(12) UK Patent Application (19) GB (11) 2 169 680 A

(43) Application published 16 Jul 1986

(21) Application No 8520309

(22) Date of filing 13 Aug 1985

(30) Priority data
(31) 8500565 (32) 10 Jan 1985 (33) GB
8505093 27 Feb 1985

(51) INT CL⁴
F16L 55/18

(52) Domestic classification (Edition H):
F2P G2

(56) Documents cited
None

(58) Field of search
F2P
Selected US specifications from IPC sub-class F16L

(71) Applicant
British Gas Corporation (United Kingdom),
152 Grosvenor Road, London SW1V 3JL

(72) Inventors
Malcolm Wayman
Geoffrey Ingles Mood

(74) Agent and/or Address for Service
R J Cummings,
British Gas Corporation, Patents Dept, 326 High Holborn,
London WC1V 7PT

(54) Mole

(57) A mole has an intermediate section including a frusto-conical wall in two parts 16 and 18, each of 180° angular extent. A ram 24 operates a wedge 22 longitudinally to move the first part 16 outwardly or inwardly transversely of the body to burst the main.

The parts 16, 18 are slidably trapped to the wedge 22 by slide components projecting into grooves.

Side loads acting on parts 16, 18 are reacted through the wedge 22. A bearing surface provided by a pad 56 for the wedge 22 prevents side and bending loads acting on the body from being imposed on the cylinder 24.

FIG.1A.

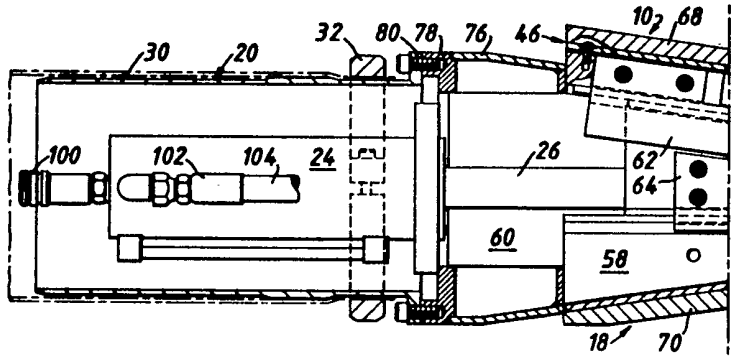
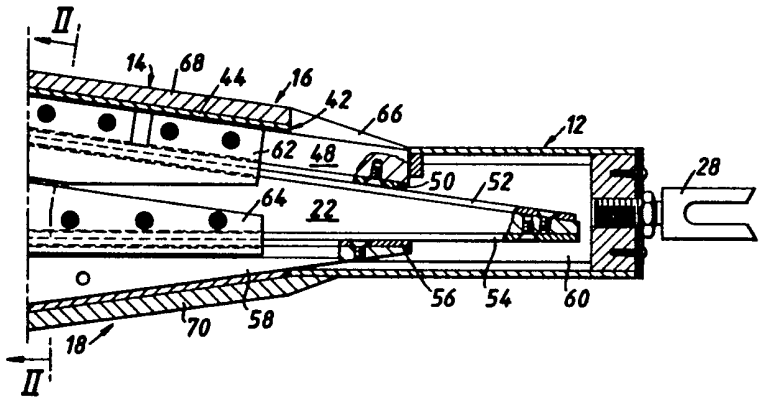


