

German patent number DE3826513 discloses a method for laying a transmission line under the ground alternative to the established method of digging a trench in the ground along the intended route of the line, laying the line into the trench and then backfilling to bury the line. One embodiment of the apparatus has

5 a pneumatically driven tunnelling head whose route is guided by a C-shaped guide attachment mounted on the end of an arm extending radially from the tunnelling head.

UK patent application number 2085670 discloses a device for loosening

10 the earth around a previously buried cable. The device has a main body comprising inner and outer cylindrical sections, which are moved alternatively, by hydraulic means, relative to one another, such that the apparatus moves along the previously buried cable with a "shinning" movement. As the apparatus moves along the cable, water is supplied to the apparatus and is ejected through nozzles

15 at the front of the apparatus to loosen the earth around the cable in front of the apparatus.

Insert
following
text

^{also} The present invention provides a method of installing a transmission line in the ground, the method comprising the steps of forming a tunnel in the ground using a mole constituted by a water-jetting head and piping for supplying

The present invention provides a tunnelling apparatus comprising: a tunnelling head having a guide means formed for sliding engagement with a pre-installed elongate member; said guide means being connected to and radially off-set from said tunnelling head so that, in use, said tunnelling apparatus forms a tunnel, spaced from, and substantially parallel to, said pre-installed elongate member; said apparatus being characterised by: said tunnelling head comprising a water jet forming head; said apparatus further comprising a length of piping for carrying water to said head, said piping being connected, in use, to said head and extending rearwardly from said head and having sufficient rigidity to enable the head to be manually pushed using said piping; and said guide means being releasably engageable with said pre-installed elongate member.

main body portion thereby defining a passage for producing a first, axially-directed water jet which, in use, cuts a tunnel along the side of the guide, and the deflection face being such as to deflect some of the water supplied along the bore so as to define a second, transversely-directed water jet which, in use, washes
 5 over the guide member.

Conveniently, deflection face is defined by a radial blind bore formed in the main body portion, the radial blind bore intersecting said first-mentioned bore.

** see separate sheet (A)*
~~Advantageously, the main body portion is provided with an externally-threaded extension portion at that end thereof remote from the axial slot.~~

10 Preferably, the guide member is constituted by a guide ring, and one end of the guide ring is fixed to the main body portion, and the other end of the ring is detachably fixed to the main body portion. This facilitates positioning of the guide ring over the buried elongate guide.

The invention will now be described in greater detail, by way of example,
 15 with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of the cutting head of a guided water-jetted mole constructed in accordance with the invention;

Figure 2 is an axial cross-section taken through the front portion of the cutting head of Figure 1;

20 Figure 3 is a plan view of the cutting head front portion;

Figure 4 is a front elevation of the cutting head of Figure 1; and

Figure 5 is an axial cross-section taken through the front portion of a modified form of cutting head.

Referring to the drawings, Figure 1 shows a cutting head H made of
 25 stainless steel. The cutting head H has a main body portion 1 and a screw-threaded shank 2. The front end of the main body portion 1 (that is to say that end remote from the shank 2) is shaped to define a tapered nose portion 1a. The main body portion 1 is formed with an axial bore 3 (see Figure 2) which is contiguous with a bore (not shown) in the shank 2. The bore 3 terminates at a
 30 deflection face 4 formed in the main body portion 1 by a cylindrical, radial blind bore 5. An axial slot 6 extends forwardly of the bore 5, terminating at the free end of the tapered nose portion 1a. The main body portion 1 is provided with a flexible guide ring 7 made from a multi-stranded, high tensile steel wire which is surrounded by short tube sections which act as rollers. One end of the guide ring

Sheet (A)

Insert at page 4, line 8

" The main body portion may be formed such that the free end of the main body portion is tapered. The main body portion may be provided with an externally threaded extension portion at the rear end of the main body portion."

