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Muto et al.

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[54] **THRUSTING DEVICE**

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[51] **Int. Cl.**..... **B61b 13/12,** B66f 1/00

[58] **Field of Search**..... 104/147, 154, 162; 105/29 R, 30, 31, 32, 161; 173/24, 46, 141, 156, 160; 175/92, 122; 299/31, 70; 254/105, 106, 107

[56] **References Cited**

UNITED STATES PATENTS

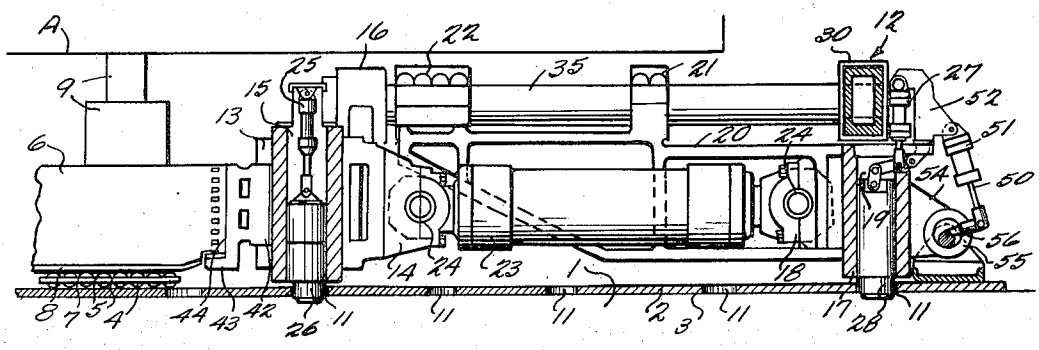
2,822,670	2/1958	Suderow	254/106
2,984,075	5/1961	Suderow	254/105
2,992,812	7/1961	Rasmussen et al.	254/107
3,008,691	11/1961	Steele et al.	254/106
3,290,007	12/1966	Yeilding	254/106
3,722,863	3/1973	Itoh	254/105

Primary Examiner—Drayton E. Hoffman
Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

A thrusting device comprising a plurality of fixed rail plates for shifting an article to be shifted thereon, each of said fixed rail plates being formed therein with substantially equally spaced pin holes arranged substantially along the center line thereof, and at least one thrusting unit striding over a selected one of said fixed rail plates and comprising running wheels provided at the bottom thereof for running along said fixed rail plate, one front block and one rear block arranged in opposed relation to each other, one thrusting hydraulic cylinder having one end connected to said front block and the other end to said rear block for thrusting said front block with said other end bearing against said rear block, supporting means for securing both of said blocks alternately to said fixed rail plate through said pin holes, two guide beams each having one end fixed to said front block and the central portion slidably supported by a bearing portion formed integrally with said rear block, and anti-stumbling means connected to said rear block rearwardly of said supporting means.

