SELF-PROPELLED AND SELF-LEVELLING OPEN TRENCH CAISSON

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FIG. 1

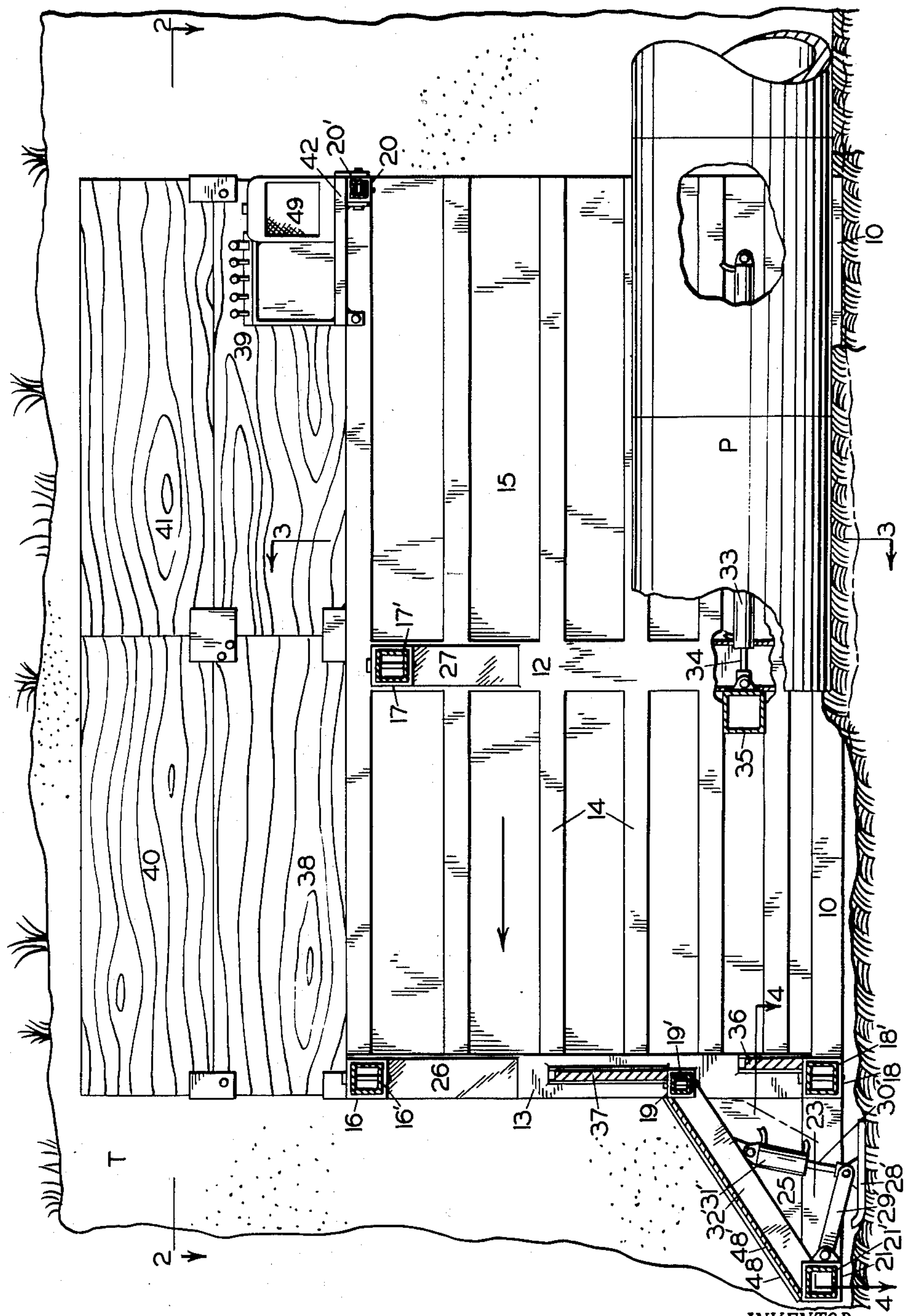

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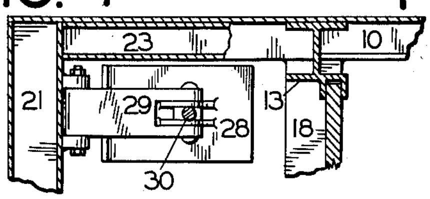
FIG. 4