CLAIMS

1. A tunnelling apparatus comprising:
 - a tunnelling head having a guide means formed for sliding engagement
 - 5 with a pre-installed elongate member; *from said tunnelling head*
 connected to and
 said guide means being radially offset; so that, in use, said tunnelling apparatus forms a tunnel, spaced from, and substantially parallel to, said pre-installed elongate member;
 - said apparatus being characterised by:
 - 10 said tunnelling head comprising a water jet forming head;
 - said apparatus further comprising a length of piping for carrying water to said head, said piping being connected, in use, to said head *and extending rearwardly from said head* and having sufficient rigidity to enable the head to be manually pushed using said piping; and
 - said guide means being releasably engageable with said pre-installed
 - 15 elongate member.

2. A method of installing a transmission line in the ground, using the tunnelling apparatus according to claim 1, said method comprising the steps of:
 - engaging said guide means with a pre-installed buried elongate member;
 - 20 attaching said piping to said head;
 - supplying pressurised water to the head;
 - manually pushing said piping substantially in the direction of said pre-installed transmission line, to form thereby a tunnel alongside said pre-installed transmission line; and
 - 25 positioning a transmission line in the tunnel so formed.

3. A method according to claim 2 wherein said transmission line is a ruggedised optical fibre and said transmission line positioning step comprises:
 - withdrawing the tunnelling apparatus; and
 - 30 rodding said fibre into the tunnel.

4. A method according to claim 2, wherein said transmission line is an optical fibre and said transmission line positioning step comprises:

withdrawing the tunnelling apparatus; and
propelling said fibre along the tunnel by the fluid drag of a gaseous medium passed through the tunnel.

- 5 5. A method according to claim 2 wherein said transmission line is an optical fibre and said transmission line positioning step comprises:
withdrawing the tunnelling apparatus;
positioning a tubular pathway within the tunnel; and
passing a gas along the tubular pathway to propel said optical fibre by the
10 fluid drag of the gas.

6. A method according to claim 2 wherein said transmission line is an optical fibre, and said transmission line positioning step comprises:
connecting tubing to said tunnelling apparatus;
15 withdrawing the tunnelling apparatus from the tunnel thereby drawing the tubing through the tunnel;
passing gas along said tubing to propel the optical fibre along said tubing by fluid drag of said gas.

- 20 7. A method according to claim 2 wherein said transmission line is an optical fibre, and said transmission line positioning step includes:
removing the water jet forming head from the piping;
connecting a second head to the piping;
attaching tubing to the second head; and
25 withdrawing the second head and piping from the tunnel thereby drawing said tubing through the tunnel.

8. A cutting head for a tunnelling apparatus, said head comprising:
an elongate main body portion; and
30 a guide member attached to the main body portion;
said guide member being sized and shaped for engagement with a pre-installed elongate member;
said head being characterised in that:

said elongate main body portion is formed with a longitudinally-extending bore for supplying pressurised water to a deflection face formed within said main body portion, said guide member is attached to the main body portion in the region of the deflection face, said main body portion further being formed with an axially extended slot on the other side of the deflection face to the bore, the slot being aligned with the bore and extending to the free end of the main body portion thereby defining a passage for producing a first, axially directed water jet which, in use, cuts a tunnel along the side of the guide, and the deflection face being such as to deflect some of the water supplied along the bore so as to define a second, transversely directed water jet which, in use, washes over the guide member.

9. A head according to claim 8, wherein the deflection face is defined by a radial blind bore formed in the main body portion, the radial blind bore intercepting said longitudinal bore.

10. A head according to claim 8 or claim 9, wherein said ^{free}~~other~~ end of the main body portion is tapered.

11. A head according to any one of claims 8 to 10, wherein the main body portion is provided with an externally threaded extension portion at ~~said one end~~.
the rear end of the main body portion.

12. A head as claimed in any one of claims 8 to 11, wherein the guide member comprises a guide ring.

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13. A head according to claim 12, wherein one end of the guide ring is fixed to the main body portion, and the other end of the guide ring is detachably attached to the main body portion.