, the tractor unit 2 comprising a rotatable device by which the apparatus 1 is driven along the conduit, and which device 2 has enhanced frictional engagement with the conduit 4 whereby the apparatus 1 can be transported and positioned as desired in the conduit 4.

The conduit 4 is usually an iron pipe, which may have a polyethylene liner 5, and the enhanced frictional engagement of the apparatus 1 with the conduit 4 or liner 5 is in the embodiment(s) achieved using a magnetic tractive unit 2. This comprises in the preferred embodiment a ring magnet 6, the most powerful being a permanent magnetic made of rare earth mixtures, mounted between two rotatable devices in the form of soft iron pole pieces or wheels 7, around the circumference of which is trained a cover element in the form of a rubber tyre-like element 8.

The tyres 8 are in actual contact with the interior surface of the conduit 4, or a polyethylene liner 5 lining it.

The apparatus 1 mounts a drive or motor means in the form of an electric motor 9 which is connected to the rotatable magnetic tractive devices by a suitable power transmitting connection such as a gear train 10.

In use, the apparatus 1 is inserted in a conduit 4, and guided along it to a desired position by a suitable control means usually at the surface when, as is usually the case, the conduit 4 is underground. The apparatus 1 is "pushed" through the conduit, or otherwise transported therealong, by the rotatable, wheeled, magnetic devices 2 which are rotated by the electric motor 9.

The effect of the magnetic wheels is to make the apparent weight of the wheel 7, much greater than it actually is because of the attraction of end wheel 7 to the iron conduit wall. This in turn means the frictional forces are far greater than they otherwise would be. Therefore the tractive effort that each wheel is capable of exerting via frictional coupling with the surface of the conduit, or liner, is much greater than with a rubber tyre alone.

The equipment 3 can be a cutter such as a ceramic cutter for preparing the ferrule prior to lining the conduit, or a finger device for inserting through the liner of an already lined conduit.

The enhanced frictional effect providing for the greater tractive effect referred to enables the apparatus 1 to be controlled, and positioned with much greater

accuracy than hitherto, as it is transported along a conduit 4 to a position beneath a ferrule or other feature of the conduit.

It will be understood that the number of driving wheels 7 can be increased without limit as each wheel has its own magnet 6 and therefore the total towing capability of the tractor unit can be tailored to each individual requirement. Moreover, the wheels 7 can be replaced by tracked devices such as caterpillar trails or the like or belts.

CLAIMS:

1. Apparatus for transporting equipment along the interior of a conduit, characterised by a rotatable device (2) by which the apparatus (1) is driven along the conduit (4), and by device (2) having enhanced frictional engagement with the conduit (4) whereby the apparatus (1) can be transported and positioned as desired in the conduit.
2. Apparatus according to claim 1, characterised by the conduit (4) having magnetic properties and by the device (2) comprising a wheeled magnetic device.
3. Apparatus according to claim 2, characterised by there being a plurality of wheeled devices (2).
4. Apparatus according to claim 2 or claim 3, characterised by the or each wheeled device (2) comprising two rotatable members (7) of magnetic material between which is mounted a magnet (6).
5. Apparatus according to claim 4, characterised by the magnet (6) comprising a permanent ring magnet.
6. Apparatus according to claim 5, characterised by the permanent ring magnet (6) comprising a rare earth magnet.
7. Apparatus according to any of claims 4 to 6, characterised by the two rotatable members (7) comprising two substantially circular members comprising soft iron pole piece members.

8. Apparatus according to claim 7, characterised by each pole piece member (7) having an external non-magnetic driving cover element (8).
9. Apparatus according to claim 8, characterised by the driving cover element (8) comprising a rubber tyre-like member.
10. Apparatus according to any preceding claim, characterised by an on-board motor (9).
11. Apparatus according to claim 10, characterised by the motor (9) comprising an electric motor connected to the rotatable device by a gear train (10).
12. Apparatus according to any preceding claim, characterised by mounting equipment (3) comprising means to prepare the bore of a ferrule of the conduit.
13. Apparatus according to claim 12, characterised by the means (3) comprising a ceramic cutter.
14. Apparatus according to claim 12, characterised by the means (3) comprising an upstanding finger for penetrating a liner of a pre-lined conduit.

