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Fikse et al.

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[45] **Oct. 2, 1973**

[54] **PROTECTIVE INCHING SHIELD FOR PIPE-LAYING**

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[73] Assignees: **Constructors-Pamco**; Seattle, Wash.

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[52] **U.S. Cl.** ..... **61/85**, 61/45 R

[51] **Int. Cl.** **E01g 3/02**

[58] **Field of Search** 61/42–45, 84, 85; 299/33

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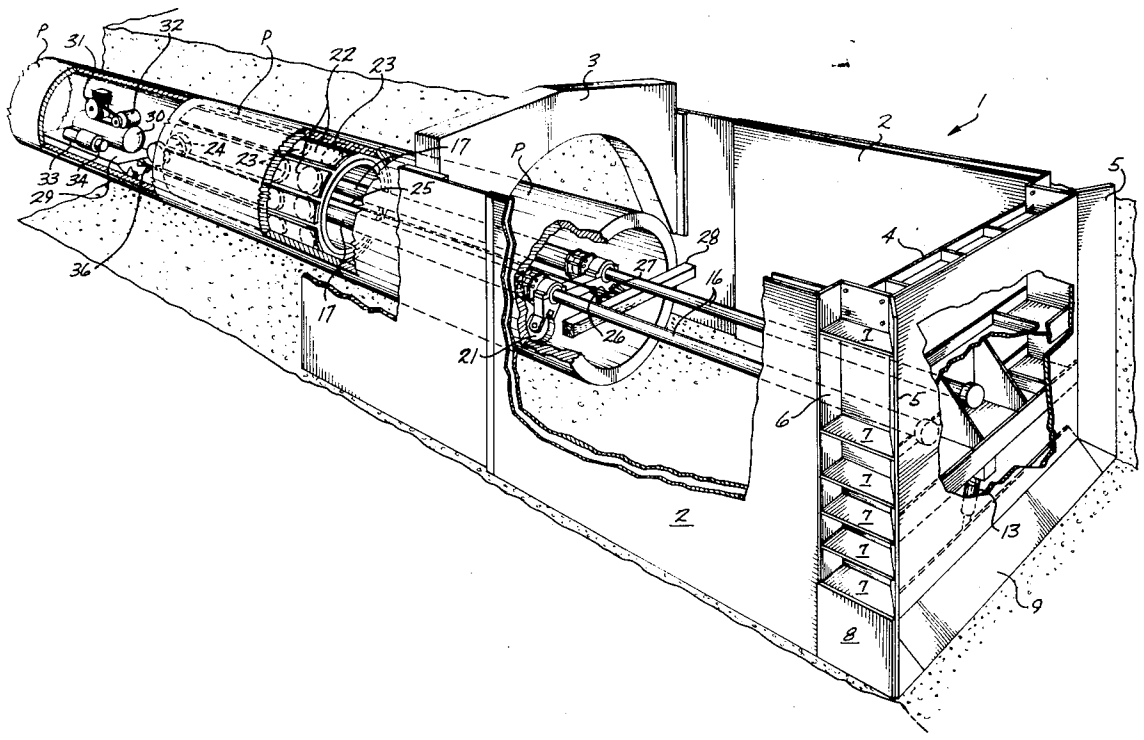
Primary Examiner—J. Karl Bell

Attorney—Robert W. Beach

[57] **ABSTRACT**

The forward end of a large pipe being laid in a trench opens into an open-topped casing. A fluid pressure jack received within the forward portion of the pipe being laid reacts between the forward wall of the casing and a tube within the pipe and anchored to it by expansion means. Extension of the jack to force the casing forward relative to the pipe is followed by retraction of the jack means sufficiently to enable the next pipe section to be placed between the forward end of the pipe and the forward casing wall. A winch anchored from the pipe can draw a cross-piece spanning the open end of the pipe toward the laid pipe for setting the last laid pipe section.