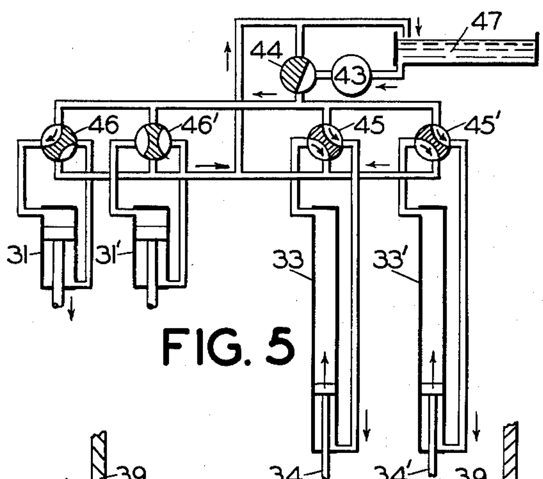
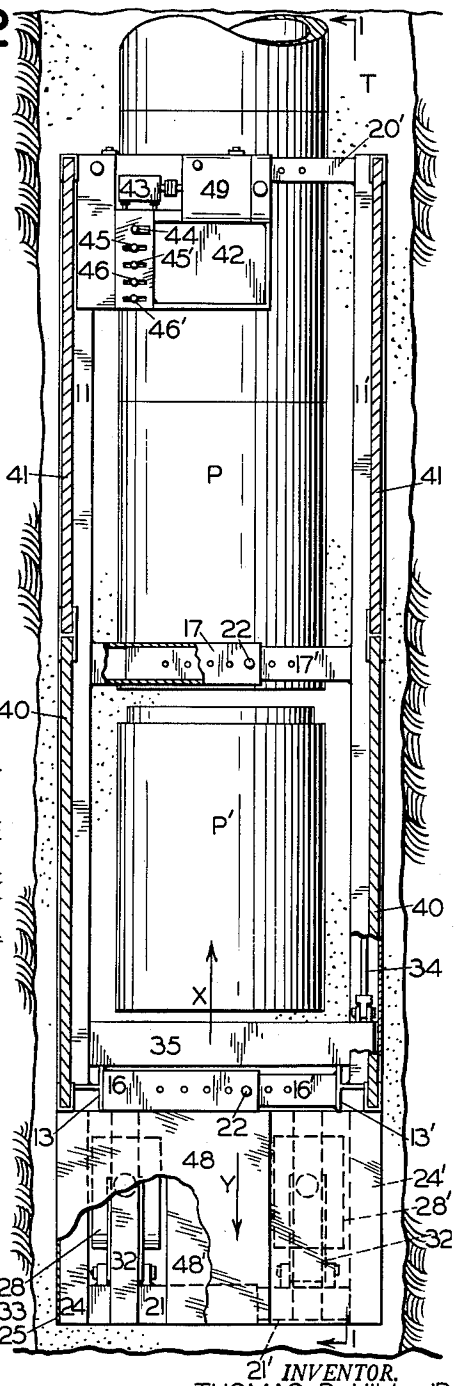