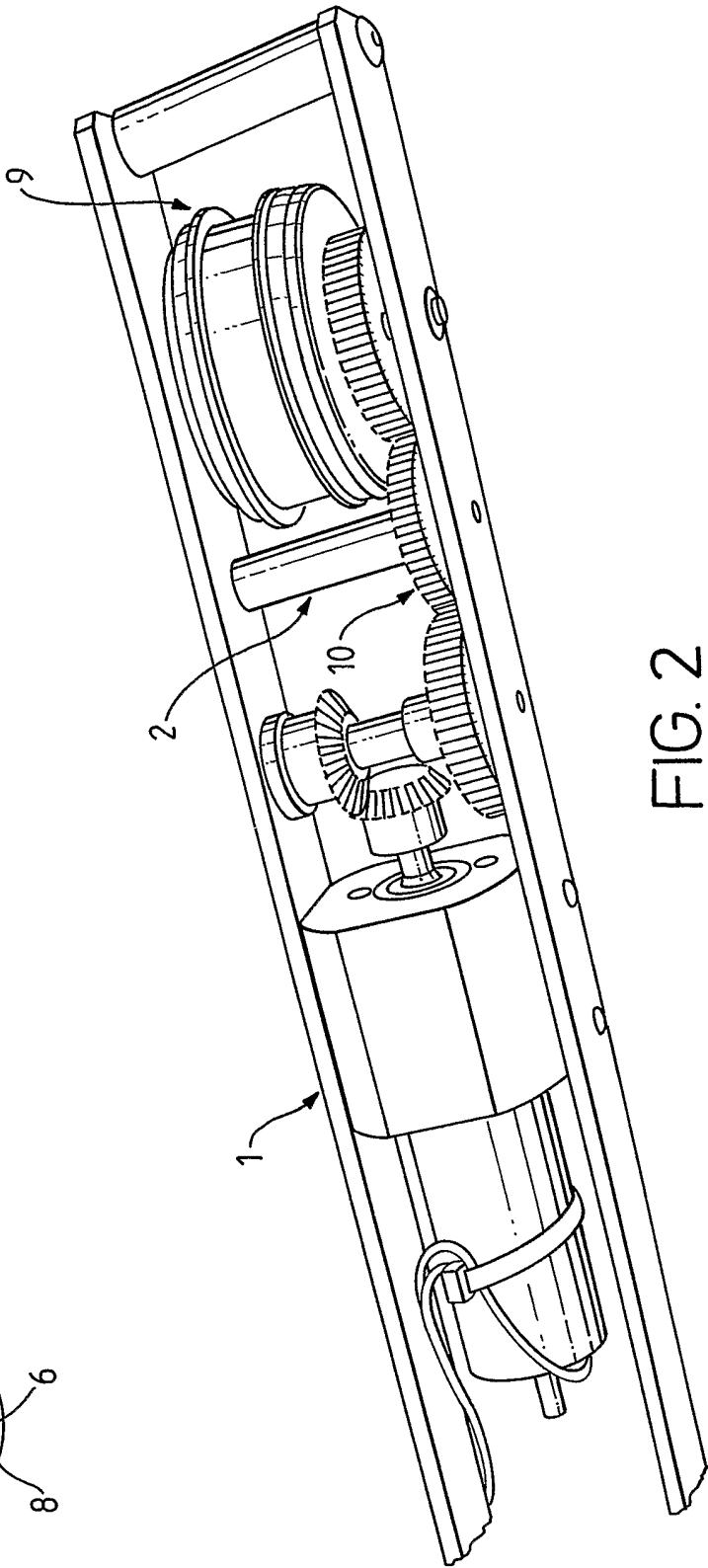
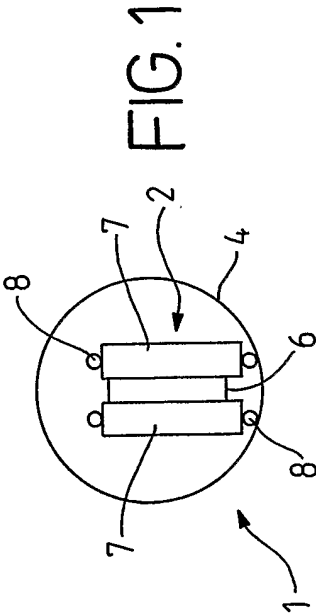