17 Claims, 11 Drawing Figures



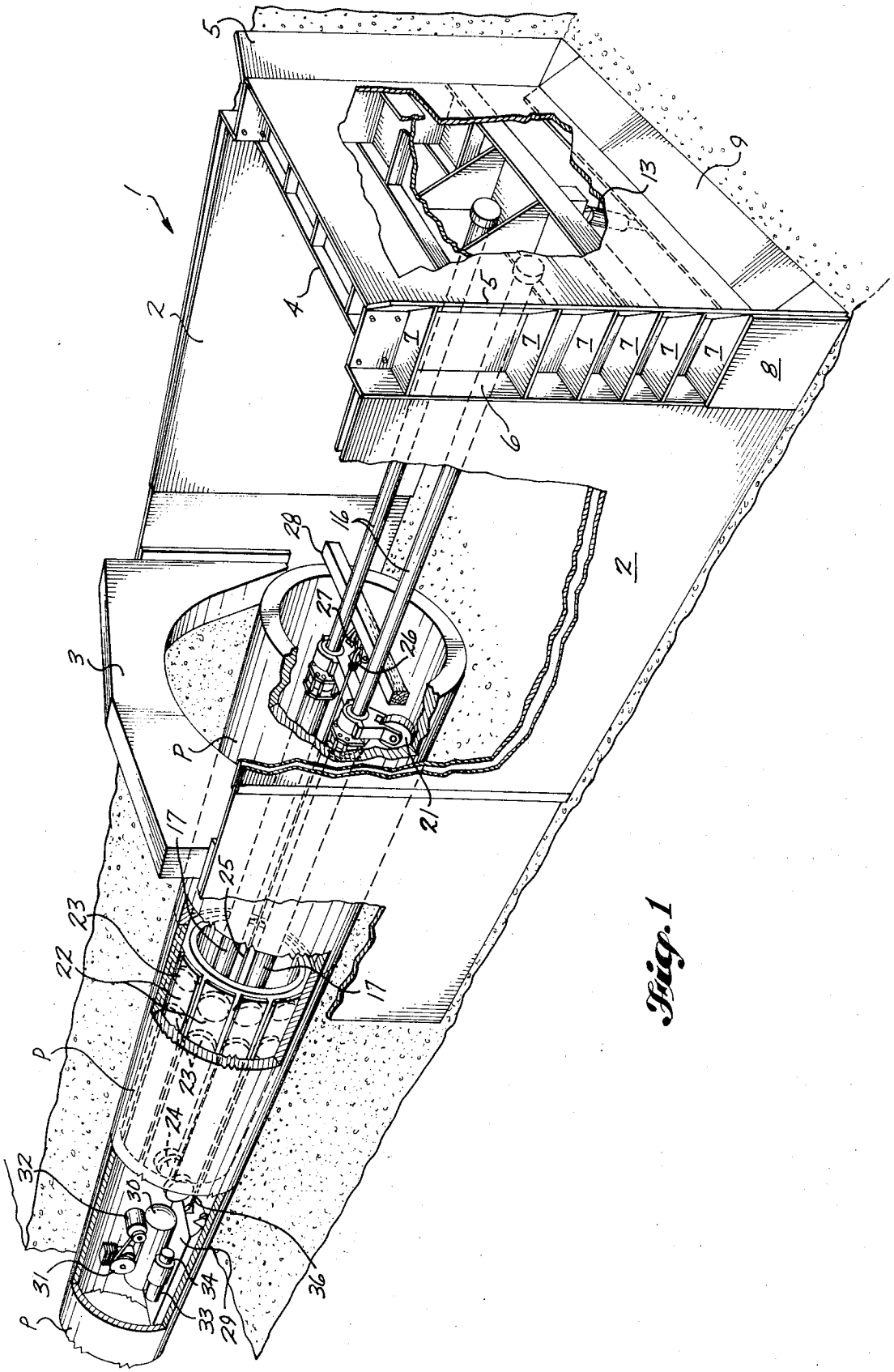


Fig. 1

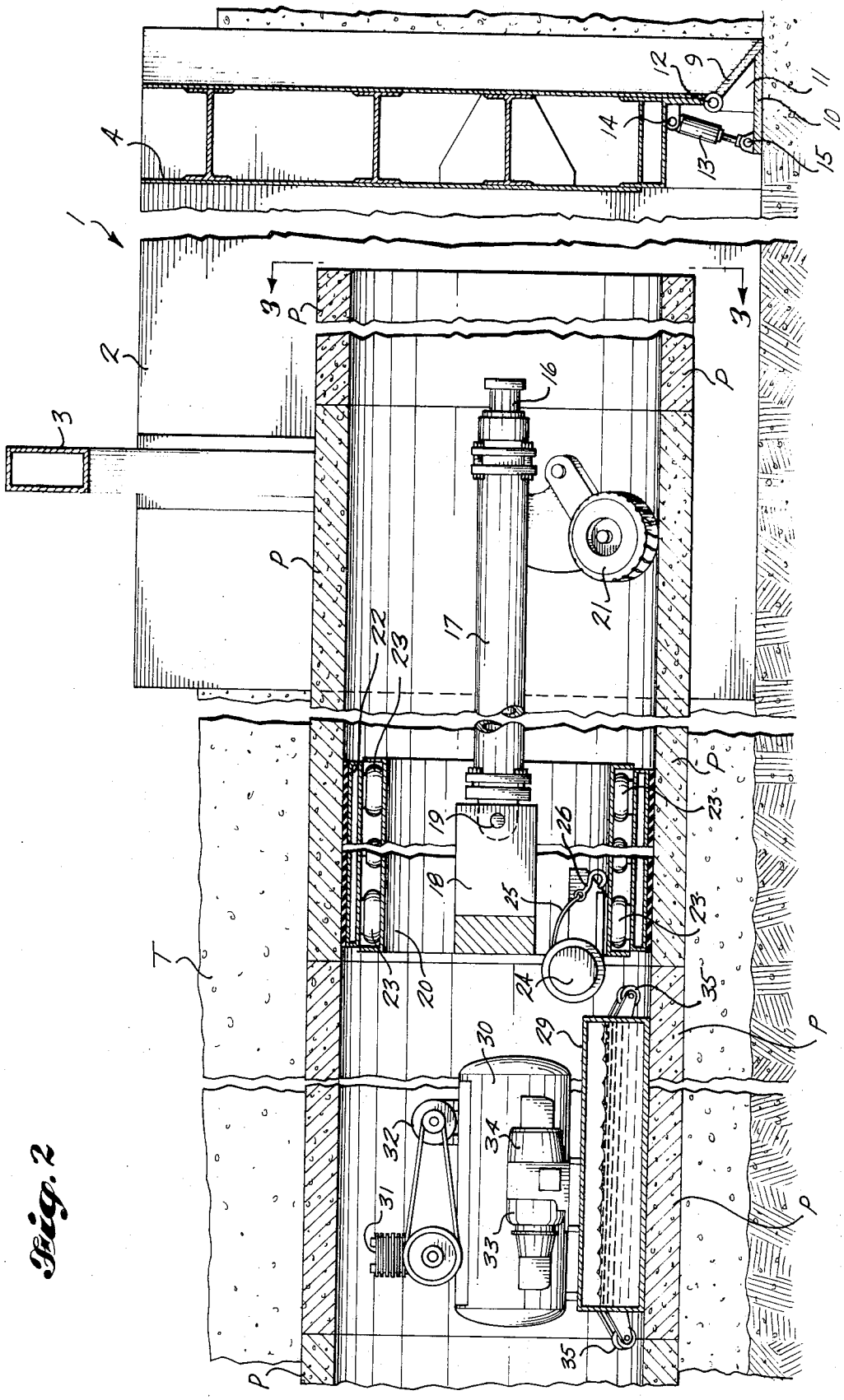

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Fig. 2