FIG. 5

FIG. 2



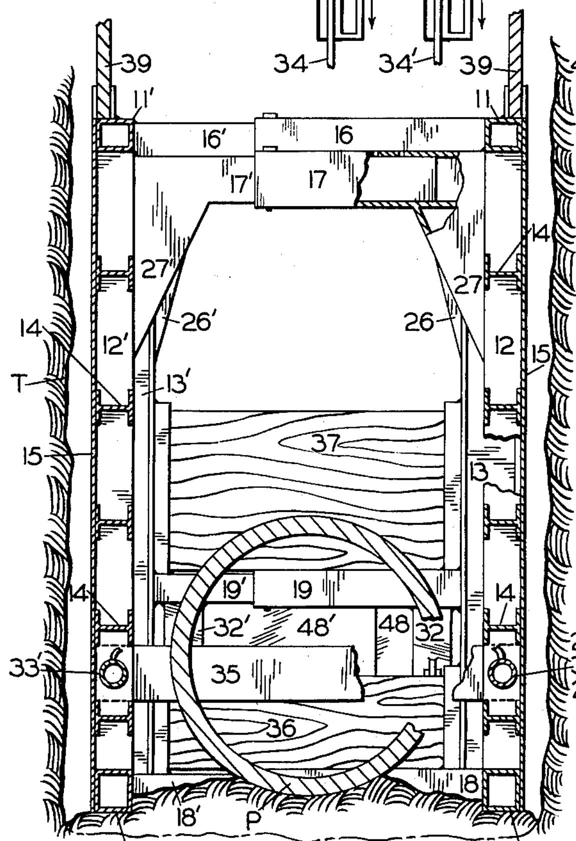


FIG. 3

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SELF-PROPELLED AND SELF-LEVELLING OPEN TRENCH CAISSON

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3 Claims. (Cl. 61—41)

This invention is concerned with the laying of pipes, conduits and the like, particularly large pipes such as concrete sewer pipes, in trenches of substantial depth, where the trenches have approximately vertical walls and are restricted as to width.

As is well known, when work of this nature is performed in trenches of any appreciable depth, it is customary and necessary to prevent possible caving in of the earth walls by providing means for temporarily shoring up the walls in order to protect workmen in the trench and also to prevent damage to extending surface areas adjacent the trench when the trench, for example, is located along a busy street or paved roadway. The common practice of temporarily shoring up the side walls of trenches by timbers and other support elements requires a considerable expenditure of time and labor, and the danger of having this precautionary work done inadequately or too carelessly is well recognized.

An object of the present invention is to provide a practical and mobile device which will dispense with the necessity of any temporary shoring up of the trench walls where the device is positioned and which can easily be set up and installed in a trench where desired and moved along as the pipe-laying operation in the trench progresses.

Another object is to provide a special open end trench caisson, open also at top and bottom, which, when installed in a trench where a pipe line is being laid, will be capable of propelling itself forwardly along the trench as the trench is dug and as the pipe sections are set in place in the pipe line.

With the customary digging of deep trenches for pipe lines the bottom of the trench will generally be left uneven or with minor depth variations, inasmuch as the additional cost in time and labor of making the bottom of the trench smooth and level throughout and without variations in depth would not be justified. A further important object of the present invention accordingly is to provide an improved trench caisson for pipe laying which will be self-levelling in addition to being self-propelling as the caisson moves along with the laying of the pipe line in the trench.

A related object is to provide an open caisson for trench work in which both the self-propelling means and the self-levelling means will be operated through simple and practical mechanism adapted for easy control by a single operator.

Since trenches in which pipe lines are laid are of various widths, depending upon the size of the pipe in the trench, and since it is not desirable to have such trenches wider than suitable for the work in hand, an additional object of this invention is to provide an improved trench caisson which can readily be adjusted in width to accommodate trenches of different size.

The means by which these objects and incidental advantages are attained with the device of the present invention, and the construction and manner of operation of this open trench caisson, will be briefly explained and described with reference to the accompanying drawings.

In the drawings:

FIG. 1 is a sectional elevation taken on line 1—1 of FIG. 2;

FIG. 2 is a plan section taken on line 2—2 of FIG. 1;

FIG. 3 is a transverse sectional elevation taken on line 3—3 of FIG. 1 but drawn to a slightly larger scale;

FIG. 4 is a fragmentary section taken on the off-set line indicated at 4—4 in FIG. 1, drawn to the same scale as FIG. 3; and

FIG. 5 is a diagram illustrating the hydraulic means by which the device is operated and controlled.

Referring to FIGS. 1, 2 and 3, the device includes a pair of composite side wall structures each having a rigid frame formed of vertical and horizontal frame members which are welded together at their junctions and having wall plates welded to the outside face of the frame. Thus the two wall structures include bottom longitudinally-extending frame member **10**, **10'** respectively, top longitudinally-extending frame members **11**, **11'** respectively, inner vertical frame members **12**, **12'**, all of which members preferably, although not necessarily, are tubular and square in cross section, forward vertical frame members **13**, **13'** respectively, shown in the drawings as I-beams, horizontal ribs or I-beam frame members **14**, **14'**, and outside wall plates **15**, **15'**.