3 Claims, 6 Drawing Figures



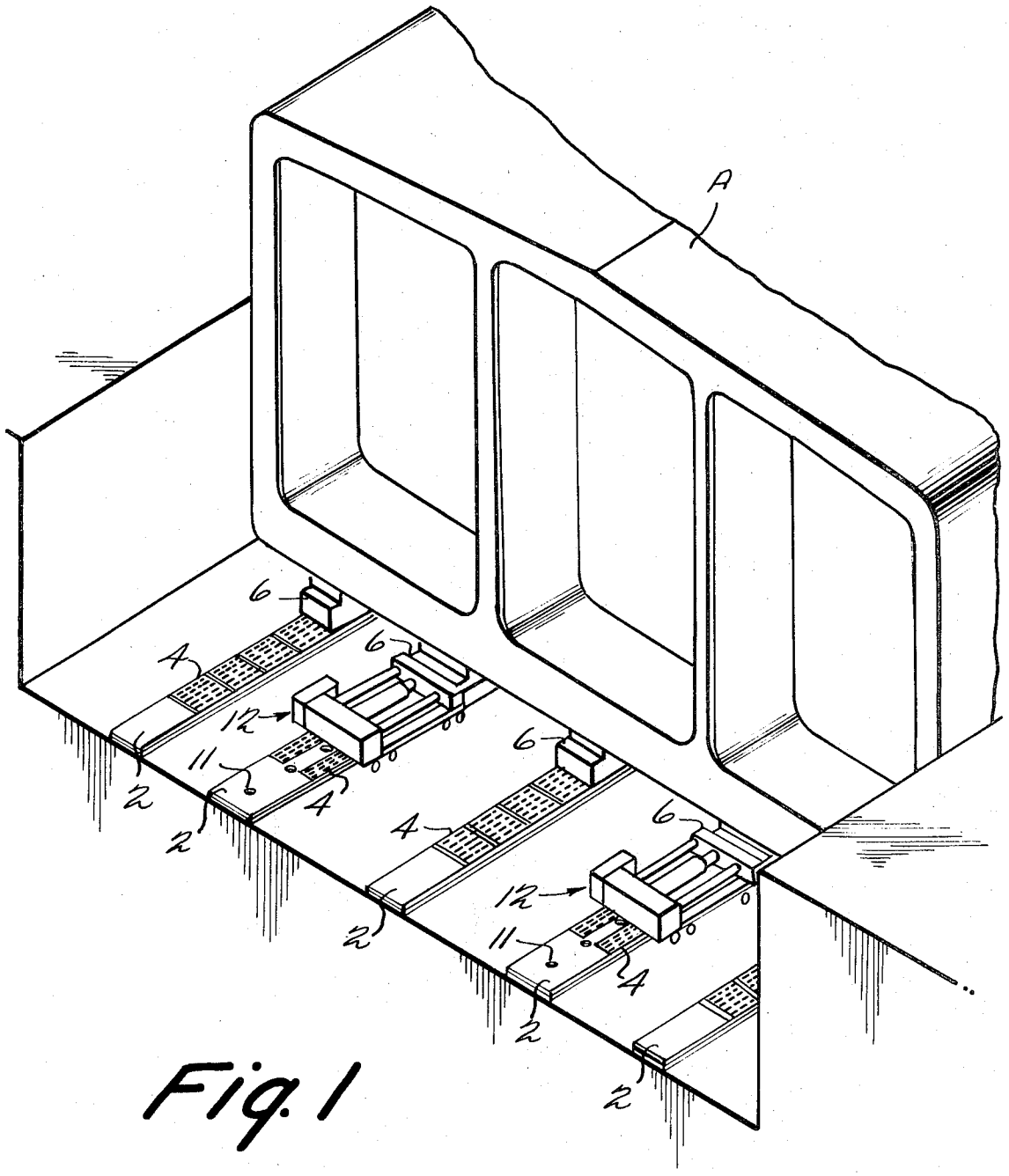


Fig. 1

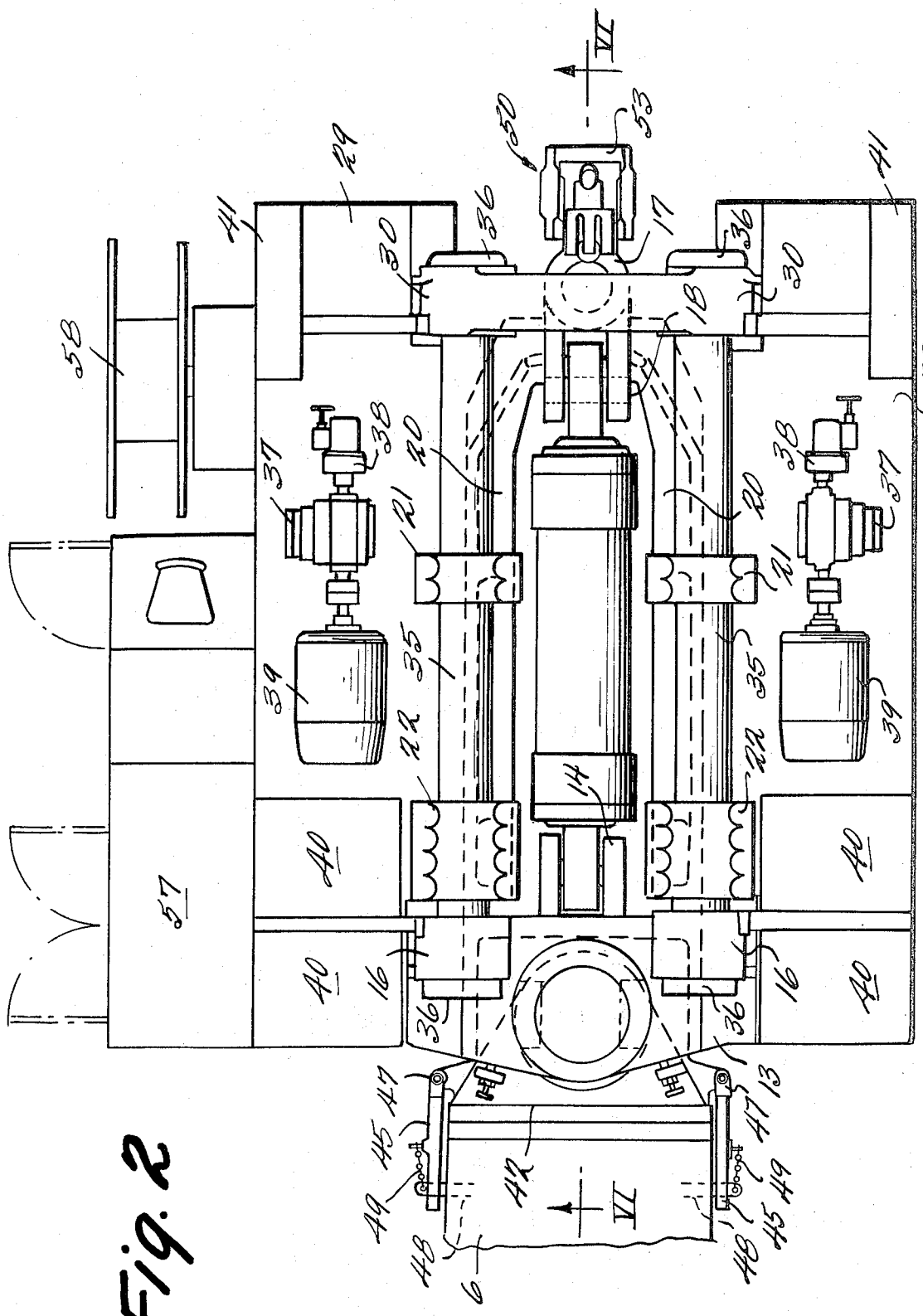


Fig. 2