Fig. 4

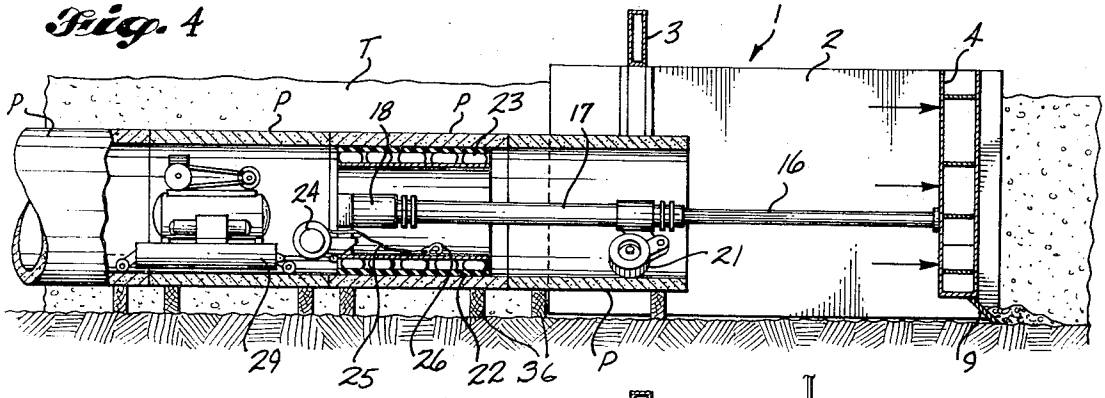


Fig. 5

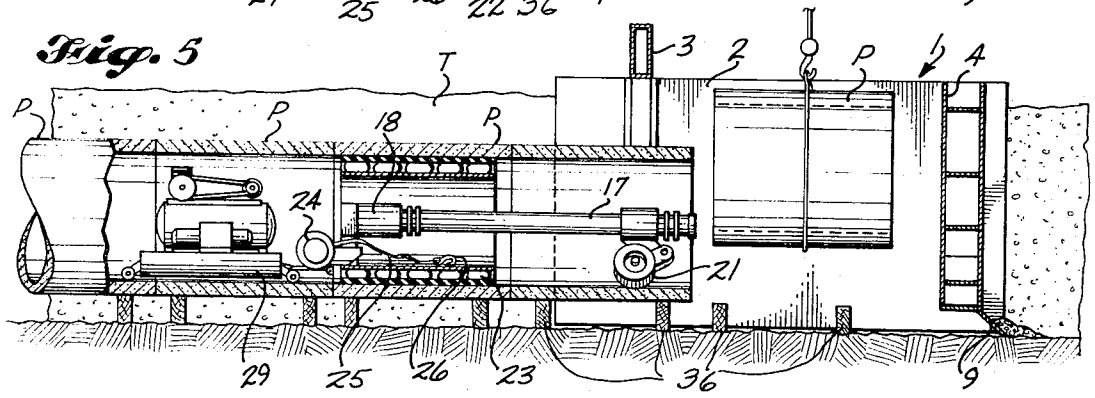


Fig. 6

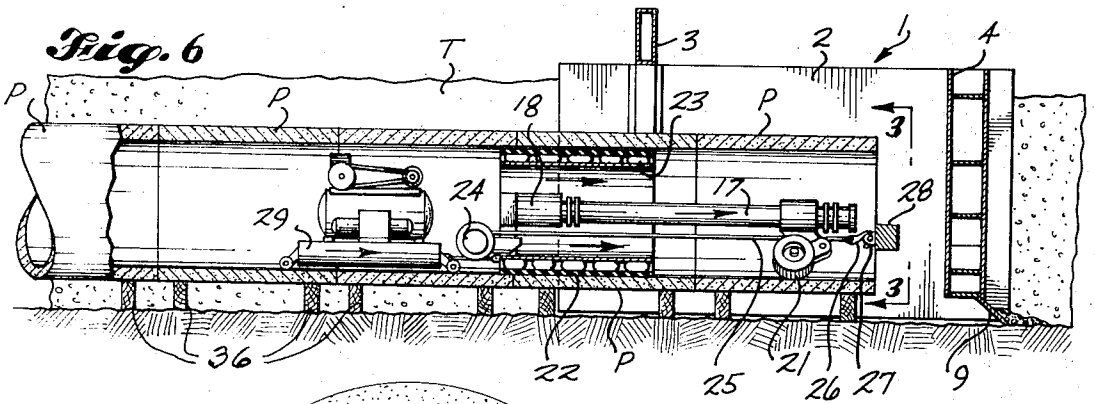
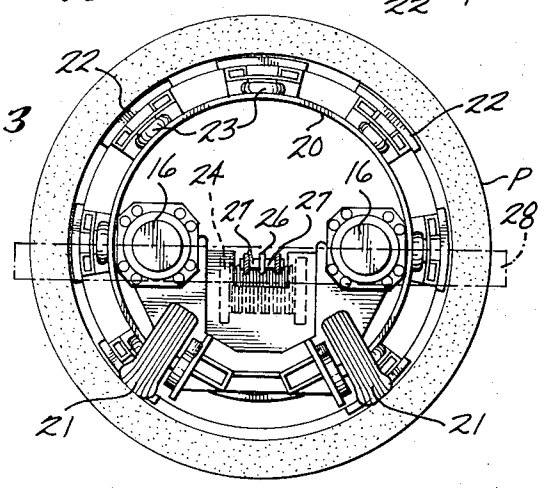


