Aug. 23, 1960 J. F. LIZZADRO 2,950,085

MACHINE FOR PUSHING PIPE OR CONDUIT

Filed May 25, 1955

3 Sheets-Sheet 1

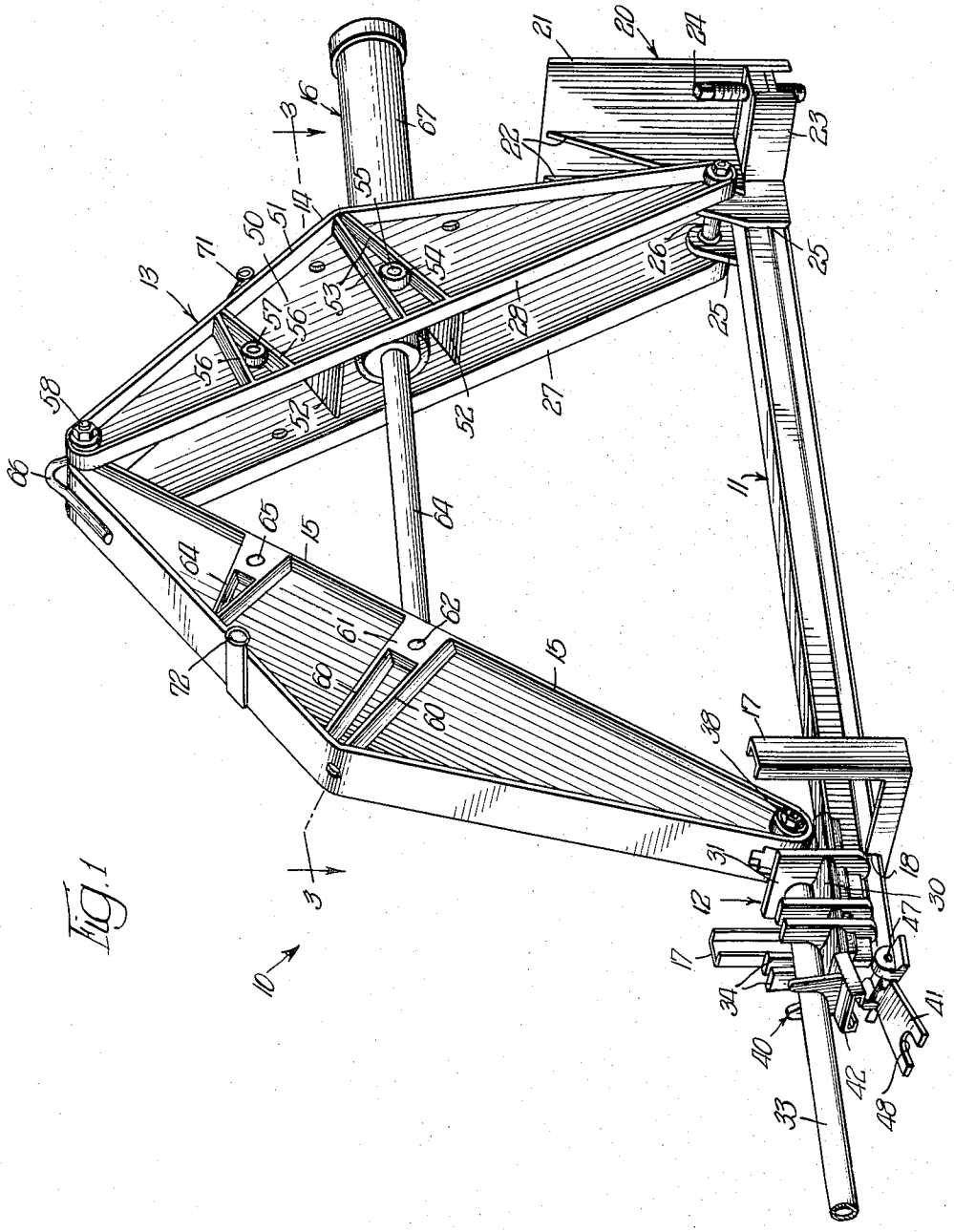


Fig. 1

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Fig. 2

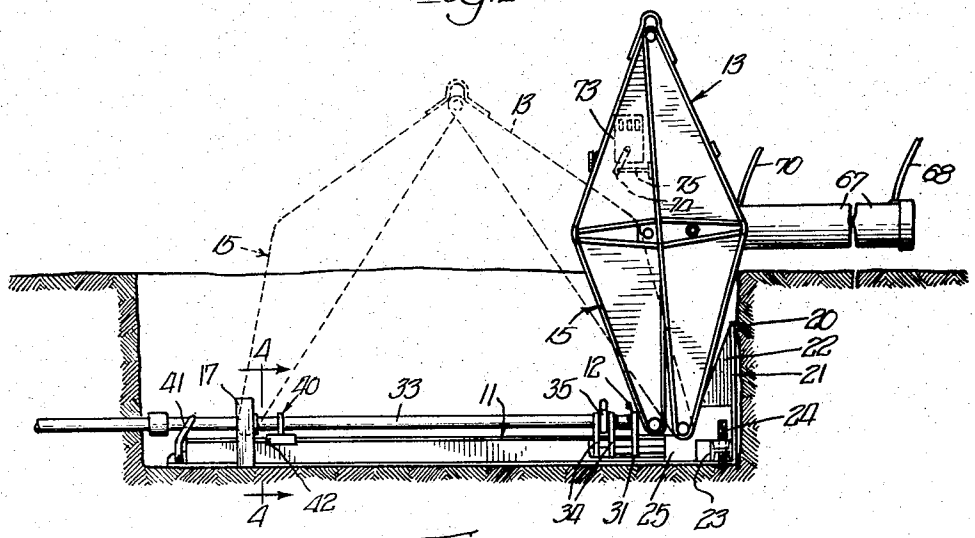


