

May 11, 1937.

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2,080,104

PIPE PUSHER

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2 Sheets-Sheet 1

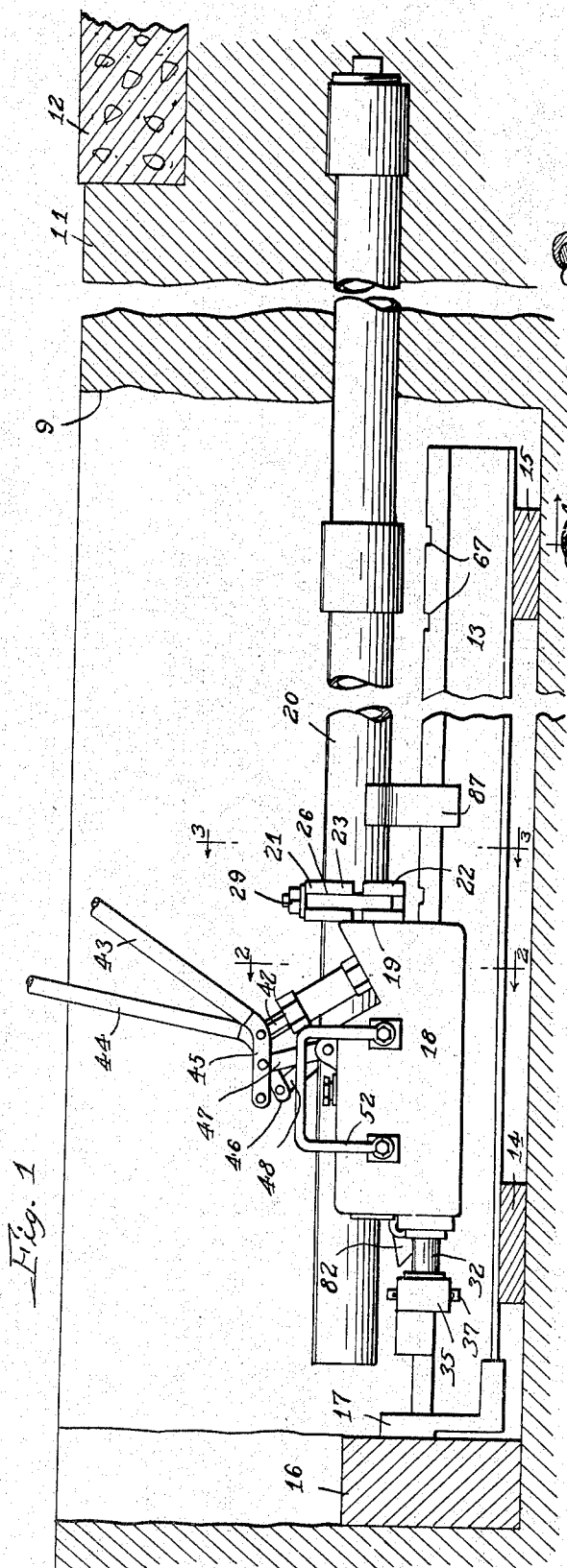


Fig. 1

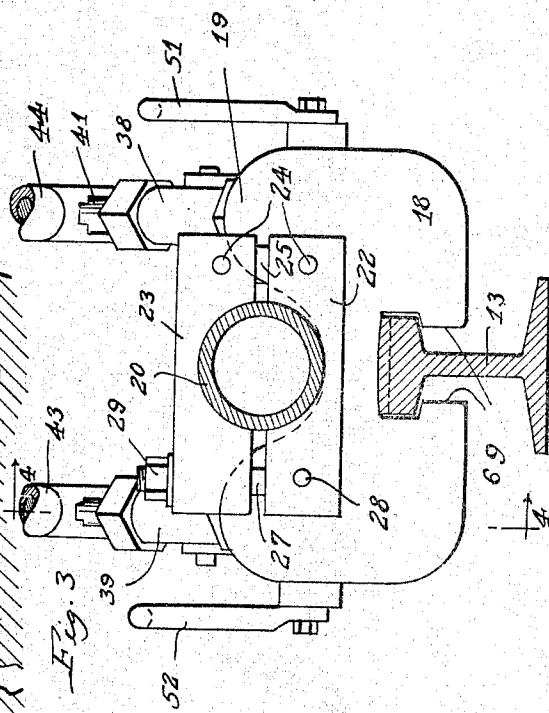