Fig. 3



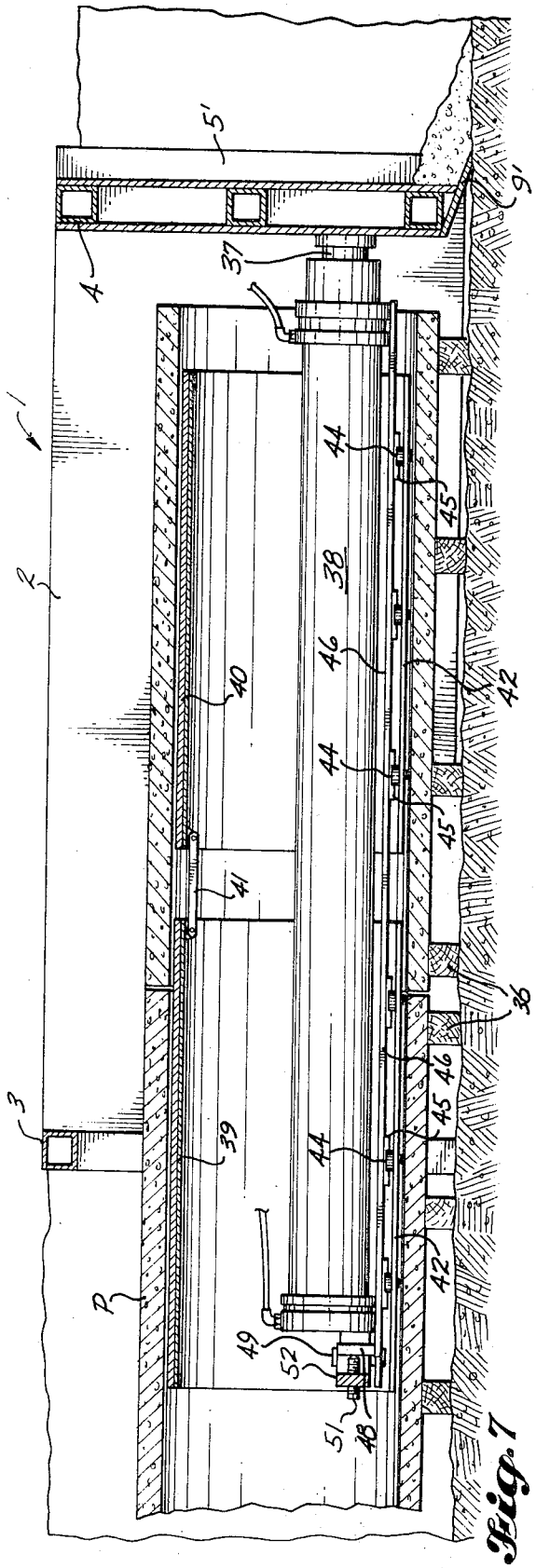

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Fig. 7

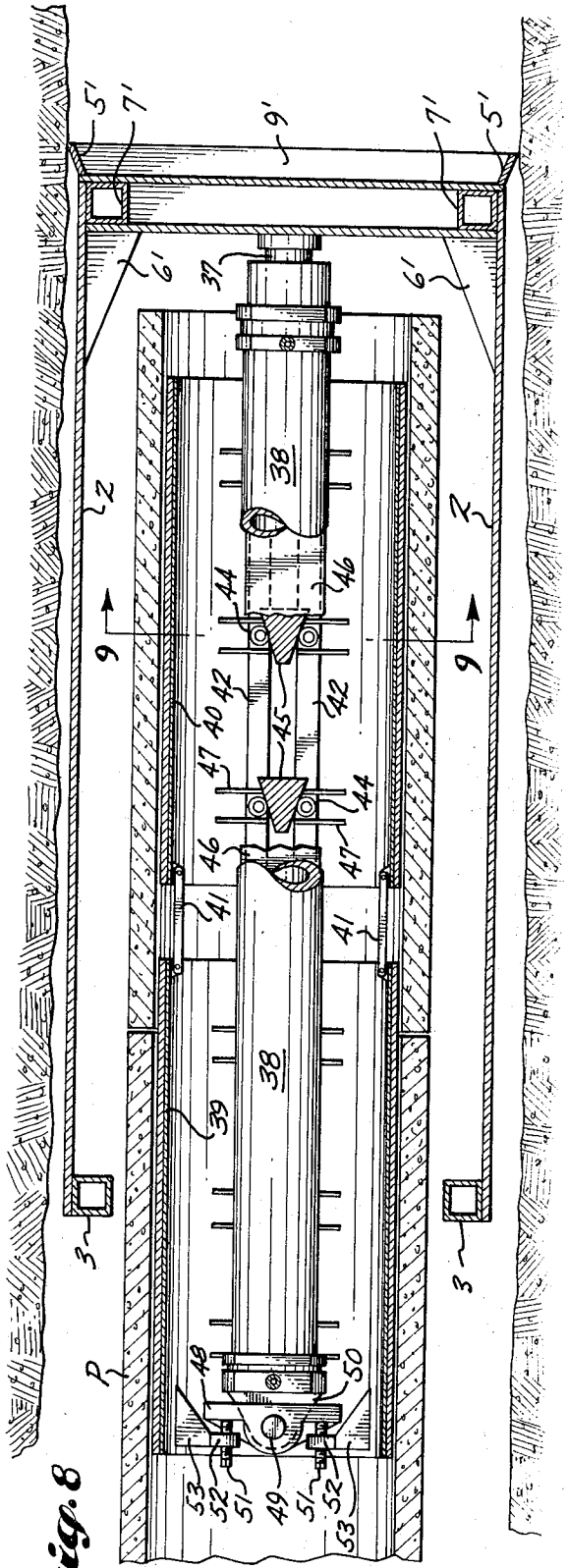