Fig. 3

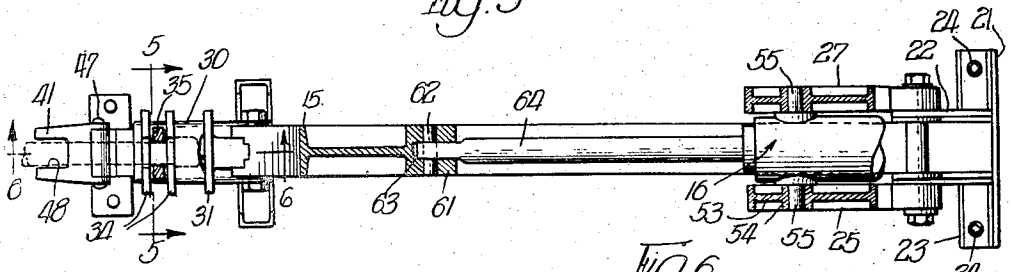


Fig. 6

Fig. 4

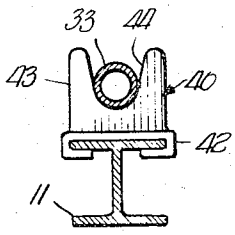


Fig. 5

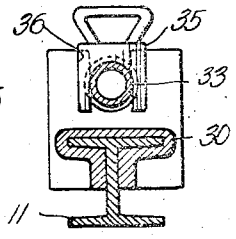
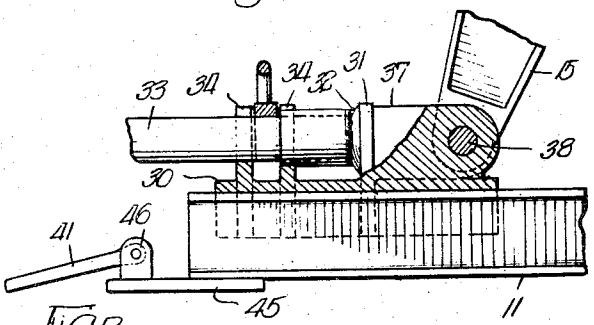
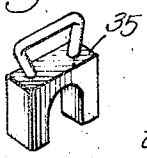