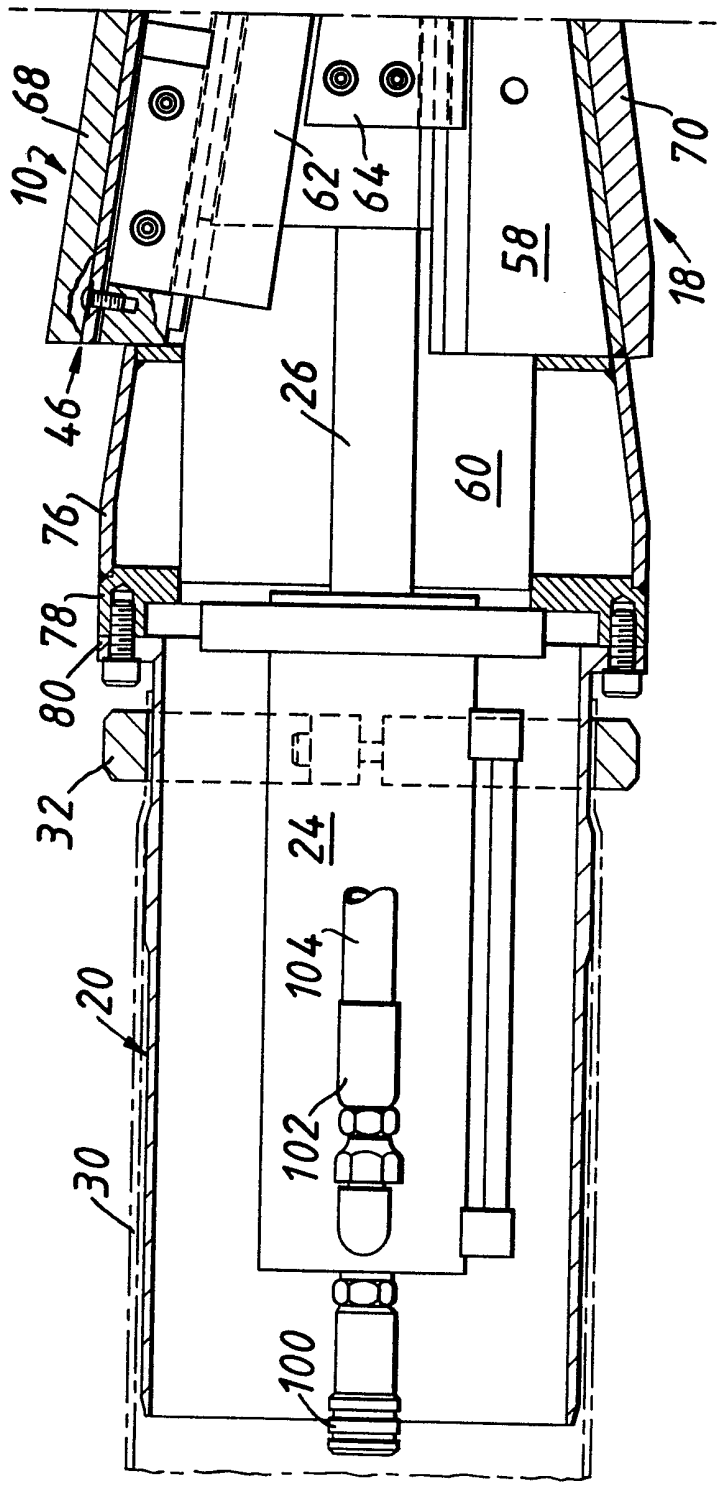
FIG.1B.



GB 2 169 680 A

2169680

FIG.1A.