In addition, each side wall structure has a forwardly-extending triangularly shaped, bottom portion comprising a substantially horizontal bottom frame member (one of these being shown at **23** in FIGS. 1 and 4), a downwardly-forwardly sloping top frame member indicated at **24**, **24'** respectively (FIG. 2), and a side wall plate, one of which is shown at **25** in FIG. 1.

The two composite side wall structures are adjustably connected by pairs of telescoping cross tubular members **16** and **16'**, **17** and **17'**, **18** and **18'**, **19** and **19'**, **20** and **20'**, and **21** and **21'**, which are mounted in the locations shown in FIG. 1. The pairs of telescoping members are provided with holes to receive securing bolts (as indicated at **22** in FIG. 2) for securing each pair of telescoping members rigidly together so as to hold the two wall structures firmly in parallel spaced position, spaced apart in accordance with the overall width desired for the device, which width will of course depend upon the width of the particular trench T in which the device is to be set to operate. The fact that the overall width of the device may be adjusted as desired is one of the important features. The junctions of the upper pairs of telescoping cross members **16**, **16'** and **17**, **17'** with the respective wall structures are reinforced by gussets **26**, **26'** and **27**, **27'** respectively to give greater overall rigidity to the device. The forwardly extending bottom portions of the wall structures and the foremost telescoping cross members **21**, **21'** constitute a forward foot extension for the caisson.

A pair of shoe runners **28**, **28'** (FIGS. 1, 2, and 4) are mounted in the forward foot extension of the caisson. These shoe runners are connected by hinge links **29**, **29'** respectively to the foremost pair of telescoping cross members **21**, **21'** respectively. The shoe runners **28**, **28'** and their hinge links **29**, **29'** are also hingedly connected to the lower ends of piston rods **30**, **30'** respectively of pistons located in double-acting hydraulic cylinders. One of these hydraulic cylinders is shown at **31'** in FIG. 1 and while only one of these cylinders and mounting connections are shown in the drawings it is to be understood that both shoe runners **28**, **28'** are identically mounted and connected with the piston rods of their respective hydraulic cylinders. The upper ends of these two hydraulic cylinders are hingedly supported from a pair of inner downwardly-forwardly sloping frame members **32**, **32'** respectively, which frame members **32**, **32'** extend from the telescoping cross members **19**, **19'** respectively, to the foremost telescoping cross members **21**, **21'** respectively.

The device is supported at the front end on the shoe runners **28**, **28'**, and the independent operation of the pair of hydraulic cylinders 31, as later mentioned, enables the front end of the device to be raised or lowered with respect to the bottom of the trench at either side.

A pair of double-acting hydraulic cylinders 33 and 33′ (FIGS. 1 and 3) are mounted in horizontal position in the side wall structures respectively in the approximate location indicated in FIG. 1. Piston rods 34, 34′ extend forwardly from the cylinders 33, 33′ respectively and pass slidably through the respective vertical frame members 12, 12′. A transversely-extending thrust bar 35 has its ends removably mounted in tracks provided by pairs of horizontal I-beams in each side wall structure respectively. The ends of the thrust bar are attached to the ends of the piston rods 34, 34′ respectively. Thus the operation of the hydraulic cylinders 33, 33′ in unison enables the thrust bar 35 to move from the forward position, shown in FIG. 2, to the rear position, shown in FIG. 1, and back again to the normal forward position.

Briefly the operation of the device as thus far described is as follows: The device, adjusted to the proper width for the size of the trench and with the proper length thrust bar set in place and attached to the piston rods 34, 34′, is set down into the trench over the pipe line with the end of the pipe line already laid extending approximately halfway along the device and thus terminating in the position shown by the last pipe section P in FIG. 1. The thrust bar 35 is moved to the left (as viewed in FIG. 1) into the normal position shown in FIG. 2. An additional pipe section P′ (FIG. 2) is then lowered down into the device and trench by suitable means (not shown) until the new pipe section is in proper axial alignment with the previously laid portion P of the pipe line. Gravel or other suitable material is dumped into the trench to enable the space beneath the new pipe section P′ to be filled and compacted for properly supporting the new pipe section, and the lowering and temporary supporting means for the new pipe section is then withdrawn. The hydraulic cylinders 33, 33′ are operated to cause the thrust bar 35 to move against the forward end of the new pipe section in the direction indicated by the arrow X in FIG. 2. With the cement or other sealing material having been applied to the end of the previously laid pipe portion P for the sealing of the new joint to be formed, the new pipe section P′ is shoved into closed position with the previously laid pipe section P. Then as the movement of the thrust bar continues relatively rearwardly with respect to the caisson the entire device is moved forwardly in the direction indicated by the arrow Y in FIG. 2 for a distance equal to the length of the added pipe section. The operation is then repeated for the next pipe section.