Fig. 7





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Fig. 8

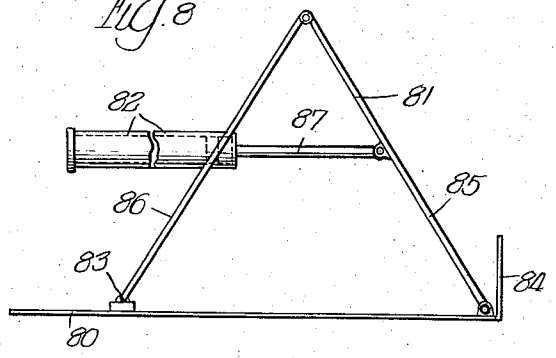


Fig. 9

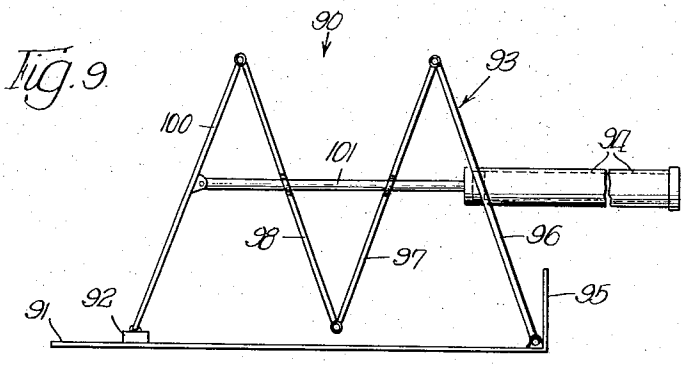
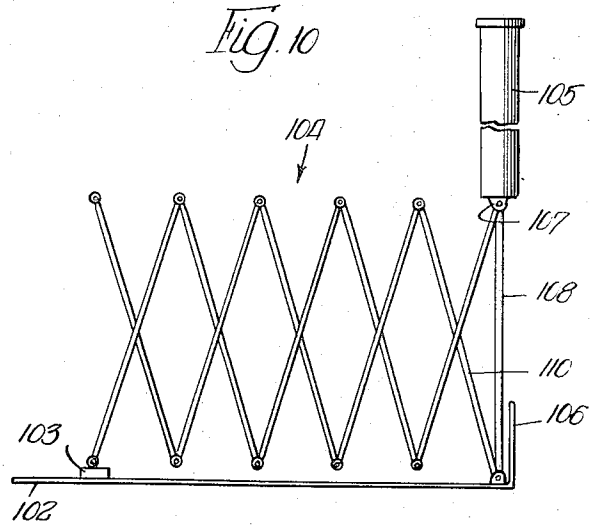


Fig. 10



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MACHINE FOR PUSHING PIPE OR CONDUIT

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4 Claims. (Cl. 254—29)

This invention relates, generally, to machines for pushing and pulling pipes or conduits through the ground, and it has particular relation to improvements and innovations in such machines.

Machines for pushing pipes or conduits through the soil so as to eliminate the need for digging a ditch or trench for the full length of the pipe to be laid, are broadly old and disclosed, for example, in several patents including 750,959 dated February 2, 1904, 1,776,798 dated September 30, 1930, and 2,656,148 dated October 20, 1953. While machines of this type are primarily designed and used to force or push lengths of pipe or conduit through the ground, by a suitable reversing of parts they may also be used to withdraw lengths of pipe or conduit which have already been laid.

The pipe pulling or pushing machines which have heretofore been commercially available have not been too satisfactory for several reasons. One of the main defects has been the shortness of the stroke of such machines. Another defect has been the slowness with which these machines operate. Still another defect of the prior pipe pulling or pushing machines has been the awkwardness involved in using them in trenches of various depths.