Fig. 3

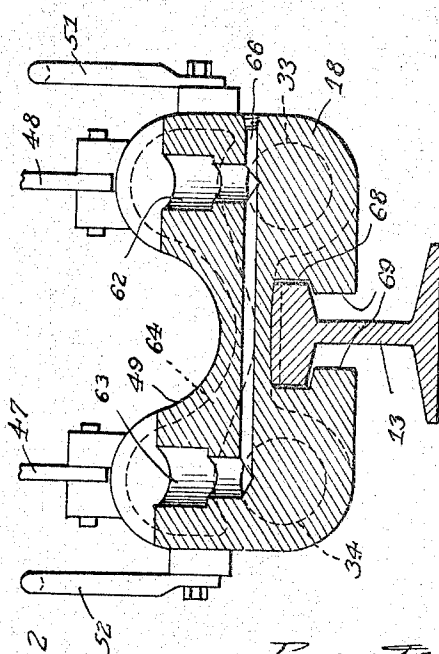


Fig. 2

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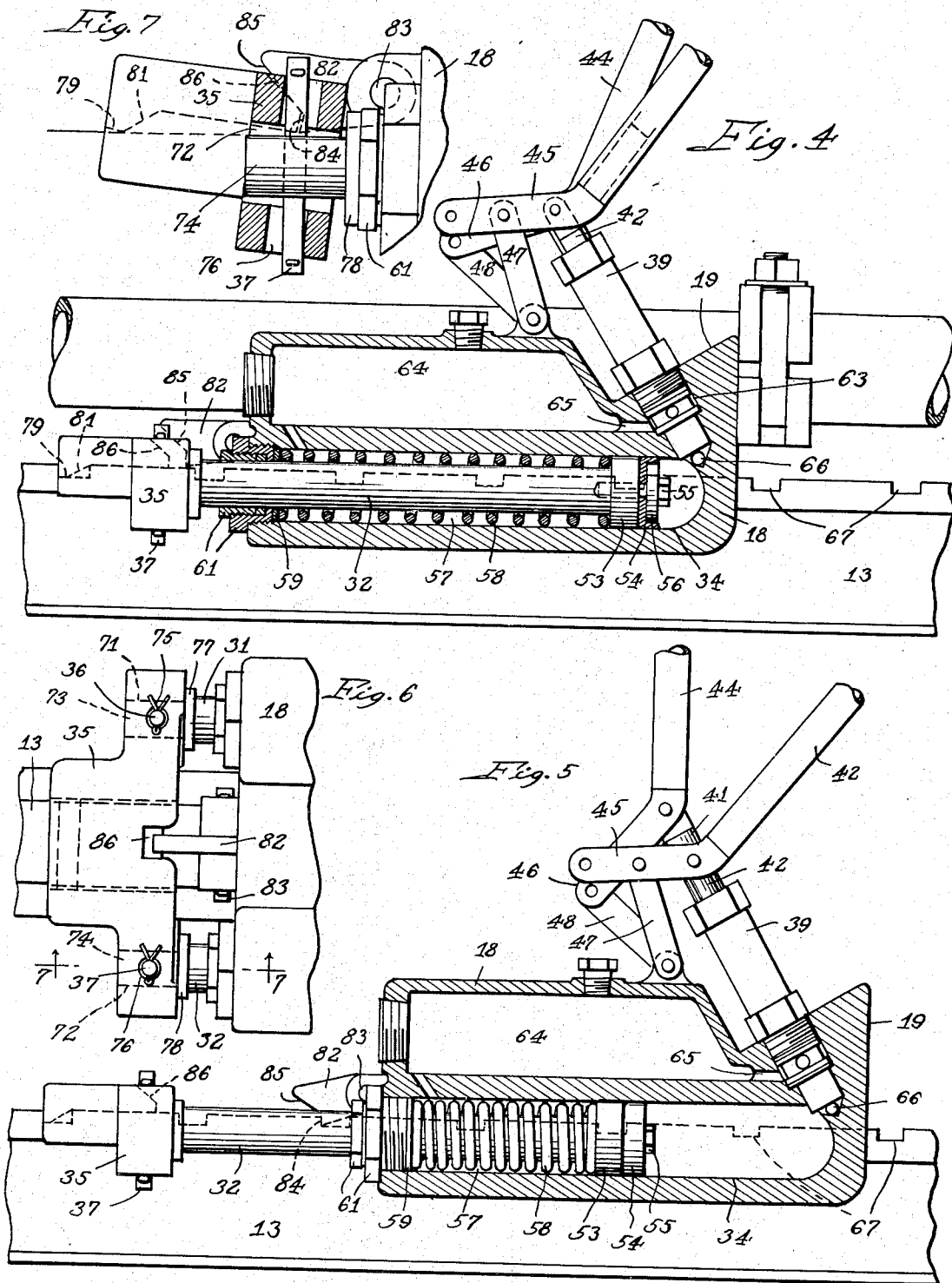
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UNITED STATES PATENT OFFICE