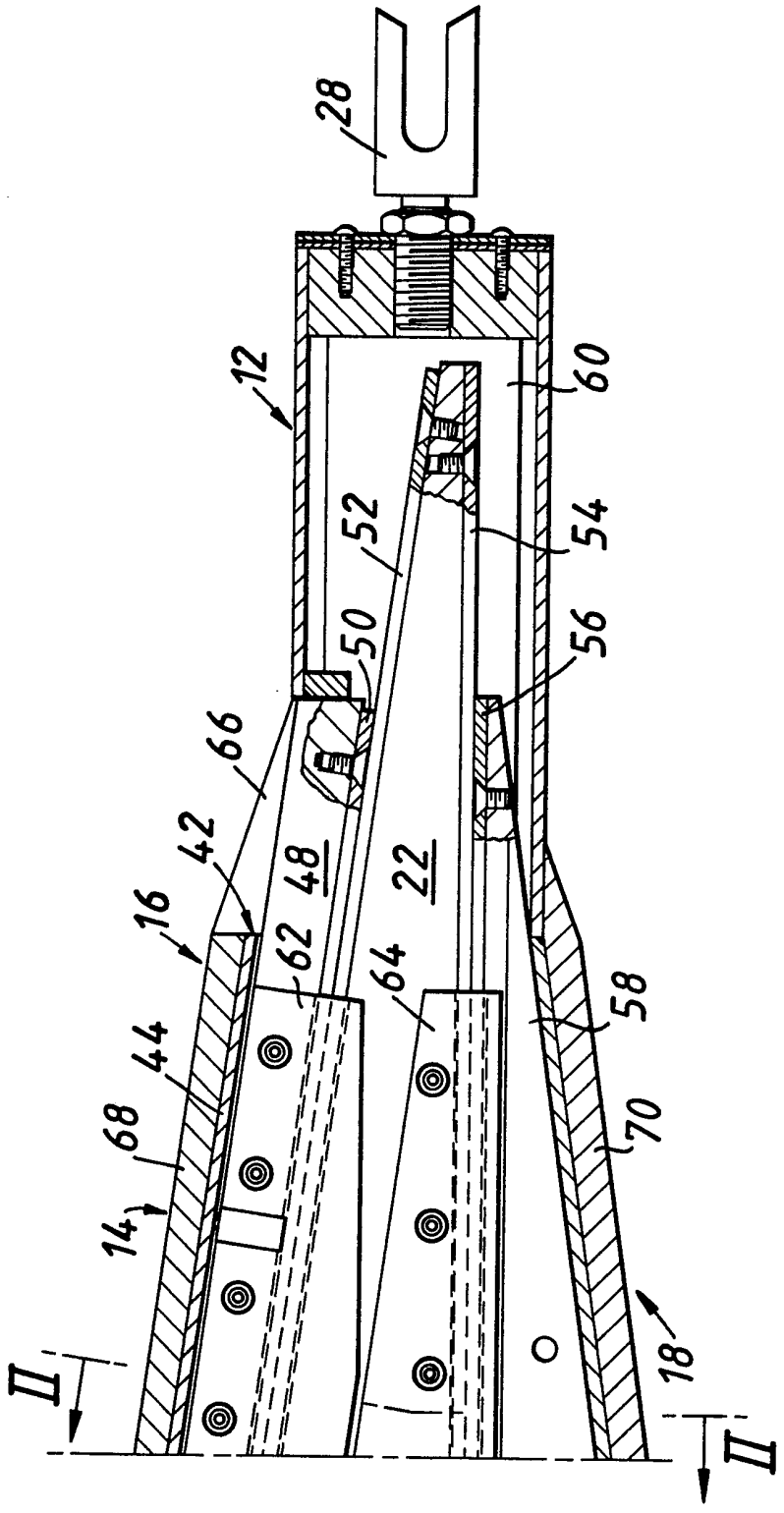


FIG. 1B.

FIG. 2.

