(12) UK Patent Application (19) GB (11) 2 353 304 (13) A

(43) Date of A Publication 21.02.2001

(21) Application No 0018020.8

(22) Date of Filing 24.07.2000

(30) Priority Data
(31) 9917145 (32) 22.07.1999 (33) GB

(71) Applicant(s)
The Engineering Business Limited
(Incorporated in the United Kingdom)
Broomhaugh House, Riding Mill, Northumberland,
NE44 6EG, United Kingdom

(72) Inventor(s)
Anthony David Trapp

(74) Agent and/or Address for Service
Harrison Goddard Foote
Tower House, Merrion Way, LEEDS, LS2 8PA,
United Kingdom

(51) INT CL[7]
E02F 5/10

(52) UK CL (Edition S)
E1F FWG113 FWG118 FWHAW

(56) Documents Cited
GB 2049094 A GB 1062250 A EP 0581357 A
US 5288172 A

(58) Field of Search
UK CL (Edition R) E1F FWGB FWHAL FWHAW
INT CL[7] E02F 5/02 5/10
Online: WPI, EPODOC, JAPIO

(54) Abstract Title
Plough with fluid transmitted vibration means

(57) A plough for use in the burial of cables or pipelines in the sea bed transmits vibration to the area being ploughed using a fluid. The plough may be fitted with pulsating water jets [20], the pulse being provided by a pump, a valve assembly or by hydrodynamic instability and the water being fed to the jets [20] via pipes [21]. The fluid may be separated from the area being ploughed by flexible diaphragms or pistons, which transmit the vibration to the area being ploughed with a reduced risk of the jets [20] becoming blocked. The rate and phase of fluid flow in the pipes [21] may be varied or kept the same, typical rates of pulsing the fluid being between 1 and 100 cycles per second.