2,080,104

PIPE PUSHER

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10 Claims. (Cl. 254—29)

This invention relates to fluid-operated devices and has particular reference to a machine for pushing pipe and the like through the ground.

An important object of the invention is to provide a pusher having a generally improved mode of operation and structural characteristics including improved means for accomplishing step by step operation, improved latching means, and an improved structural cooperation between the pusher and the pipe being operated upon.

Other objects and advantages will become apparent from the following description and the accompanying drawings, in which—

Figure 1 is a side elevation of the pusher located in a pit in its normal operating position;

Fig. 2 is a section on the line 2—2 of Figure 1;

Fig. 3 is a section on the line 3—3 of Figure 1;

Fig. 4 is a section on the line 4—4 of Fig. 3;

Fig. 5 is a view similar to Fig. 4 showing the parts in moved position;

Fig. 6 is a fragmentary top view of the rear portion of the pusher, and

Fig. 7 is a section on the line 7—7 of Fig. 6.

The present invention relates to a device of the general nature shown in our Patent No. 1,962,228, wherein a pipe or similar article is pushed through the ground in a step by step fashion by means of a hydraulically operated piston or pistons which are alternately projected and retracted, and this invention relates primarily to improvement in the structural features and mode of operation of such a device.

Directing attention first to Figure 1 wherein a typical pipe pushing installation is portrayed, the unit is shown positioned in a pit 9 formed in the ground 11 adjacent to a concrete pavement 12 or similar surface obstruction under which a pipe is to be pushed. A base, designated generally by 13, is supported on plank or similar supports 14 and 15 on the floor of the pit. The rear end of the base 13 bears against a backing timber 16 through an intermediate backing plate 17. A carriage 18 is positioned on the frame 13 and is adapted to be moved toward the right facing Figure 1, through a succession of pushing strokes. The forward end of the carriage 18 has an abutment 19 adapted to bear against a clamp designated generally by the numeral 21 normally carried on the pipe. This clamp may advantageously consist of a pair of clevis members 22 and 23 (Fig. 3) pivoted as shown at 24 to a cross piece 25. The ends of the clevis members 22 and 23 opposite the pivot pins 24 are slotted as shown at 26 and a threaded pin 27 is pivotally secured in the clevis member 22 as

shown at 28 so as to swing in the slots 26 to the position shown in Fig. 3 wherein a nut 29 may be screwed down to clamp the clevis pieces against the pipe so that movement of the carriage 18 will be transmitted to the pipe through the clamp 21. The carriage 18 is provided with a pair of spaced pistons 31 and 32 positioned at opposite sides of the carriage in cylinders 33 and 34, the outer ends of the pistons being interconnected by a yoke 35 attached to the pistons by means of pins 36 and 37 in a manner presently to be described in further detail. Injectors 38 and 39 are positioned on the carriage adjacent opposite sides thereof and are provided with plungers 41 and 42 of different displacements so as to pump different quantities of oil into the cylinders of the carriage when reciprocated by means of handles 43 and 44 carried on levers 45 and 46 and articulated on links 47 and 48 at the top of the carriage. The carriage is recessed as shown at 49 intermediate its sides to provide a depression for the reception of the pipe being acted upon, indicated in this instance by the numeral 20. Handles 51 and 52 on opposite sides of the carriage serve for manual handling of the device.

Referring now more particularly to Figs. 4 and 5, the pistons 31 and 32 carry a head 53 at their inner end to which a packing 54 is attached by means of a screw 55 and a plate 56. The rearward part of the piston is of smaller diameter to provide an annular recess 57 within which a coiled spring 58 is positioned, one end of the spring bearing against the head 53 and the opposite end bearing against a washer 59 which in turn bears against packing nuts 61 threaded into the end of the cylinder. The injectors 38 and 39 are threaded into seats 62 and 63 (Fig. 2) and serve to draw oil or other liquid from a reservoir 64 by way of channels 65 and pass the same into the cylinders 33 and 34, the cylinders being interconnected by a channel 66 (Fig. 2) so as to equalize the pressure in the two cylinders. As oil is pumped into the cylinders the carriage moves forward from the position shown in Fig. 4 into the position shown in Fig. 5, simultaneously compressing the springs 58, which springs serve to return or draw the pistons back into the cylinders into the position shown in Fig. 4 when the fluid is released from the cylinders.