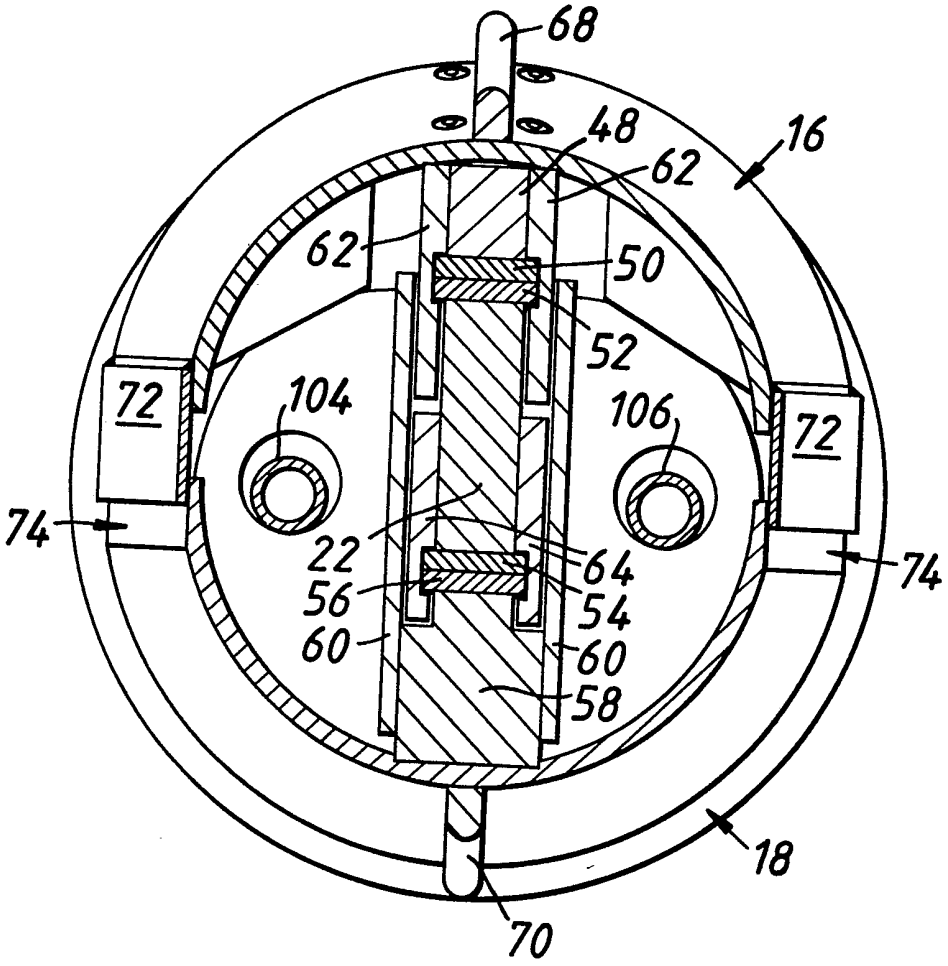


FIG. 3.