FIG. 2

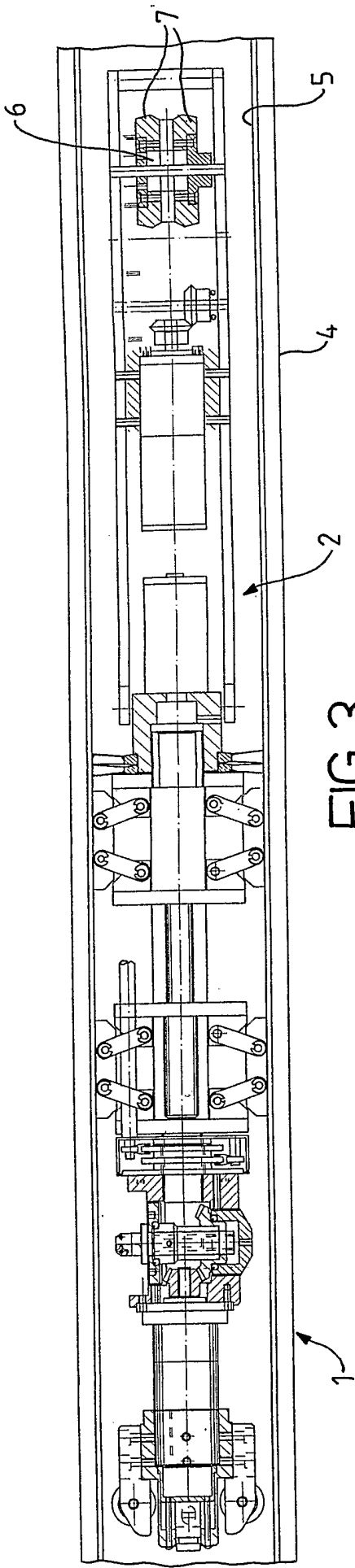


FIG. 3

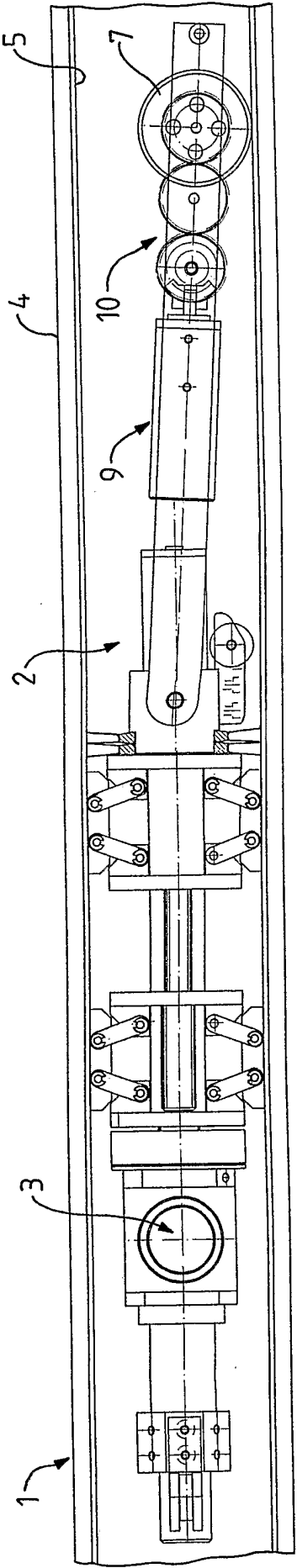


FIG. 4

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 388 528 A (PELRINE RONALD E ET AL) 14 February 1995 (1995-02-14) abstract; figures 1,2 column 3, line 32 - line 41 column 3, line 47 - line 49 column 3, line 53 - line 66 column 4, line 10 - line 13 column 4, line 16 - line 19 column 4, line 22 - line 26 column 4, line 33 - line 35 column 4, line 38 - line 48	1-5, 7-11
Y	---	12
Y	WO 96 12134 A (UFFMANN HANS PETER) 25 April 1996 (1996-04-25) abstract; figures 1-3	12
A	---	13, 14

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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 04, 30 April 1996 (1996-04-30) -& JP 07 323701 A (HITACHI METALS LTD), 12 December 1995 (1995-12-12) abstract; figures 1-3 paragraphs '0007!-'0010! -----	1-7, 10
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