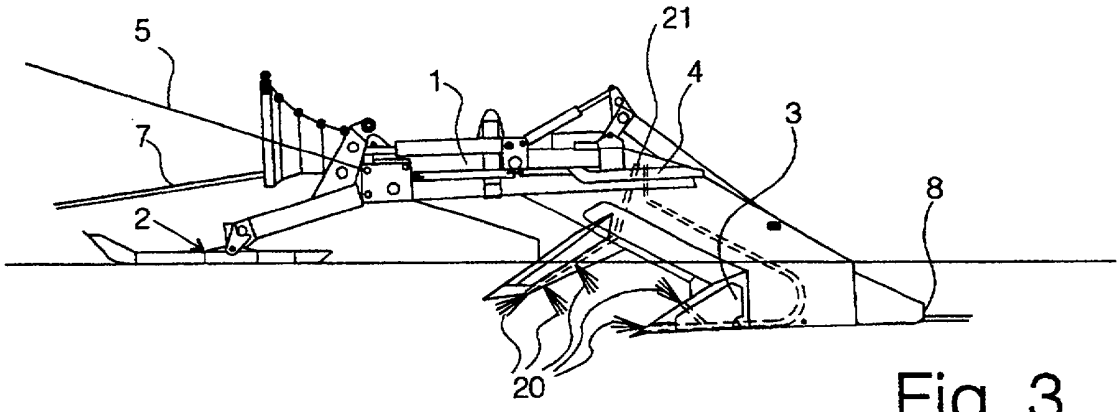

Fig. 3

GB 2 353 304 A

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

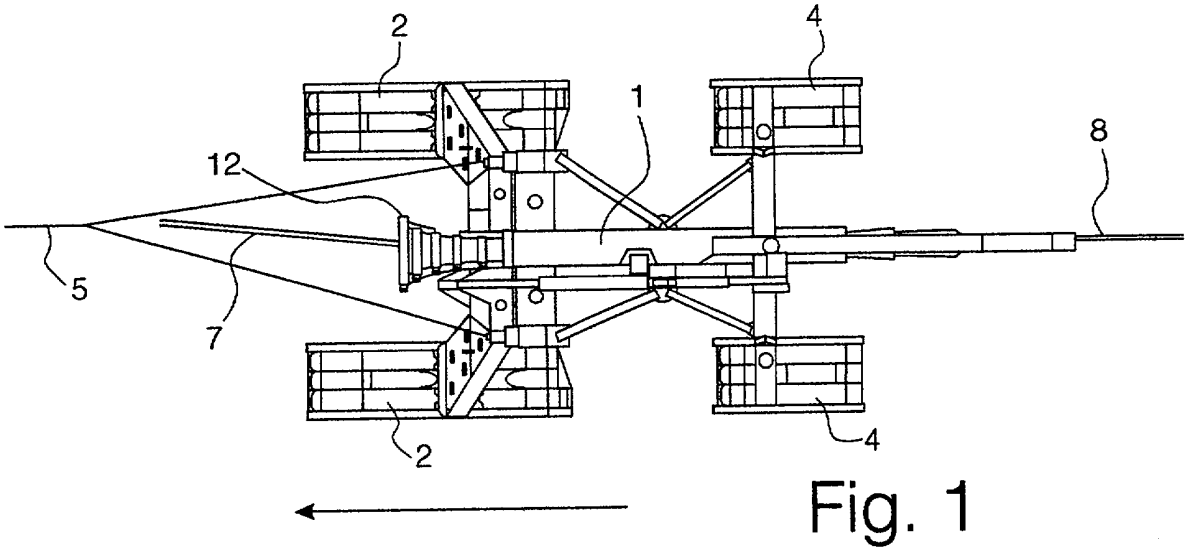

Fig. 1

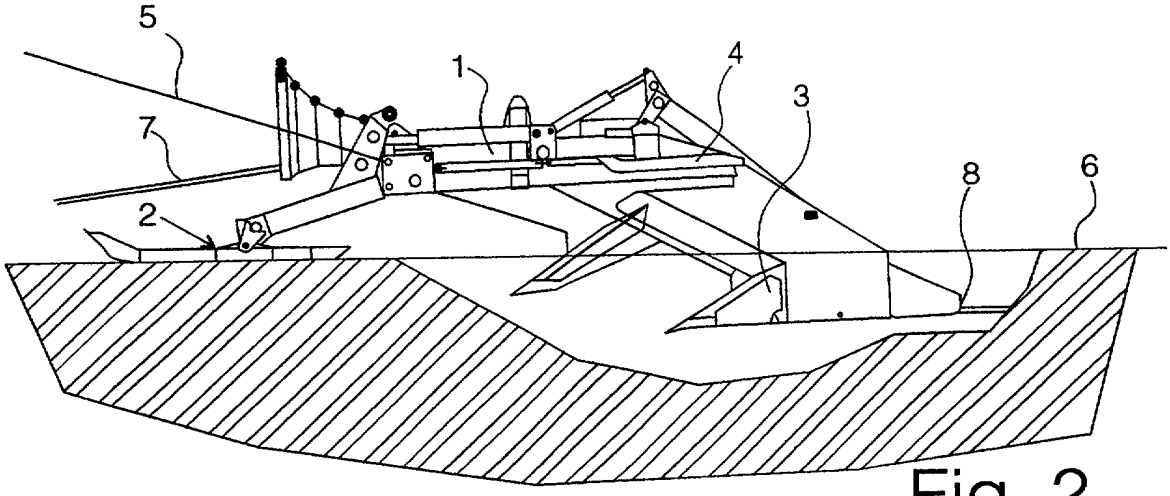

Fig. 2

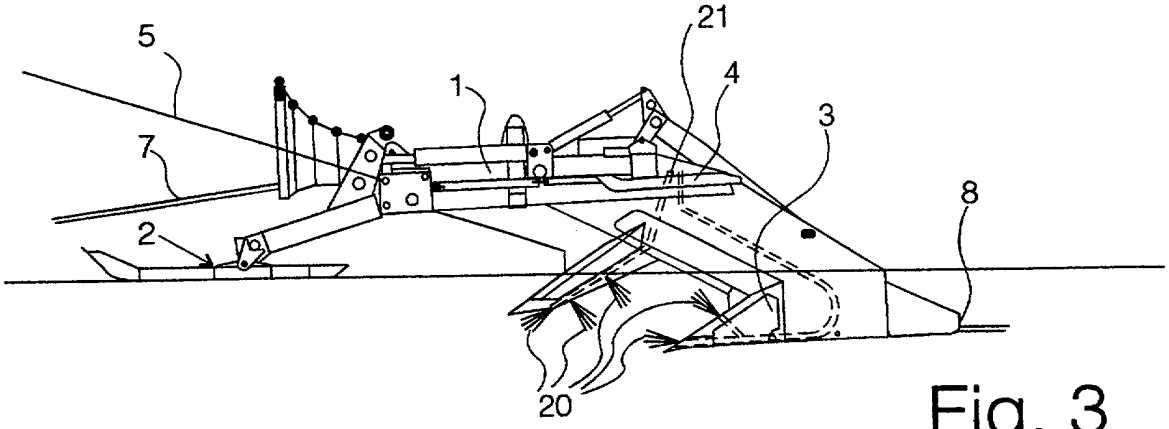

Fig. 3

IMPROVEMENTS TO PLOUGHS

This invention relates to ploughs, particularly those used to bury cable or pipe in the bed of the sea or other water.

Ploughs are well-known methods of protecting cable and pipelines underwater. The cables or pipelines are buried to protect them from damage by, for example, fishing equipment or anchors. Typically these ploughs are towed via a towrope by a vessel on the surface of the water, but may be towed by an underwater tractor. Such ploughs are fitted with a soil-engaging share that is shaped to dig into the seabed under the action of the towing force and produce a trench that the cable or pipe is placed into.

Hitherto, these ploughs have been operated successfully in many types of seabed and over great distances, but sometimes experience problems if hard seabed, rock, or certain types of sand or silt seabed is encountered. Under these circumstances the plough fails to bury the cable or pipe to the required depth to protect it. This can be a serious disadvantage resulting in a high risk of damage to the cable or pipe.

There are known methods of using powered means to vibrate or oscillate the soil-engaging ploughshare. These, under the correct circumstances, result in a reduction in the force required to pull the plough or an increase in the depth the plough penetrates the soil. This method of reducing pull has been applied to ploughs for operation on land and on the seabed. These designs do, however suffer some disadvantages in relation to use on seabed ploughs. In particular, the share of a sub-sea plough makes up a substantial part of the plough weight, and so it is difficult to make this vibrate rather than the remainder of the plough.