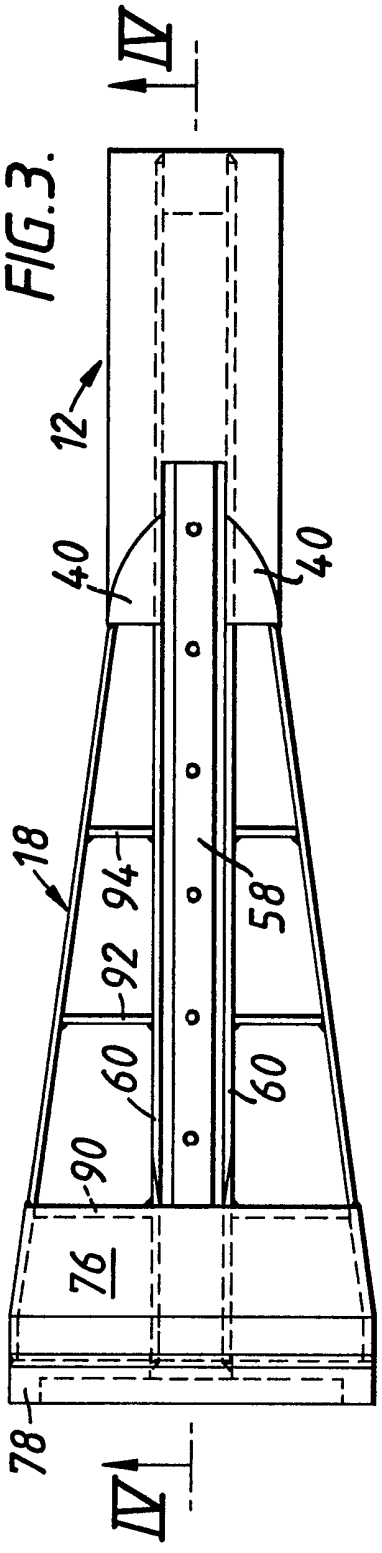
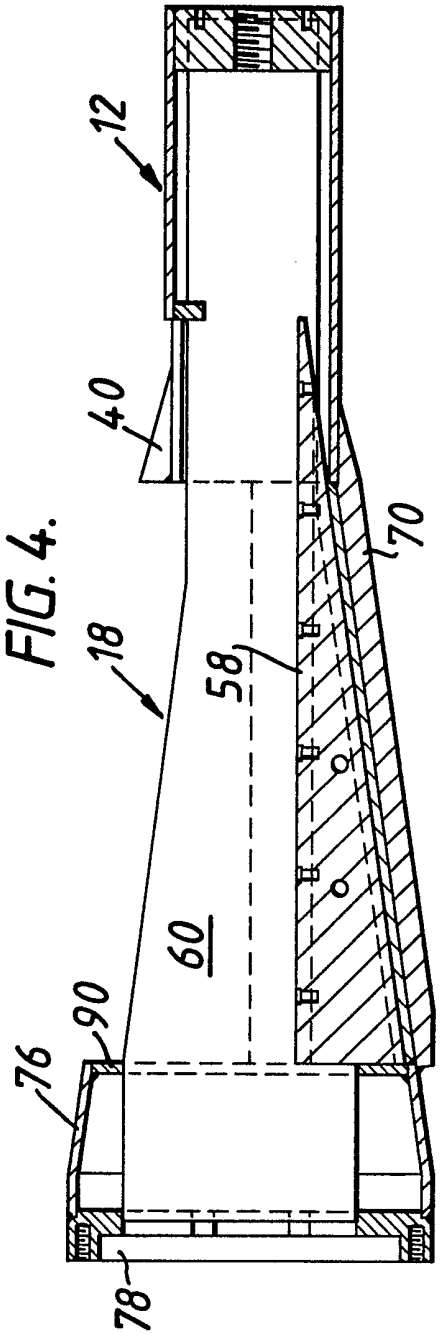


FIG. 4.



SPECIFICATION

Main bursting tool

The invention relates to main bursting tools particularly, though not exclusively, such tools for bursting gas, water or sewer mains.

One form of main bursting tool described in British patent application Publication No 2092701A has been used which consists of a body which is drawn through the main by a cable and which includes a percussive mechanism operable to subject the main to repeated impacts. The tool has a relatively narrow blade which is pivotally connected at its leading end to the tool body and which is angularly displaceable outwardly and inwardly by a hydraulic cylinder. The blade is intended to cut through main joints by outward displacement. Such a tool has been found to be ineffective in bursting mains of some constructions and in certain types of ground. A similar form of tool has been proposed in British patent application Publication No 2139938A in which a pneumatic hammer strikes pivotal blades.

Another form of tool has been proposed in British patent application Publication No 2122299 A for use in correcting misalignment or reduced cross-section of sewer pipes so that the original internal diameter is restored. Side-loads acting on the displaceable elements and on the wedge which displaces the elements are transferred to the piston rod of the hydraulic cylinder which moves the wedge. Accordingly, the cylinder assembly is subjected to bending loads which could be prejudicial to the life or proper working of the tool.

It is the object of the invention to provide a main bursting tool by which the drawbacks of the previously used or proposed tools are reduced or eliminated.

A main bursting tool, according to the invention, comprises an elongated body, first and second means for attaching the body, respectively, to a towing device and to a bore liner, the body comprising an outer wall having an outer shape tapering towards the leading end of the body and divided longitudinally into first and second parts between which a wedge is movable longitudinally of the body by a hydraulic cylinder to cause the first part to move transversely of the body as the wedge slides against a bearing surface associated with the first part and a bearing surface on the body arranged to prevent side-loads and bending loads acting on the body from being imposed on the cylinder.

Preferably, said second part extends forwardly from an annular portion of the wall of the body.

Preferably, each of said first and second parts is of 180° circumferential extent.