The foregoing and other defects associated with the pipe pulling or pushing machines heretofore available have been eliminated in the pipe or conduit pushing or pulling machines provided by the present invention.

Generally stated, the object of the present invention is the provision of pipe or conduit pushing or pulling machines characterized by (1) simplified and rugged design; (2) long strokes; (3) fast operation; (4) the machines may be used in trenches of any depth; (5) ease and convenience of operation; (6) flexibility; and (7) increased accuracy in controlling the direction of the pipe or conduit.

Another object of the invention is a pipe pushing or pulling machine in which an extensible linkage is actuated by a power device in such manner that the stroke of the power device is only a fraction of the pipe pushing stroke of the linkage.

Certain other objects of the invention will, in part, be obvious and will, in part, appear hereinafter.

For a more complete understanding of the nature and scope of the invention, reference may now be had to the following detailed description thereof taken in connection with the accompanying drawings, wherein:

Fig. 1 is a perspective view of a pipe or conduit pushing and pulling machine forming one embodiment of the present invention with the respective parts being shown in the relative positions they occupy at the completion of a pushing stroke;

Fig. 2 is a side elevational view of the machine shown in Fig. 1 positioned in a trench with the parts being shown in full line in the relative positions they occupy at the beginning of a pushing stroke and being indicated in broken line at the completion of the pushing stroke;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is an enlarged sectional view taken on the line 4—4 of Fig. 2;

Fig. 5 is an enlarged sectional view taken on the line 5—5 of Fig. 3;

Fig. 6 is an enlarged sectional view, partly broken away, taken on line 6—6 of Fig. 3;

Fig. 7 is a perspective view of a clip which is used when pipe or conduit is pulled by the machine;

Fig. 8 is a diagrammatic view illustrating a second embodiment of the invention;

Fig. 9 is a diagrammatice view shownig a third embodiment of the invention; and

Fig. 10 is a diagrammatic view showing a fourth embodiment of the invention.

Considering first the embodiment of the invention shown in Figs. 1–7, the pipe or conduit pushing or pulling machine is indicated generally at 10 in Fig. 1 and comprises the following main units or sub-assemblies: a rail member 11; rail follower 12; extensible linkage 13 comprising levers 14 and 15; and power unit 16.

The rail member 11 is in the form of an I-beam and is adapted to rest on the bottom of a trench as shown in Fig. 2. In order to facilitate the leveling of the machine 10 and maintain it in an upright position, the rail member 11 is provided on one end (the front) with a U-shaped frame 17 which may suitably be fabricated from lengths of channel stock with the bottom member being provided with a notch 18 in the center for receiving the bottom flange of the I-beam 11.

At the rear, the rail 11 is provided with a ground engaging base plate 20 which may be fabricated from a plate member 21, gussets 22 and an I-beam member 23. The end of the rail is welded to the middle of the I-beam 23. In order to level the machine 10, leveling screws 24—24 are provided at opposite ends of the I-beam member 23.

A pair of plates 25—25 are welded to opposite sides of the rear end of the rail 11 and project thereabove on opposite sides with registering apertures for receiving a pin 26. The opposite sides 27 and 28 of the lever 14 fit over the outside of the plates 25 and the pin 26 extends through the registering openings provided in the bottom ends of the side plates 27 and 28, as shown.

The follower assembly, indicated generally at 12, comprises a hollow T-shaped member 30 (Fig. 5) which fits slidably over the upper portion of the rail 11. A pusher plate 31 is welded to the side member 30 and carries on the front side thereof a rounded boss 32 adapted to fit into the end of a length of pipe designated at 33 or a nipple screwed over the end thereof. Forwardly of the pusher plate 31 a pair of pipe or conduit support plates 34—34 are secured on the slide member 30 and these are spaced apart for receipt therebetween of a pipe nipple clip 35 (Fig. 7), the purpose of which will be described below. Each of the members 34 is provided with a V- or U-shaped opening 35 in the top thereof for receipt of the pipe or conduct 33.