The base 13 may advantageously comprise a railroad rail into which have been cut a plurality of equally spaced cross slots 67 on the upper surface thereof. The carriage 18 slides along the surface of this rail as best shown in Fig. 2, the

carriage having a recess 68 for the reception of the upper portion of the rail, and a pair of ribs 69 adapted to be received below the upper portion of the rail so as to retain the carriage thereon. During the pushing operation, that is, while fluid is being injected into the cylinders, the pistons are held against movement while the cylinder and carriage move forward to exert a pushing pressure against the clamp 21. The pistons are held against movement through the agency of the yoke 35 best shown in Figs. 6 and 7. Openings 71 and 72 in the yoke serve to receive reduced ends 73 and 74 of the pistons 31 and 32, the openings 71 and 72 being considerably larger than the reduced ends of the pistons so that the yoke may have a tilting movement thereon in the manner shown in Fig. 7. The pins 36 and 37 pass through the reduced ends of the pistons and through openings 75 and 76 in the yoke which openings are also of considerably greater size than the pins whereby the aforementioned tilting movement of the yoke is permitted. Flanges 77 and 78 on the pistons are so positioned as to bear directly against the forward side of the yoke during a pushing stroke so that the pressure is transmitted directly from the collars to the yoke and not through the pins 36 and 37. The rear end of the yoke 35 has a downwardly projecting portion 79 adapted to ride along the upper surface of the rail and to drop into the notches 67 so as to latch the yoke against backward movement under the pushing pressure, the forward edge 81 of this projection being sloped so that when the yoke is drawn forward the projection 79 will be lifted out of the slot 67.

A second latch member 82 is articulated on a pin 83 at the rear of the carriage 18 in such position that it rides along the upper surface of the rail. This latch has a notch engaging portion 84 and a cam portion 85 adapted to cooperate with a cam portion 86 on the yoke 35 so that when the yoke is drawn up to its forward position with respect to the carriage by action of the springs 58, the cam portion 86 will engage the cam portion 85 and hold the slot engaging portion 84 out of engagement with the top of the rail as shown in Fig. 7.

In operation, the pusher is positioned in the pit in the manner shown in Figure 1, the clamp 21 is placed on a pipe and the pipe lowered onto the carriage. A guide block 87 may advantageously be provided to guide the forward end of the pipe. In view of the fact that the upper side of the carriage is open, the pipe may be lowered directly into its pushing position regardless of the position of the carriage 18. The position of the clamp 21 is then adjusted so that the forward end of the carriage will bear against the same. With the projection 79 of the yoke 35 engaged in one of the cross slots of the base 13 as shown in Fig. 4 the handles 43 and 44 are reciprocated, pumping liquid into the cylinders 33 and 34. Since the pistons 31 and 32 are incapable of backward movement, the carriage is propelled forward forcing the pipe forward through contact of the abutment 19 with the clamp 21. The injectors are operated until the latch 82 drops into the second cross slot as shown in Fig. 5. Thereupon the handles 43 and 44 are depressed to release the liquid in the cylinders in the manner described in our above mentioned patent, upon the release of which the springs 58 cause the pistons to move toward the right facing Figs. 4 and 5 drawing the yoke 35 forward until the projection 79 drops into the next succeeding cross slot of the rail.

Thereupon the handles 43 and 44 are again reciprocated moving the carriage forward through the next step or until the latch 82 drops into the next succeeding cross slot. In this manner the carriage is moved forward in a step by step fashion pushing the pipe forward in the same manner. When the carriage 18 reaches the forward end of the base 13 it is necessary to return the pushing unit to the position shown in Figure 1 under which circumstances the handles 43 and 44 are depressed permitting the fluid to flow from the cylinders back into the reservoir 64 and the springs 58 to return the pistons to the forward end of the cylinders. However, instead of raising the handles 43 and 44 and stopping the return of the pistons when the projection 79 drops into the next succeeding cross slot of the base, the handles are held depressed until the yoke 35 engages the pawl 82, whereupon the pawl 82 is raised by contact with the cam surface 86 of the yoke. Thereafter the yoke 35 is manually raised and the carriage manually moved backward on the base to its rear position. Likewise, the clamp 21 is moved on the pipe to a new position and the step by step pushing operations previously described are repeated. When a length of pipe has been pushed into the ground sufficiently to permit of the attachment of a further length of pipe at the rear end thereof, successive lengths of pipe are added as shown in Figure 1.