An embodiment of the invention will now be descibed by way of example with reference to the accompanying drawings, in which:—

Figure 1A together with *Figure 1B* is a longitudinal vertical section through the main bursting tool;

Figure 2 is a vertical section on the line II–II in Fig. 1;

Figure 3 is a plan of part of the body of the tool shown in Figs 1 and 2; and

Figure 4 is a vertical section on the line IV-IV in Fig. 3.

The tool shown in the drawings consists of the following main components: a body 10 made up of three sections namely, a leading cylindrical section 12, an intermediate section 14 having a wall of frusto-conical shape and made up of a first part 16 and a second part 18; a cylindrical trailing section 20; a wedge 22 arranged between the parts 16 and 18; and a hydraulic cylinder 24 housed in the trailing section 20 and having a piston rod 26 connected to the wedge 22.

The tool is towed through the main to be burst by a towing device such as a self-advancing mechanism which can "walk" inside the main or by a towing device in the form of a cable connected to a winch. The cable or other device is attached to a clevis 28 secured to the leading end of the leading section 12. The tool forms an enlarged bore in the ground and draws into the bore a liner 30 which extends over the trailing section 20 and which is secured to it by a clamp 32.

The leading section 12 and the intermediate section 14 are of welded steel, fabricated construction. Alternatively, they may be of cast construction. The leading section 12 is a hollow cylinder which accomodates the leading end of the wedge 22 when it is advanced beyond the smaller diameter end of the intermediate section 14. The leading section 12 has an opening in its wall at its trailing end which receives the leading end of the first part 16 of the intermediate section 14 (Fig. 4). At each side of the opening the trailing portion of the leading section 12 carries a shroud 40. The two shrouds 40 shroud the leading edge 42 of a wall 44 of the first part 14.

The wall 44 is of part-frusto-conical shape and forms 180° of the circumference of the intermediate section 14 between the smaller-diameter end of the section 14 and the trailing end 46 of the wall 44. The wall 44 is carried by an inner elongate support 48 having an inner bearing pad 50 slidably engaging a bearing pad 52 on the upper side of the wedge 22. The member 48 movably accommodated between the shrouds 40.

The lower side of the wedge 22 has a bearing pad 54 slidably engaging a bearing pad 56 carried by a counter-support 58. The support 58 is secured to the second part 18 of the intermediate section 14.

The support 58 is positioned between two side-plates 60, which extend right through the

intermediate section 14 and the leading section 12 and which accommodate the wedge 22 between them.

The outer margins of the support pads 50, 52 are trapped in sliding engagement in opposed grooves in a pair of plates 62 secued to respective opposite sides of the member 48. The pads 54, 56 are similarly trapped in opposed grooves in a pair of plates 64 secured to respective opposite sides of the wedge 22. In that way, the first part 16 is obliged to retract inwardly when the wedge 22 is retracted leftwards, as seen in Fig. 1.

The member 48 carries a short outer rib 66 as a continuation of a rib 68 formed on the outside of the wall 44. The leading end of the rib 66 does not protrude beyong the outer surface of the leading section 12 even in the outer position of the part 16 shown in Fig. 1. The part 18 has an outer rib 70 diametrally opposite the rib 68. Such ribs are optional.

The first part 16 has at each side margin an extension strip 72 welded to its outer surface (Fig. 2). The inner surfaces of the strips 72 slide on plane marginal surfaces 74 of the lower, second part 18. The intermediate section 14 includes an annular, generally frustoconical wall portion 76. The second part 18 of the section is secured to, and extends forwardly from, the leading edge of the wall portion 76. The trailing edge of the portion 76 is secured to a circular plate 78, which has an approximately cruciform opening. The trailing section 20 is a steel cylinder and has a leading, external flange 80 secured by bolts to the plate 78. The hydraulic cylinder 24 has a forward flange secured to the plate 78. The trailing ends of the side-plates 60 are received in the opening in the plate 78 and are secured to the plate.