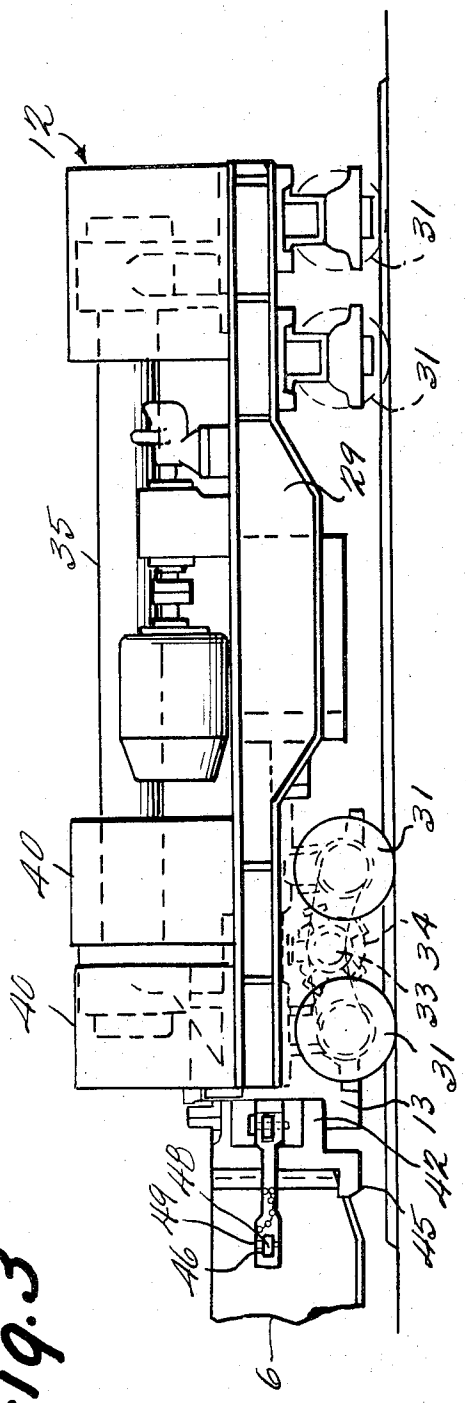

12
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Fig. 3

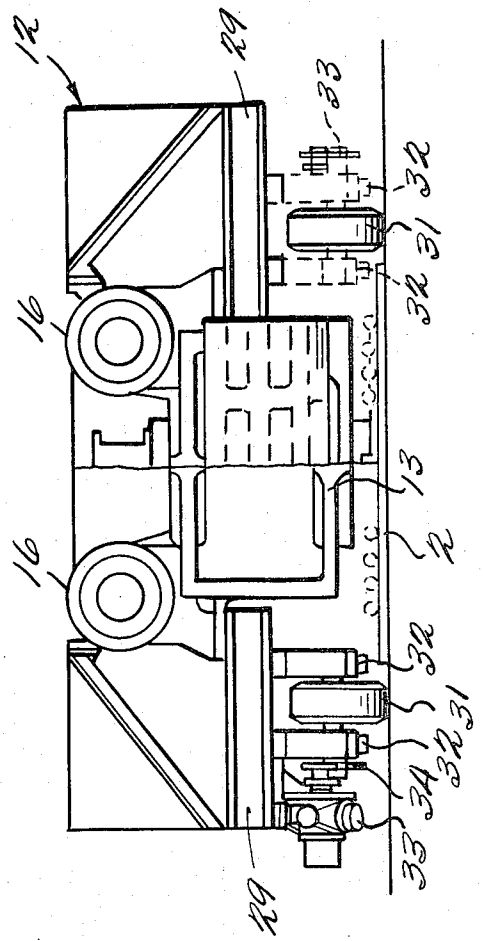