Rearwardly of the pusher plate 31 the follower 12 is provided with a large rearwardly extending lug 37 adapted to fit in-between the bifurcated bottom end of the lever 15. The rear end of the lug 37 is transversely apertured for receipt of a pin 38 which serves to pivotally connect the apertured bottom end of the lever 15 to the follower 12.

When the extensible linkage means 13 is in its closed or retracted position as shown in Fig. 2 with the follower 12 drawn to the end of the rail 11 adjacent the rear end of the machine, the forward end of the length of pipe 33 is supported over the front end of the rail 11 by means of two members—a slide member 40 (Fig. 4) and a swingable support member 41. The slide member 40 has a channeled bottom portion 42 which fits slidably over the top side of the I-beam or rail 11 and has an upstand-

ing portion 43 provided with a pipe-receiving V- or U-shaped opening 44. A flat plate 45 (Fig. 6) has a portion secured to the underside of the lower flange of the rail 11 and a portion extending forwardly of the front end of the rail, the latter portion being provided with a pair of upstanding lugs 46. The swingable support member 41 has one end pivotably mounted between the lugs 46, as at 47 (Fig. 1), and its other end provided with a pipe-receiving V- or U-shaped opening 48. The weight of the pipe resting on the bottom of the slot 48 in the rearwardly inclined upper end of the member 41 maintains it in pipe-supporting position until it is tilted out of the way by the slide member 40 when the follower 12 reaches the forward end of its stroke as described more fully hereinafter.

While the levers 14 and 15 comprising the extensible linkage 13 may take several forms, the forms shown in the drawings provide a very rigid and economical design. As mentioned, the lever 14 is comprised of two side members 27 and 28 of the same design. Each has a central web portion 50 generally triangular in shape, with the flange 51 extending around the periphery thereof. The side members 27 and 28 are secured together adjacent the middle portions thereof by means of connecting plates 52—52 welded therebetween. On the outer sides of the webs 50 cross members 53—53 provide additional bracing. A collar 54 is secured in an aperture in the web 50 intermediate the reinforcing members 53—53 in each side member 27 and 28. The collars 54 serve as journals for the trunnions 55—55 which project horizontally from opposite sides of the power cylinder unit 16.

Preferably the side members 27 and 28 are provided with a second pair of bracing members 56—56 upwardly from the midportion thereof and each of the webs 50 is provided with a second collar 57 which can serve as another journal for the trunnions 55.

The upper ends of the side members 27 and 28 fit on opposite sides of the upper end of the lever 15, and the upper ends of both levers 14 and 15 are apertured for receiving a hinge pin 58.

The lever 15 is fabricated in generally the same way as one of the side members 27 or 28 but is made heavier so as to have approximately the same strength as the combined strength of the side members 27 and 28. In the middle portion the lever 15 is provided on opposite sides with reinforcing cross members 60—60 between each pair of which is located a collar 61. The collars 61 serve as journals for a pin 62 projecting through the lever 15 and through an eye 63 formed on the end of the piston rod 64. As in the case of the lever 14, the lever 15 is also provided with additional cross braces 64—64 and collars 65 for mounting the power unit 16 in an alternate position.

In order to facilitate the lowering of the machine 10 into a trench and for removing it therefrom, the upper end of the lever 15 is provided with a suitable hook 66 under which the hook on the end of a chain or cable may be slipped.

The power unit 16 for actuating the machine is a double-acting hydraulic cylinder unit 16 of known design, the details of which do not form a part of the present invention. In general this power unit is of the type known as a double-acting cylinder and when provided with a valve control unit of known type hydraulic fluid may alternately be fed to opposite ends of the cylinder 67 (Fig. 2) through the hose connections 68 and 70. By manipulating the valve unit (not shown) the piston or connecting rod 64 may alternately be projected from and retracted into the cylinder 67. It will be apparent that other known types of double-acting or reversing mechanisms may be used in place of unit 16.