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Fig. 8

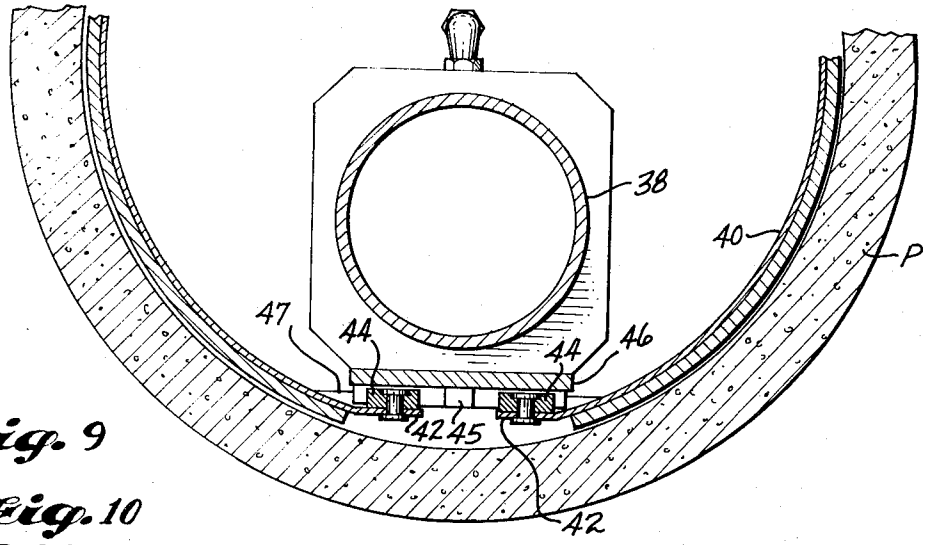
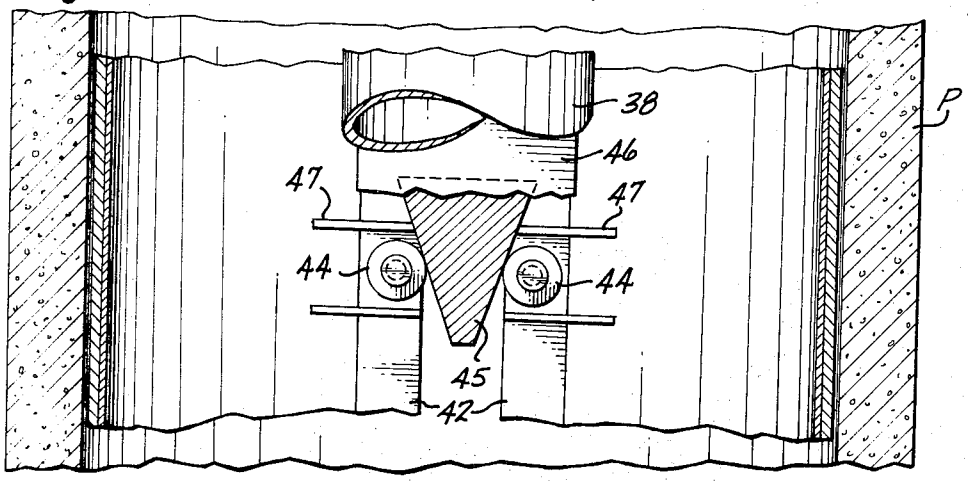