The side-plates 60 are braced by transverse plates 90, 92 and 94, which are secured to the side-plates and to the portion 76 or the second part 18. At their leading ends, the side-plates 60 are secured to the inside surface of the leading section 12.

The cylinder 24 has connections such as 100 by which fluid can be conveyed from and to a power pack (not shown) via conduits extending through the liner 30. When the tool is towed by a self-propelled device, further connections such as 102 enable fluid to be conveyed to the cylinders of the towiging device via conduits 104, 106 passing through the body 10 and out through apertures (not shown) through the leading end of the leading section 12.

When the tool is towed (as is preferred) by a tow cable only hydraulic connections to the cylinder are required. In that case the leading section is preferably modified from that shown to provide a tapered lug to which a D-shaped shackle is connected by a pin.

OPERATION

Assuming the tool is to be towed by a cable and winch, the cable is fed through a section of existing buried main, the ends of which have been exposed by excavation. The winch is preferably a hydraulically-driven winch accommodated in the excavation at the end of the main so that the cable passes in a straight line out of the main winch barrel.

One end of the relatively thin liner 30 of plastic material is fitted over the trailing section 20 and attached to it by the clamp 32. The cable is attached to the body 10 and the winch is operated to draw the tool into the main. The first part 16 is retracted at this stage. Next, the cylinder 24 is operated to advance the wedge 22 which forces the first part 16 outwardly. Typically, for example, hydraulic pressures up to 207 bar (3000 lbs. per sq. inch) are used to develop forces up to 36 Tonnes exerted by the first and second parts 16, 18 upon the main and the surrounding ground. The outward movement of the part 16 bursts the main and considerably enlarges the bore in the ground. For example, a typical main has an inside diameter of 150 millimetres (6 inches) and the diameter of the fully-expanded bore formed by the tool is 240mm (9.5 inches) to receive a liner 30 of 202 mm (8 inches) outside diameter. The same tool can also be used, when suitably designed, to burst mains having inside diameteres of 127 mm (5 inches), 178 mm (7 inches) or 203 mm (8 inches). The tool made in a different size will burst mains having inside diameters of 102 mm (4 inches) or 127 mm (5 inches) for example. The tool is effective in bursting mains of ductile iron, as well as of cast iron, clay or vitreous ceramic material.

The winch can be set to operate at a constant pressure which allows the winch to be effectively self-controlling so that relatively little, if any, action is required by the operator to control the winch. A relatively low cable tension is sufficient of not more than 3 Tonnes, and typically of around 1 Tonne. The tool advances while resistance is low i.e. after the first part 16 has been retracted following a bursting action. The cable tension keeps the tool in engagement with the unburst main. The actions described above are repeated, the first part 16 successively advancing and retracting and the tool being progressively advanced by the cable tension as the main is burst and expanded.

The fact that the first part 16 advances without changing its angular orientation relatively to the body means that the leading ends of the two parts 16 and 18 are effective in bursting the main and enlarging the opening which contained it. The full outward travel of the first part 16 is available at the leading end as well as throughout the remainder of the part.

The first part 16 is shown in Fig. 1 in its

fully-advanced position, in which the transverse dimension between the trailing edge 46 and the diametrically opposite point of the body 10 is the same as the maximum outer diameter of the portion 76. This fact, with the relatively reduced diameter of the trailing section 20 considerably relieves the liner 30 of frictional forces during operation.

After the liner 30 has been pulled through the burst main the tool is released from the liner 30. A new main typically of plastic material such as polyethylene is pulled through the liner 30, which protects the outer surface of the main from abrasion and scratches. Alternatively, the liner and the new main arranged within the liner are both attached to the tool and pulled through the enlarged bore together. As a further alternative, typically in for sewer main replacement for example, only a new main is attached to the tool and pulled through the bore, no separate liner being used. The new main itself then constitutes the sole liner and in this specification the term "liner" means either a main itself or a liner through which the new main passes or will pass.