Preferably, the machine 10 is provided with sights, for example, a peep sight combination. In Fig. 1 the rear or peep element 71 of a peep sight is mounted on the side of the lever 14 and the front element of the sight combination is carried on the lever 15, as indicated at 72.

In order to automatically total the footage of pipe installed by the machine 10, suitable counter mechanism may be installed thereon. For example, as shown in Fig. 2, a trip type counter of known type and indicated at 73 is mounted on one side of the lever 15 so as to be operated by means of a trip arm 74. The trip arm 74 is in turn operated by a projection 75 carried by the lever 14. The trip arm 74 is biased in a counterclockwise direction as viewed in Fig. 2 and resets itself each time that the linkage 13 is opened. Each time the linkage 13 is closed, the arm 74 is tripped and another stroke of the machine is recorded on the meter.

In operation: A trench of the desired length and depth is dug and the bottom is leveled. The trench should have a length and width which will permit the machine 10 to be conveniently lowered into place. When the machine 10 is in place, it is leveled with the back plate or base plate 20 engaging the rear wall of the trench as shown in Fig. 2. After preliminary leveling, the machine is sighted on a sighting stake held in front of the machine by means of the sights 71—72. Some additional leveling and sighting may be necessary before final alignment is obtained and the alignment should be checked from time to time during use.

With the machine 10 in the retracted position as shown in Fig. 2, a length of pipe 33 is put in place thereon. If this is the first length of pipe to be pushed, then it is provided on the forward end with a pointed nose which not only closes the end but also serves to penetrate the ground or soil. If one or more lengths of pipe have already been pushed into the soil, then an additional length is screwed into the coupling on the projecting end of the most recently driven length of pipe. The rear end of the length of pipe with a coupling screwed thereon is mounted on the follower 12 as described and shown in the drawings. The weight of the pipe will serve to keep it in place particularly when the front end is screwed into the end of the preceding length of pipe and the rear end of the length of pipe is engaged by the protuberance 32 on the pusher plate 31. The valve unit controlling the power cylinder unit 16 is now operated so as to apply pressure to the rear end of the cylinder 67 and the back side of the piston therein, thereby forcing out the connecting rod 64. As the connecting rod is forced out, it forcibly separates the levers 14 and 15 and advances the follower assembly 12 on the rail 11, thereby advancing the pipe 33 through the ground. Pressure is continuously applied until the follower 12 reaches the front end of the rail 11. If pushed out far enough, the follower 12 will push the slide member 40 off the end of the rail as indicated in Fig. 1 which, in turn, pushed down the tiltable pipe support member 41 as shown in Figs. 1 and 6. The operator now reverses the flow of hydraulic fluid to the cylinder unit 16, thereby retracting the piston rod and closing the extensible linkage to the position shown in Fig. 2. Another length of pipe is put in place and the operation is repeated as often as required.

Occasionally there is a requirement to withdraw conduit or pipe which has already been laid. The machine 10 may be readily used to withdraw pipe or conduit in such instances. When this is done, the machine 10 is staked in the trench so that it will not shift. With the linkage in the open position as shown in Fig. 1, the coupling on the end of the pipe to be withdrawn is located in the follower 12 so that the inner end of the coupling is flush with the rear plate 34. The clip member 35 (Fig. 7) is then dropped in place as shown in Figs. 5 and 6 so that the opposite legs thereof fit behind the end of the nipple. The clip member 35 is made heavy enough so as to remain in position. Pressure is now applied to the cylinder unit 16 so as to push the follower towards the opposite end of the trench. The legs of the clip 35

engage the end of the coupling and serve to apply the withdrawing force thereto. Length after length of the pipe is withdrawn in this manner.