Fig. 9

Fig. 10



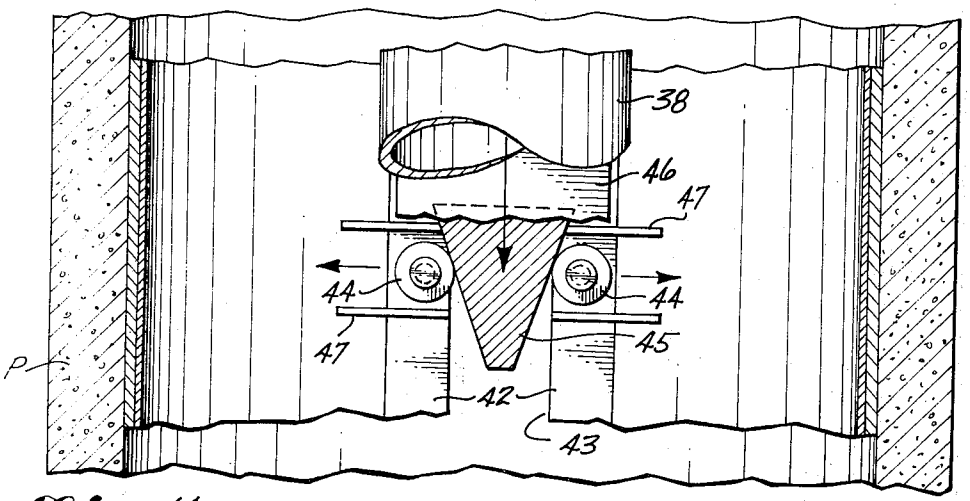


Fig. 11

PROTECTIVE INCHING SHIELD FOR PIPE-LAYING

The present invention relates to an apparatus and method to facilitate laying pipe of large size in sections in an open-cut trench.

A principal object of the invention is to provide a self-propelled shield for protecting workmen and pipe being laid from caving of the trench in which the pipe is being laid.

A further object is to provide apparatus which will serve the dual purpose of setting in place successive pipe sections which are laid in a trench and which will also advance the protective casing along the trench.

Another object is to provide apparatus for advancing a protective casing which can be deflected to some extent to one side or the other to follow the course of the trench in which the pipe is being laid.

It is also an object to house in the previouslylaid pipe portion apparatus for shifting the protective casing along a trench.

Still another object of the invention is to provide apparatus which will effect incremental movement of a protective casing along a trench without interference with the operation of laying pipe sections in such trench.

FIG. 1 is a top perspective of a section of laid pipe and a protective casing in a trench associated with such pipe, portions of the pipe and casing being broken away.

FIG. 2 is a vertical section through such section of laid pipe and protective casing.

FIG. 3 is a transverse vertical section taken along line 3—3 of FIG. 2.

FIGS. 4, 5 and 6 are longitudinal sections through a section of laid pipe and protective casing similar to FIG. 2, but showing apparatus in different operative positions.

FIG. 7 is a longitudinal vertical section through a section of laid pipe and a protective casing showing a different form of apparatus, and

FIG. 8 is a horizontal section through such pipe and apparatus, parts being broken away.

FIG. 9 is a fragmentary vertical transverse section through the apparatus shown in FIGS. 7 and 8 on an enlarged scale. FIGS. 10 and 11 are horizontal sections through a portion of such apparatus on an enlarged scale, showing parts in different operative positions.

Protective casings have been used heretofore to prevent caving of the sides of a trench in connection with a pipe-laying operation. Such casings have been lowered into place by a crane and either have been shifted along the trench by a crane or pulled by a vehicle such as a tractor. In both cases the shifting of the casing along the trench is an unwieldy operation and difficult to control precisely; and for safety the workmen should not be in the casing while it is being shifted. The casing of the present invention is self-propelled and can be inched along a trench in which a pipe is being laid under complete control of an operator stationed within the protective casing and without danger to such operator or to other workmen that may be in the casing.

The protective casing 1 forming a shield for a pipe-laying operation includes opposite side walls 2 and has an open top and bottom. An arch 3 spanning between the side walls 2 bridges across the forward portion of laid pipe P which projects into the space within the casing. A forward wall 4 connects the forward ends of the side walls 2 at a location spaced lengthwise of the casing and trench from the arch 3. The cross-sectional shape of the casing conforms substantially to the cross-sectional shape of the trench in which the pipe is to be laid, preferably being substantially wider than the diameter of the pipe P in order to afford adequate room for workmen to work in the space between the casing and the pipe.

In order to minimize resistance to movement of the casing side walls 2 along the trench, upright scouring flanges 5 are provided along opposite vertical edges of the forward wall 4 inclined fownardly from such wall. To brace such flanges, rear flanges 6 also project from the opposite upright edges of the forward wall 4, and each pair of flanges 5 and 6 are connected by horizontal spacer plates 7 and a bottom vertical plate 8. A bottom flange 9 inclined forwardly from the lower edge of the wall 4 will scour the bottom of the trench. Such side and bottom flanges will not dig the trench, of course, which must be excavated ahead of the casing by suitable excavation equipment, but such flanges will shave the side walls and bottom of the trench as the casing is moved forward to provide adequate clearance for the side walls 2 of the casing and a clean bottom for the trench.

Particularly in laying sewer and drainage pipes, it is important that the pipe be laid on a predetermined grade, which may change from time to time. In order to facilitate laying of the pipe to such a grade the slope of the trench bottom can be increased or decreased by altering the angle of inclination of the lower flange 9 on the forward wall 4. For this purpose the flange is integrated with a bottom plate 10 disposed at an angle to the forwardly projecting flange 9 by angular connecting plates 11, as shown in FIG. 2. The rigid structure of triangular cross section thus formed is mounted for swinging about a horizontal axis on the lower edge of the forward wall 4 of the casing by pivot rods 12.

The angle of the flange 9 relative to the forward wall of the casing can be altered by varying the effective length of a fluid pressure jack or jacks 13. Each jack has its upper end connected to the lower portion of the wall 4 by a pivot 14 and its lower end connected to the lower plate 10 by a pivot 15. By varying the effective length of the jack or jacks 13 appropriately, the leading edge of flange 9 and plate 10 can be raised to decrease the slope of the trench floor or lowered to increase the slope of the trench floor.