There are also known methods of adding water jetting to ploughs in which water is jetted at a constant flow to improve the performance, but these are not effective under some conditions.

It is an object of the present invention to provide a method and an apparatus that improve and makes more effective the application of vibration to the soil.

According to a first aspect of the invention there is provided a plough comprising: soil vibrating means which comprises fluid in which the fluid is used to transmit vibration to the soil.

According to a second aspect of the invention there is provided a method of ploughing comprising:

providing a soil vibrating means comprising fluid;

vibrating soil using the soil vibrating means in which the fluid is used to transmit vibration to the soil.

The plough and method of the invention can be used in trenching or in laying pipeline or cable.

Preferably the fluid is pulsed.

Preferably the soil vibrating means comprises one or more pulsating fluid flow.

Preferably, more than one fluid flow is provided and two or more of these are pulsed at substantially the same frequency.

Preferably the fluid flows are substantially in phase or at substantially a constant phase difference with one another.

Preferably one or more of the fluid flows comprise a fluid jet.

Preferably the fluid acts directly on the soil.

Preferably the fluid acts on a separating means which acts upon the soil. Such separating means may include a flexible diaphragm or a piston and so on.

Preferably one or more soil vibrating means are situated on a share or shares of the plough.

Any reference to the term "soil" should be interpreted as meaning any material to be ploughed e.g. including but not limited to mud, shale, sand and in certain circumstances rock.