In Fig. 2 of the drawings it will be noted that the hydraulic power unit 16 is interconnected to and between the levers 14 and 15 of the linkage 13 at approximately the midpoints thereof. Accordingly, when the linkage is operated, the bottom ends of the levers 14 and 15 move twice as far as the connecting rod 64 moves in closing or opening. Therefore, a long pipe pushing stroke is obtained for a relatively short stroke of the power-actuating unit. This relationship between the length of the pipe pushing stroke and that of the power stroke is also maintained with respect to the time element. In other words, the pipe is pushed or pulled at a speed twice that at with the connecting rod 64 travels. By moving the power unit 16 to the upper set of suspension collars 57—57 and 65—65, the advantage of time and distance can be redoubled. In other words, for one foot of movement of the piston rod 64 in this upper position, the follower 12 will move approximately 4 feet. The follower 12 will also move four times as fast as the connecting rod 64 moves.

In the majority of cases, the trenches in which the machine 10 is used will be shallow enough so that the power unit 16 is located at or slightly above the ground level, as shown. However, there are instances in which the trenches are so deep that extra excavation would be required to accommodate the cylinder unit 16 below the ground level. In Fig. 8 of the drawings a modification is shown diagrammatically in which the pipe pushing and pulling machine may be lowered to any depth without requiring such extra excavation. Referring to Fig. 8, in which the elements are indicated diagrammatically, the rail member is indicated at 80, the extensible linkage generally at 81, the power unit at 82, the rail follower at 83 and the base plate at 84. The extensible linkage 81 is composed of hinged levers 85 and 86. In this embodiment it will be seen that the cylinder unit 82 is pivotally mounted on the forward lever 86 while the lower end of the connecting rod 87 is pivotally connected to the rear lever 85. Accordingly, the cylinder 82 overhangs the rail member 80 and therefore does not require any extra trenching. The machine made in accordance with the embodiment shown in Fig. 8 may therefore be lowered into and operated in a trench of any depth without extra excavation.

Referring to Fig. 9, another embodiment of the invention is shown therein in which the extensible linkage is composed of two sets of hinged levers. Referring to this figure, a pipe pulling or pushing machine is indicated generally at 90 and comprises a rail member 91, a rail follower 92, an extensible linkage 93, a power cylinder unit 94 and a base plate 95. The extensible linkage 93 is composed of levers 96, 97, 98 and 100. The bottom end of the rear lever 96 is hinged adjacent to the rear end of rail member 91 while the bottom end of the forward lever 100 is hinged to the rail follower 92. The lever members 95—100 are hinged together as indicated. The front end of the connecting rod 101 is pivotally connected to the forward lever 100 while the power cylinder unit 94 is pivotally mounted on the rearward lever 96. The machine 90 operates in generally the same manner as the machine 10 in Figs. 1–7.

In Fig. 10 still another embodiment of the invention is illustrated wherein the extensible linkage is in the form of a lazy tongs arrangement. In this figure the rail member is indicated at 102, the rail follower at 103, the extensible linkage at 104, the power cylinder unit at 105, and the base plate at 106. The bottom forward end of the lazy tongs 104 is pivotally connected to the rail follower 103 while the rear end of the lazy tongs is connected to a fixed point adjacent the rear end of the rail member 102. The power cylinder unit 105 is vertically mounted on the upper end of the lever 107 while the bottom end of the connecting rod 108 is pivotally connected to the bottom end of the lever 110. It will be seen that in operation of the cylinder 105 the linkage 104 is extended or contracted, thereby pushing or pulling the rail follower 103 along the rail 102.

Since certain changes may be made in the embodiments of the invention described above and shown in the accompanying drawings, and since additional embodiments may be provided without departing from the spirit and scope of the invention, all matter described above or shown in the accompanying drawings is intended to be interpreted as illustrative and not in a limiting sense.

What is claimed as new is:

1. A pipe or conduit pushing and pulling machine comprising, rail means adapted to rest on the bottom of a trench for receiving said machine, follower means mounted on said rail means and movable therealong for receiving and supporting one end of a length of pipe or conduit, extensible linkage means for moving said follower means along said rail means, and a pressure cylinder unit for actuating said extensible linkage means, said extensible linkage means comprising at least two pairs of levers with the levers in each pair hinged together at the top ends and with bottom ends of the front and rear levers of adjoining pairs being hinged together, the bottom end of the rearmost lever of said linkage being pivotally anchored adjacent the rear end of said rail means and the bottom end of the frontmost lever of said linkage being pivotally connected to said follower means for moving the same along said rail means, said pressure cylinder unit having the cylinder thereof pivotally connected to said rearmost lever of said linkage and the piston thereof pivotally connected to said frontmost lever of said linkage.