Extending generally centrally through the laid sections of pipe P are jack means including at least one plunger 16 reciprocable in a fluid pressure cylinder 17, preferably of the hydraulic type. In FIG. 1 twin jacks are shown which are spaced apart horizontally. An end of each jack cylinder is connected to an anchor block 18 by a pivot 19 defining a horizontal axis about which the jacks can swing up and down. The anchor block 18 is received in and carried by an anchor tube 20 which can be locked relative to the pipe P. The end of jack cylinders 17 remote from the anchor block 18 are supported from the pipe P and stabilized by wheels 21 carried by downwardly diverging legs.

The anchor tube 20 can be fixed lengthwise of pipe P by expanding its circumference into tight engagement with the pipe interior. Such expansion is effected bu urging shoes 22 outwardly by supplying fluid under pressure to inflatable bags 23 interposed between the tubes 20 and the shoes 22.

The operating mechanism further includes a winch 24 mounted on the end of tube 20 farther from the open end of the pipe P. A line 25 having a hook 26 on its free end is wound on the winch. Such hook can engage a rod 27 secured to the central portion of a crossbar 28, extending substantially diametrally across the open end of the pipe P and bearing on its opposite sides, as shown in FIGS. 1, 3 and 6.

The power mechanism for operating the apparatus may be incorporated in a unit located in the pipe at the side of the anchor tube 20 remote from the open pipe end. Such unit includes a liquid reservoir 29 from which fluid may be supplied under pressure to the cylinders 17 of the hydraulic jack. An electric motor 33 and pump 34 pump such liquid through suitable hoses (not shown) to the jack cylinders 17. A compressed air receiving tank 30 is mounted on the hydraulic reservoir 29 and air compressor 31 and its driving motor 32 are mounted in turn on the tank 30 for compressing air and supplying it to such receiving tank. Such compressed air is supplied through suitable hoses to inflate bags 23. The power unit can be supported from the pipe P by rollers 33 for travel along the pipe.

FIGS. 1 and 4 show the apparatus completing a forward incremental movement for inching of the casing 2. The air bags 23 are expanded to hold the anchor tube 20 in place in the pipe P. The undercarriage wheels 21 support the jack cylinders 17 at a location adjacent to the forward open end of the pipe P. Hydraulic liquid supplied from the reservoir 29 to the jack cylinder has forced the plungers 16 forward against the forward wall 4 of the casing 1, and extension of such plungers has pushed the forward wall away from the open forward end of the pipe P a distance greater than the length of a pipe section. Greater pressure may be supplied to one or the other of the cylinders 17 if it should be desired to cant the forward end of the casing to one side or the other for effecting the desired alignment of the casing with the trench in which the casing is located.

The valves controlling flow of hydraulic liquid to the jack cylinders 17 is then reversed to effect retraction of the plungers 16 into the cylinders, as shown in FIG. 5. The next section of the pipe P can then be lowered into the trench between the forward end of the laid pipe and the forward wall 4 of the casing 1. Such pipe section is set on blocks 36 to align it with the pipe already laid and to enable fill material to be compacted under the pipe after it has been set in order to provide proper bedding for the pipe. The new section of the pipe is set against the laid pipe end by placing the crossbar 28 across its forward end as shown in FIG. 6, connecting hook 26 and pulling such crossbar toward the anchored tube 20 by reeling in line 25 on which 24 to draw such new pipe section snugly against the previously laid pipe.

With the new pipe section thus set in place the entire operating apparatus can be moved forward an increment approximately equal to the length of a pipe section. Such movement is accomplished by relieving the fluid pressure in the bags 23 so that the tube-anchoring shoes 22 will not be pressed against the inner wall of the pipe. The power unit behind the anchor tube 20 can be connected to that tube for movement with it. If the winch 24 is then reeled in further with the line 25 anchored by hook 26 to crossbar 28, the anchor tube 20 and power unit will be pulled forward while the wheels 21 of the under-carriage supporting the jack cylinders 17 will roll along the pipe until the apparatus has been shifted to the position shown in FIG. 6.

The tube-anchoring bags 23 can now be inflated again to anchor the tube 20 once more within the pipe P. The winch 24 is operated to slaken the line 25 so that the hook 26 can be disengaged from rod 27 and the crossbar 28 removed. Next, hydraulic liquid is supplied to the cylinders 17 of the jacks for extending plungers 16 into engagement with the end wall 4 of the casing 1 for pushing the casing forward the next increment through a distance approximately equal to the length of a section of the pipe P. The plungers 16 are then retracted and the next section of pipe P is lowered into the trench, as described above.

The mechanism shown in FIGS. 7 to 11, inclusive, is generally the same as that described above. The casing 1, including the side walls 2, arch 3 and forward wall 4 may be identical, but the upright flanges 5' and horizontal bottom flange 9' on the forward wall of the casing are shown as differing to some extent. The apparatus shown in these figures is adapted for use in a smaller pipe than that for which the apparatus of FIGS. 1 to 6 is best suited. In the apparatus of FIGS. 7 to 11 a single hydraulic jack is shown including a plunger 37 reciprocable in the hydraulic cylinder 38. In this apparatus the jack extends through two anchoring tubes 39 and 40 arranged in tandem and having their adjacent ends connected by links 41 to facilitate their placement in and removal from the pipe P.