As previously mentioned, the front end of the caisson is supported on the pair of shoe runners 28, 28′, and, as the device is shoved forwardly along the trench with each relatively rearward movement of the thrust bar, the two shoe runners slide along on the bottom of the trench, and the raising or lowering of the shoe runners enables the caisson to be maintained at the desired level regardless of irregularities along the bottom of the trench as the trench is dug. This is another important feature of the invention.

Preferably the filling of the trench on top of the laid pipe line takes place at the immediate rear of the caisson as it moves along. Also the digging of the trench can take place a short distance ahead of the traveling caisson. Thus with such procedure only a minimum portion of the trench will ever be entirely open with its side walls unprotected against cave-in.

The forward-extending foot portion of the device, formed by the triangular side wall extensions and the foremost pair of bottom telescoping cross members 21, 21′, carries a pair of overlapping top plates 48, 48′ which are secured at their outer edges to the two downwardly-forwardly sloping top members 24, 24′ of the opposite side walls respectively. The purpose of these sloping top plates is to prevent any excessive amount of earth or gravel, from the bottom of the trench in front of the moving caisson, from passing into the caisson and interfering with the positioning of a new pipe section as a new pipe section is let down into the caisson and trench, since the accumulation of such material at this location within the caisson prior to the lowering of the new pipe section would necessitate removal of such material by hand and thus slow down the pipe laying operation.

Preferably the two forward vertical I-beams 13, 13′ are provided with pairs of sockets for supporting a pair of cross boards 36 and 37 (FIGS. 1 and 3) which serve also to prevent undesirable earth and gravel from passing into the interior of the front portion of the caisson.

For use with extra deep trenches the caisson is provided with auxiliary removable top board extensions 38, 39, 40 and 41 for each of the side wall structures, as indicated in FIG. 1, suitable sockets being provided on the top longitudinal frame members 11, 11′ for the pairs of extension boards 38 and 39, and these boards in turn carry sockets for the next upper boards 40 and 41. Obviously other means for mounting removable top extensions on the side wall structures might be employed.

The operating power plant for the device is carried on a platform 42 mounted on the top of the caisson at the rear, as shown in FIGS. 1 and 2. The power plant is a simple one including either an electric motor or internal combustion engine 49 for operating a hydraulic pump. The power plant is equipped with suitable valves which are easily and conveniently manipulated by the operator stationed on the platform 42 who thus is able to control the entire operation of the caisson.

Referring briefly to the diagram in FIG. 5, the operation of the pump 43 with the master control valve 44 in the position illustrated, enables the hydraulic fluid from reservoir 47 to be delivered under pressure into either end of the cylinders 33, 33′, as desired, through the valves 45, 45′ respectively, for operation of the thrust bar. Ordinarily the two valves 45, 45′ will be open and closed in unison, but, in the event the piston in either of the cylinders 33, 33′ moves slightly faster than the other piston, this can be corrected by adjustment of these individual valves. Similarly the manipulation of valve 46 and valve 46′ enables the corresponding hydraulic cylinders for the shoe runners 28 and 28′ to be operated when raising or lowering of the front end of the caisson at either side with respect to the bottom of the trench is required.

It would be possible to have various minor modifications in the structure herein illustrated and described without departing from the principle of the invention, and while the device in the form described has proved very satisfactory in operation and such structure is regarded as the preferred means for the carrying-out of this invention, it is not desired to limit the invention otherwise than as provided in the claims.