2. A pipe or conduit pushing and pulling machine comprising, a rail adapted to rest on the bottom of a trench into which said machine may be lowered, a follower slidably mounted on said rail for supporting and pushing one end of a length of pipe or conduit, said follower having a bottom portion slidably connected to said rail and a superstructure comprising an upstanding pipe pusher plate adapted to engage the rear end of a length of pipe to be pushed and a pair of juxtaspaced upstanding pipe support plates disposed forwardly of said pipe pusher plate and having aligned recesses in their upper ends in which a pipe may rest, the space between said upstanding support plates providing room for a bifurcated clip member adapted to straddle a piece of pipe and engage the end of a coupling thereon, extensible linkage means for moving said follower comprising a pair of levers hinged together at their top ends with their bottom ends adapted to be alternately closed and spread, means for securing the bottom end of one of said levers adjacent to one end of said rail, means for pivotally attaching the bottom end of the other lever to said follower, and a pressure cylinder unit for extending and closing said linkage means having the cylinder thereof secured to one of said levers intermediate the ends thereof and the piston rod thereof pivotally connected to the other lever intermediate the ends thereof.

3. A pipe or conduit pushing and pulling machine comprising, a rail adapted to rest on the bottom of a trench into which said machine may be lowered, a follower slidably mounted on said rail for supporting and pushing one end of a length of pipe or conduit, extensible linkage means for moving said follower comprising a pair of levers hinged together at their top ends with their bottom ends adapted to be alternately closed and spread, means for securing the bottom end of one of said levers adjacent to one end of said rail, means for pivotally attaching the bottom end of the other lever to said follower, a pressure cylinder unit for extending and closing said linkage means having the cylinder thereof secured to one of said levers intermediate the ends

thereof and the piston rod thereof pivotally connected to the other lever intermediate the ends thereof, and a tiltable pipe support pivotally mounted on the front end of said rail, said support having a rearwardly inclined top portion in which a length of pipe is adapted to rest and slide and being forwardly tilted out of supporting position when engaged by said rail follower.

4. A pipe or conduit pushing and pulling machine comprising, a rail adapted to rest on the bottom of a trench into which said machine may be lowered, a follower slidably mounted on said rail for supporting and pushing one end of a length of pipe or conduit, extensible linkage means for moving said follower comprising a pair of levers hinged together at their top ends with their bottom ends adapted to be alternately closed and spread, means for securing the bottom end of one of said levers adjacent to one end of said rail, means for pivotally attaching the bottom end of the other lever to said follower, a pressure cylinder unit for positively extending and closing said linkage means having the cylinder thereof secured to one of said levers intermediate the ends thereof and the piston rod thereof pivotally connected to the other lever intermediate the ends thereof, and a sepaarte pipe support slidably mounted on said rail for supporting a length of pipe at a point adjacent the front end of said rail and comprising a bottom portion slidably connected to said rail and an upstanding pipe support plate having an opening therein in which a length of pipe may rest and slide, said separate pipe support being slidable on the rail when engaged by said rail follower.

References Cited in the file of this patent

UNITED STATES PATENTS

1,776,798	Sloan	Sept. 30, 1930
2,080,104	Abramson et al.	May 11, 1937
2,124,154	Sovincz	July 19, 1938
2,373,848	Owens	Apr. 17, 1945
2,501,001	Neely	Mar. 21, 1950
2,517,813	Wallace	Aug. 8, 1950
2,556,175	Frost	June 12, 1951

FOREIGN PATENTS

27,435	Finland	May 14, 1955