The anchoring tubes 39 and 40 are slotted throughout their lengths at the bottom to provide adjacent marginal portions 42 on opposite sides of the slot 43. Rollers 44 are mounted at spaced intervals along the margins 42 for rotation about generally radial axes. Such rollers are arranged in pairs with the two rollers of each pair located in circumferential registration at opposite sides of the slot 43. Wedging heads 45 engageable between the rollers of the respective pairs are mounted on an elongated plate 46 extending longitudinally of the jack cylinder 38 and located beneath it. Such plate is anchored to the jack cylinder and is supported on crossbars 47 carried by the margins 42 of the tubes 39 and 40 at opposite sides of their slots 43.

The end of the elongated plate 45 carrying the wedges 45 remote from plunger 37 has an anchor bar 48 secured to it. This anchor bar is connected to the corresponding end of the cylinder 38 by pivot 49 extending through a central projection from such anchor bar and a projection from such cylinder end. The angular position of such anchor bar and consequently of the plate 46 can be adjusted by set screws 51 engaging the respective ends of the anchor bar. These set screws are threaded through ears 52 carried by plates 53 secured to the inner wall of the split tube 39.

The operation of the apparatus shown in FIGS. 7 to 11 is generally the same as that described in connection with the apparatus of FIGS. 1 to 6, inclusive. After a section of pipe P has been set in the trench on blocks 36, fluid under pressure is supplied to the cylinder 38 to project the plunger 37 into engagement with the forward wall 40 of the casing 1. The head of the plunger is then secured to such casing wall and fluid under pressure is supplied to the jack cylinder 38 in a jack-contracting manner. Because the head of plunger 37 is secured to the wall 4, the plunger cannot move and consequently the jack cylinder will be moved to the

right relative to the pipe P as seen in FIGS. 7 and 8 until the split tubes 39 and 40 reach the positions shown in those figures. The tubes can slide through the pipe under these circumstances because the wedges 45 will be moved to the right to allow the tubes 39 and 40 to contract.

When the apparatus has reached the disposition shown in FIGS. 7 and 8, the supply of fluid under pressure to jack cylinder 38 can be reversed again, in which case the wedges 45 will be forced to be left as seen in FIG. 8 to spread the rollers 44 and expand the tubes 39 and 40 circumferentially so that their peripheries, having surface layers of friction material, will be pressed into frictional engagement with the inner wall of the pipe P. Continued supply of fluid under pressure to the jack cylinder 38 will then force the plunger 37 to the right for moving casing 1 along the trench an incremental distance approximately equal to the length of the next section of pipe P. The head of the plunger 37 is then disconnected from the wall 4, and the supply of fluid under pressure to the jack cylinder 38 is reversed so that the plunger is retracted into the cylinder to enable the next section of pipe P to be lowered into the trench onto blocks 36. Fluid is then supplied to the cylinder 38 to extend plunger 37 again, its head is secured to the wall 34, and the inching operation of the apparatus is repeated.

We claim:

1. Inching shield apparatus for protecting a pipe-laying operation comprising an open-topped casing disposable in a trench ahead of a sectional pipe being laid and including a forward wall and opposite side walls, anchor means received within and operable to grip the interior of laid pipe having a forward end opening into said casing, and force-exerting means engaged between said anchor means and said forward wall of said casing for exerting force to increase the spacing between the pipe forward end and said casing forward wall for receiving a further section of pipe between the forward pipe end and the casing forward wall.

2. The apparatus defined in claim 1, in which the anchor means include means expandable into engagement with the interior wall of laid pipe.

3. The apparatus defined in claim 2, in which the expandable means are inflatable bags.

4. The apparatus defined in claim 2, in which the expandable means include a split tube.

5. The apparatus defined in claim 4, and wedging means for expanding the split tube.

6. The apparatus defined in claim 5, in which the wedging means are operated by the force-exerting means to effect expansion of the expandable means.

7. The apparatus defined in claim 1, in which the anchoring means includes a circumferentially expandable tube and the force-exerting means are located inwardly of said expandable tube.

8. The apparatus defined in claim 1, in which the force-exerting means include fluid-pressure jack means.

9. The apparatus defined in claim 8, and fluid pressure supply means located within laid pipe for supplying fluid under pressure to the jack means.

10. The apparatus defined in claim 8, in which the jack means are elongated lengthwise of laid pipe and are located within and generally centrally of such laid pipe, and supporting means spaced lengthwise of the pipe from the anchor means for effecting support for the jack means.

11. The apparatus defined in claim 10, in which the supporting means includes wheels engageable with the lower portion of the pipe inner wall and spaced arcuately of the pipe.

12. The apparatus defined in claim 8, in which the jack means includes twin cylinders and plungers spaced apart generally horizontally for engagement of the plungers with spaced locations of the casing forward wall.

13. The apparatus defined in claim 1, and pulling means engageable between the pipe forward end and the anchor means for effecting movement of the anchor means toward the pipe forward end.

14. The apparatus defined in claim 13, in which the pulling means includes a winch located within the laid pipe.

15. The apparatus defined in claim 1, in which the casing includes arch means spaced longitudinally of the side walls from the forward wall of the casing and spanning between the upper portions of the opposite side walls.

16. The apparatus defined in claim 1, in which the casing forward wall has shearing edges projecting forwardly therefrom for shearing the trench walls.

17. The apparatus defined in claim 16, in which the edge flanges include a flange on the bottom of the casing forward wall, pivot means connecting said bottom flange to the casing forward wall, and means connected between said bottom flange and the casing forward wall for effecting swinging of said bottom flange relative to the casing forward wall about a generally horizontal axis.

* * * * *