We claim:

1. A self-propelled and self-levelling caisson for an open pipeline trench including a pair of reinforced side walls, cross bars adjustably securing said walls in parallel vertical planes spaced apart a distance corresponding approximately to the width of the trench, a pair of hydraulic cylinder assemblies mounted on the inside of said side walls respectively, a transversely extending movable thrust bar, guide ways for the ends of the thrust bar in said side walls respectively and located in the same horizontal plane with said hydraulic cylinder assemblies, the ends of said thrust bar slidable in said guide ways and connected with the piston rods of said cylinder assemblies respectively, said cylinder assemblies and said thrust bar positioned at such height above the bottom of said side walls that said thrust bar will extend across the end of the pipeline in the trench within the caisson when said caisson is positioned in the trench, whereby the forcible movement of said thrust bar against the end of each pipe section as such section is added to the pipeline within said

caisson will cause said caisson to be moved forwardly in the trench, a pair of shoe runners supporting the forward end of said caisson and adapted to slide along on the bottom of the trench, adjustable flexible mounting means on said caisson for said shoe runners, said mounting means including hydraulic cylinders for raising or lowering each shoe runner independently, and a power plant on said caisson with controls for said first mentioned cylinder assemblies and for said last mentioned hydraulic cylinders.

2. A self-propelled and self-levelling caisson for an open pipeline trench including a pair of reinforced main side walls, cross bars adjustably securing said walls in parallel vertical planes spaced apart a distance corresponding approximately to the width of the trench, a pair of hydraulic cylinder assemblies mounted on the inside of said side walls respectively, a tranversely extending movable thrust bar, guide ways for the ends of the said thrust bar in said side walls respectively located in the same horizontal plane with said hydraulic cylinder assemblies, the ends of said thrust bar slidable in said guide ways and connected with the piston rods of said cylinder assemblies respectively, said cylinder assemblies and said thrust bar positioned at such height above the bottom of said side walls that said thrust bar will extend across the end of the pipeline in the trench within the caisson when said caisson is positioned in the trench, whereby the forcible movement of said thrust bar against the end of each new pipe section as such section is added to the pipeline within said caisson will cause said caisson to be moved forwardly in the trench, a rigid foot extension on the forward end of said caisson extending forwardly in the direction of travel of said caisson, said foot extension including triangularly-shaped reinforced side wall extensions having their bottom edges in alignment with the bottom edges of said main side walls, an adjustable cross bar connecting the tip ends of said side wall extensions, an adjustable cover plate assembly mounted on said foot extension, a pair of shoe runners supporting the forward end of said caisson and adapted to slide along on the bottom of the trench, adjustable flexible mounting means on said caisson for said shoe runners, said mounting means including hydraulic cylinders for raising or lowering each shoe runner independently, and a power plant on said caisson with controls for said first mentioned cylinder assemblies and for said last mentioned hydraulic cylinders.

3. A self-propelled and self-levelling caisson for an open pipe trench consisting of a pair of reinforced main side walls, cross bars adjustably securing said walls in parallel vertical planes spaced apart a distance corresponding approximately to the width of the trench, a pair of hydraulic cylinder assemblies mounted on the inside of said side walls respectively, a transversely extending movable thrust bar, guide ways for the ends of said thrust bar in said side walls respectively located in the same horizontal plane with said hydraulic cylinder assemblies, the ends of said thrust bar slidable in said guide ways and connected with the piston rods of said cylinder assemblies respectively, said cylinder assemblies and said thrust bar positioned at such height above the bottom of said side walls that said thrust bar will extend across the end of the pipeline in the trench within the caisson when said caisson is positioned in the trench, whereby the forcible movement of said thrust bar against the end of each new pipe section as such section is added to the pipeline within the caisson will cause the caisson to be moved forwardly in the trench, a rigid foot extension on the forward end of said caisson extending forwardly in the direction of travel of said caisson, said foot extension including triangularly-shaped reinforced side wall extensions having their bottom edges in alignment with the bottom edges of said main side walls, an adjustable cross bar connecting the tip ends of said side wall extensions, an adjustable cover plate assembly mounted on said foot extension, a pair of shoe runners supporting the forward end of said caisson and adapted to slide along on the bottom of the trench, adjustable flexible mounting means within said foot extension on said caisson for said shoe runners, said mounting means including links connecting said shoe runners to said last mentioned cross bar and a pair of hydraulic cylinders mounted in said foot extension and connected with said shoe runners respectively for positioning each shoe runner independently, and a power plant on said caisson with controls for said first mentioned cylinder assemblies and for said last mentioned hydraulic cylinders.

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