Our device offers a number of important advantages over the constructions of the prior art and over our above mentioned patent. For example, it will be noted that in this construction the pipe is pushed through movement of the carriage rather than through movement of the pistons and the repositioning of the yoke 35 and its attached latch portion is occasioned by operation of the springs 58. The advantage of this mode of operation is the fact that the carriage is caused to move by the very high hydraulic pressure in the cylinder and consequently any binding action which may take place between the base and the carriage tending to interfere with the movement is relatively small with respect to the power being applied. Such binding action frequently occurs because of a small movement of the position of the pipe 20 being pushed, which change in position may result from a variation in the resistance to the pushing operation along the various sides of the pipe. When this occurs the pipe tends to twist the carriage on the frame, causing a binding action between the base and the carriage. However, since the carriage is moved under the very high force developed by the injectors, this binding action is of minor consequence. It will be seen that the only work required from the springs 58 is that of moving the yoke 35 along the top of the base 13 and that of moving the pistons through the stuffing boxes. Since the yoke 35 is loose on the pistons there is no tendency or possibility of it binding so that the springs move the pistons freely. Furthermore, it will be noted that the load on the springs 58 is relatively small as compared to the load when the springs are required to move the body as in our previously mentioned patent.

Another advantage of moving the body of the pusher during the pushing stroke lies in the fact that the pushing pressure on the pipe need not be released in order to draw up the yoke 35. In other words, with the present construction, as soon as the pawl 82 drops into a slot, the pressure of the fluid in the cylinders may be released and the pipe held under this tension while

the pistons and the yoke 35 are drawn up to the next position. As a result of this, the movement required in prior constructions to take up for resiliency in the pipe and in the various parts prior to the point where an actual moving pressure is applied to the pipe, is not lost. The operation of this device is thus distinguished from those in which the element of the pusher applying the pushing force to the pipe must be moved beyond its latching position and then allowed to drop back to the latching position so as to relieve the back pressure of the pipe on the pusher unit.

Another feature of the invention lies in the fact that the pipe may be loaded directly onto the top of the carriage instead of being passed through an opening of some sort as in many prior art patents. As a result of this construction a shorter pit may be employed, since the pit need not have the additional length required to slide the pusher over the pipe. Furthermore, this construction permits a new piece of pipe to be inserted without changing the position of the pusher unit on the base. A still further advantage of this construction lies in the fact that the pushing force is applied to one side of the clamp 21 so that it tends slightly to tilt the clamp and increase the clamping action. Another and important advantage of this construction lies in the fact that it permits of considerable lateral movement on the part of the pipe without causing the body to materially bind on the rail or base. In other words, the pipe is relatively free to move within limits to adjust itself to the resistance of the earth through which it is being pushed.

Another advantage of our improved construction lies in the fact that the springs 58 are positioned directly in the fluid cylinders of the device and surrounding the pistons. This tends to materially reduce the overall width of the machine and also eliminates the difficulty with foreign matter interfering with the action of the springs. Furthermore, in this construction the springs act on the compression principle and are completely enclosed so that they cannot be conveniently tampered with by unskilled operators.

Another important structural feature of the device is the construction of the yoke 35 which is loosely supported on the ends of the pistons but so arranged that the pins supporting the yoke on the pistons do not receive the pushing force, this being transmitted directly from the pistons to the yoke. Another advantage of this construction is the arrangement whereby the pawl 82 is actuated by the yoke 35 to permit the pushing unit to be easily moved from end to end of the base.

While we have thus described and illustrated a specific embodiment of our invention, we are aware that numerous alterations and changes may be made without departing from the spirit of the invention or the scope of the appended claims, in which—

We claim:

1. A pipe pusher comprising in combination a fluid cylinder, a base for supporting said cylinder through a succession of pushing strokes, a piston in said cylinder, means to hold the piston in a succession of pushing positions, means to inject fluid into the cylinder to move the cylinder, and means for moving the piston with respect to the base and the cylinder to the next pushing position at the completion of a stroke.