The tool is effective regardless of its angular orientation about its central longitudinal axis. In some operations the tool may turn about that axis initially as it advances until the first part 16 is presented to one side of the main. After that, the tool then continues to operate in that same orientation. However, that mode of operation is entirely effective.

The body 10 is of strong construction and includes the counter-support 58 on which the bearing pad 56 is mounted. The cylinder 24 is mounted at one end, cantilever-wise upon the plate 78. Bending loads and side loads acting on the body are borne by the strong body and reacted within it. For example, side-loads acting on the first and second parts 16, 18 are reacted through the wedge 22. The bearing surface provided by the pad 56 for the wedge 22 accordingly prevents side and bending loads acting on the body from being imposed on the cylinder 24.

In a modification (not shown) there are more than one first part, for example two first parts each of 180° extent with overlap provided at the side edges by extension strips. The wedge slides between the two first parts. The second part 18 is dispensed with in such a construction.

In such a modificaton, the body has a spine member rigidly secured to the portion 76. The spine member corresponds to the counter-support 58 and is slidingly engaged at its bearing pad by the wedge. Thus, side-loads and bending loads acting on the body are prevented by the spine member from being imposed on the cylinder assembly.

In the retracted position of the first part 16 shown in Fig. 1, the wall 44 is a frusto-conical continuation of the wall of the portion 76. A bulk-head is formed by a transverse plate inside the first part 16 adjacent the rear end of the wall 44 and close to the portion 76, so that when the first part is advanced there is no open gap between the wall 44 and the portion 76.

The first and second parts 16, 18, the leading section 12 and the wall portion 76 provide a virtually closed housing complementary to the cylinder 24. The wedge 22 and exposed part of the piston rod 26 are shielded by that housing at all times during operation, whether the first part 16 is advanced or retracted.

CLAIMS

1. A main bursting tool comprising an elongated body, first and second means for attaching the body, respectively, to a towing device and to a bore liner, the body comprising an outer wall having an outer shape tapering towards the leading end of the body and divided longitudinally into first and second parts between which a wedge is movable longitudinally of the body by a hydraulic cylinder to cause the first part to move transversely of the body as the wedge slides against a bearing surface associated with the first part and a bearing surface on the body arranged to prevent side-loads and bending loads acting on the body from being imposed on the cylinder.

2. A tool according to claim 1, in which said second part is immovable relatively to said bearing surface on the body.

3. A tool according to claim 2, in which said second part extends forwardly from an annular frusto-conical portion of the wall of the body.

4. A tool according to claim 1, 2, or 3, in which each of said first and second parts is of 180° circumferential extent.

5. A tool according to any preceding claim in which the longitudinal margins of one of said first and second parts are overlapped by respective longitudinal marginal extensions of the other of said first and second parts.

6. A tool according to any preceding claim, in which a leading section of the body extends longitudinally of the body ahead of the frusto-conical wall and in which shroud means on the leading section protrude outwardly to shroud the leading edge of the first part of the wall even when it is in its outermost position.

7. A tool according to claim 5, in which the first part of the wall is carried by an elongated longitudinal inner member and in which the shroud means is in two parts between which said member is movably accommodated.

8. A tool according to any preceding claim, in which said first and second parts carry longitudinally-extending and diametrally-opposed longitudinal external ribs.

9. A tool according to claim 8, in which the rib on the first part extends forwardly beyond the rib on the second part.

10. A tool according to claim 8 or claim 9, in which the leading end of the rib on the first part does not protrude beyond the outer surface of said leading section even when the first part occupies its outer position.

11. A tool according to any preceding claim, in which the wedge is longer than said first part.

12. A tool according to claim 11, in which the wedge extends beyond the leading end of said first part in all positions of the wedge.

13. A tool according to any preceding claim, in which said second means comprise a hollow trailing section of the body which accommodates the hydraulic cylinder and over which the leading end of the liner is fitted.

14. A tool according to claim 1, substantially as hereinbefore described with reference to the accompanying drawings.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1986, 4235.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.