Thus, a pipeline or cable plough is provided with, in one embodiment, a powered soil vibrating system utilising fluid to transmit the vibration to the soil.

Preferably the vibrating device is in the form of pulsating water jets.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a plan view of a plough of a conventional type.

Figure 2 shows an elevation of the plough shown in figure 1.

Figure 3 shows an elevation of a plough according to the invention.

Referring to figures 1 and 2, a seabed cable plough of a conventional type is mde up of a chassis (1), a share (3), and support skids (2 and 4). The front skids (2) support the plough on the seabed (6) and the share (3) penetrates the seabed as the plough is towed by a ship (not shown) via towrope (5). The front skids (2) are adjustable hydraulically to set the trenching depth of the plough. Cable (7) enters the plough at bellmouth (12) and exits underground at the back of the plough (8). Rear skids (4) support the back of the plough when operating in very soft seabed soils. The plough

may be fitted with a control and monitoring system and a hydraulic power pack, allowing the operators on the ship to operate it effectively.

Referring to figure 3, a cable plough according to the invention, similar to that shown in figures 1 and 2, is fitted with pulsating water jets (20). The jets are made to pulse by means of a suitable pump, a valve assembly or by hydrodynamic instability in which the properties of the fluid itself are utilised to provide pulses e.g. using fluid logic devices. The fluid may be separated from the soil by flexible diaphragms or pistons, which transmit the vibration with reduced risk of blockage. The jets may be mounted on any part of the plough structure, but are most effective when fitted to the main share and/or any auxiliary share. The powered fluid causing the vibration or pulsation is transmitted via pipes (21). The rate and phase of fluid flow in each pipe is typically substantially the same so that each pipe is fed from the same fluid source. However, it is possible to vary the rate and phase of the fluid flow in any pipe or pipes as required. Typical rates of pulsing the fluid, which is usually a liquid such as water although a gas could be used, are within the range 1 to 100 cycles per second although other pulse rates may be used.

CLAIMS

1. A plough comprising:

soil vibrating means which comprises fluid in which the fluid is used to transmit vibration to the soil.

2. A method of ploughing comprising:

providing a soil vibrating means comprising fluid;

vibrating soil using the soil vibrating means in which the fluid is used to transmit vibration to the soil.

3. A plough or method according to claim 1 or 2 in which the fluid is pulsed.

4. A plough or method according to claim 3 in which the soil vibrating means comprises one or more pulsating fluid flow.

5. A plough or method according to claim 4 in which more than one fluid flow is provided and two or more of these are pulsed at substantially the same frequency.

6. A plough or method according to claims 4 or 5 in which more than one fluid flow is provided and two or more of these are substantially in phase or at substantially a constant phase difference with one or another.

7. A plough or method according to any of claims 4 to 6 in which one or more of the fluid flows comprises a fluid jet.

8. A plough or method according to any preceding claim in which the fluid acts directly on the soil.

9. A plough or method according to any of claims 1 to 7 in which the fluid acts on a separating means which acts on the soil.

10. A plough or method according to claim 9 in which the fluid acts on a flexible diaphragm or piston or the like.

11. The plough or method according to any of claims 3 to 10 in which the fluid is pulsed at a rate of 1 to100 cycles per second.

12. The plough or method according to any preceding claim in which the fluid comprises water.

13. A plough or method according to any preceding claim in which one or more soil vibrating means are situated on a share or shares of the plough.

14. A plough substantially as described herein with reference to and/or as illustrated in figure 3.

15. A method substantially as described herein with reference to and/or as illustrated in figure 3.

P71536GB

Application No: GB 0018020.8
Claims searched: 1-15

Examiner: Philip Ord
Date of search: 15 December 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: FWHAL, FWHAW, FWGB

Int Cl (Ed.7): E02F: 5/02, 5/10

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2049094 A	(COFLEXIP) See esp. abstract	-
A	GB1062250	(HARMSTORF) See esp. p7 lines 66-80	-
A	EP0581357	(PARAGON) See esp. abstract	-
A	US5288172	(REUHL) See esp. abstract	-

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.