2. A pipe pusher comprising in combination a

fluid cylinder, a base for supporting said cylinder in a succession of pushing strokes, a piston positioned in said cylinder adapted to engage said base to predetermine said pushing strokes, manually operable means for selectively injecting fluid into said cylinder at any of a plurality of rates to project said piston at different rates of speed to adapt the speed and power to the strength of the operator and the difficulty of the work, and means for moving said piston on the base to the next pushing position at the completion of each stroke.

3. A pipe pusher comprising in combination a carriage having at least one fluid cylinder and means to support a pipe being pushed, a fluid operated piston in said cylinder, a base including a rail centrally disposed beneath said carriage to slidably support the same, means between said piston and said rail to secure the former in a succession of pushing positions, means acting between said carriage and said pipe for transmitting motion of the former to the latter, manually operable means on the carriage for injecting fluid into said cylinder to move the carriage in a pushing stroke, and means controlled by said manually operable means for returning the piston into the cylinder to reposition the parts for the next succeeding pushing stroke.

4. A pipe pusher comprising in combination a fluid cylinder, a piston positioned in said cylinder, a base having means thereon for holding said piston in a succession of pushing positions, the cylinder being movable on the piston to exert a pushing stroke on a pipe to be pushed, means for preventing return movement of the cylinder, and spring means acting between the piston and the cylinder for drawing the piston into the cylinder to the next succeeding pushing position.

5. A pipe pusher comprising in combination a base, a cylinder movable on the base through a pipe pushing stroke, a hydraulic piston in said cylinder, means for developing pressure in said cylinder to produce relative movement between the cylinder and the piston, latch means on the piston engaging said base at a succession of pushing positions to move the cylinder in pushing strokes, latch means on the cylinder for preventing return movement thereof, and spring means acting between the cylinder and the piston for bringing the piston to the next succeeding pushing position upon release of pressure in said cylinder.

6. A pipe pusher comprising in combination a base, a cylinder movable on the base through a pipe pushing stroke, a hydraulic piston in said cylinder, means for developing pressure in said cylinder to produce relative movement between the cylinder and the piston, latch means on the piston engaging the base at a succession of pushing positions to move the cylinder in pushing strokes, latch means on the cylinder for preventing return movement thereof, and spring means acting between the cylinder and the piston to bring the latter to either the succeeding pushing position or the end of its stroke dependent upon the release of pressure from the cylinder.

7. A pipe pusher comprising in combination a base, a cylinder movable on the base through a pipe pushing stroke, a hydraulic piston in said cylinder, means for developing pressure in said cylinder to produce relative movement between the cylinder and the piston, latch means on the piston engaging the base at a succession of pushing positions to move the cylinder in pushing strokes, latch means on the cylinder for pre-

venting return movement thereof, spring means acting between the cylinder and the piston to bring the latter to either the succeeding pushing position or the end of its stroke dependent upon the release of pressure from the cylinder, and means for releasing the latch on the cylinder when the piston reaches the end of its stroke.

8. A pipe pusher comprising in combination a base having means defining a succession of pushing positions, a carriage movable on the base through a pushing stroke and having laterally spaced fluid cylinders, pistons in said cylinders, a latch member connecting said pistons and supported thereon for tilting movement, said latch member having latch means for engaging said base at said pushing positions to prevent movement of the pistons in a backward direction, latch means on said carriage engaging said base toward the end of said stroke to prevent return movement thereof, and means to bring the pistons to the next succeeding pushing position upon the release of pressure from said cylinders.

9. A pipe pusher comprising in combination a base having transverse slots spaced longitudinally thereof to define a plurality of pushing positions, a carriage movable on said base through

a plurality of pushing strokes, said carriage having a fluid cylinder, a piston in said cylinder having a transverse pin and an annular collar, a latch member for latching said piston to the base at the slots, said member having openings receiving said piston and said pin for tilting movement thereon, the latch member and piston being shaped and spaced for transmission of pushing pressure from said piston to said member wholly through said annular collar.

10. The combination in a pipe pusher of a base, a carriage movable thereon having a central longitudinally disposed depression on its top accessible from the top of the carriage and defining a pushing position of a pipe, manually operable levers spaced laterally on the top of the carriage on opposite sides of said depression, an abutment at one end of said carriage, a pipe pushing clamp adapted to engage a pipe, and means to move the carriage forward on the base to urge said abutment against said clamp upon manual operation of said levers to push a pipe forward through the earth.

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