12
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Fig. 4

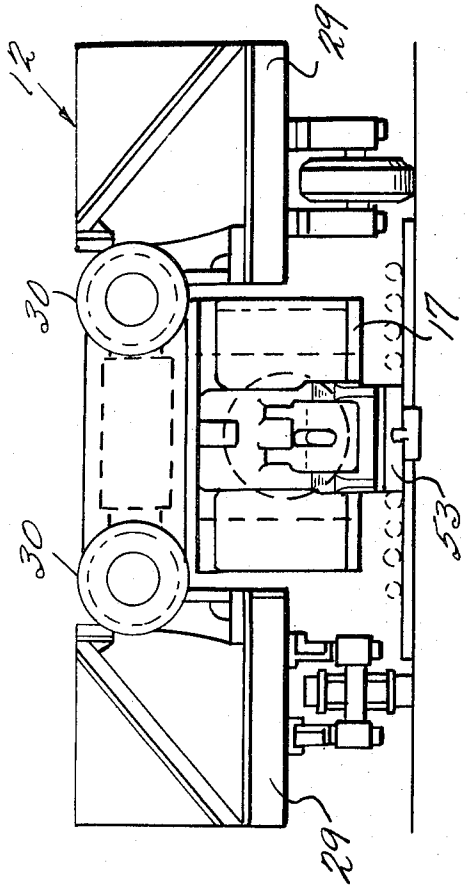


Fig. 5

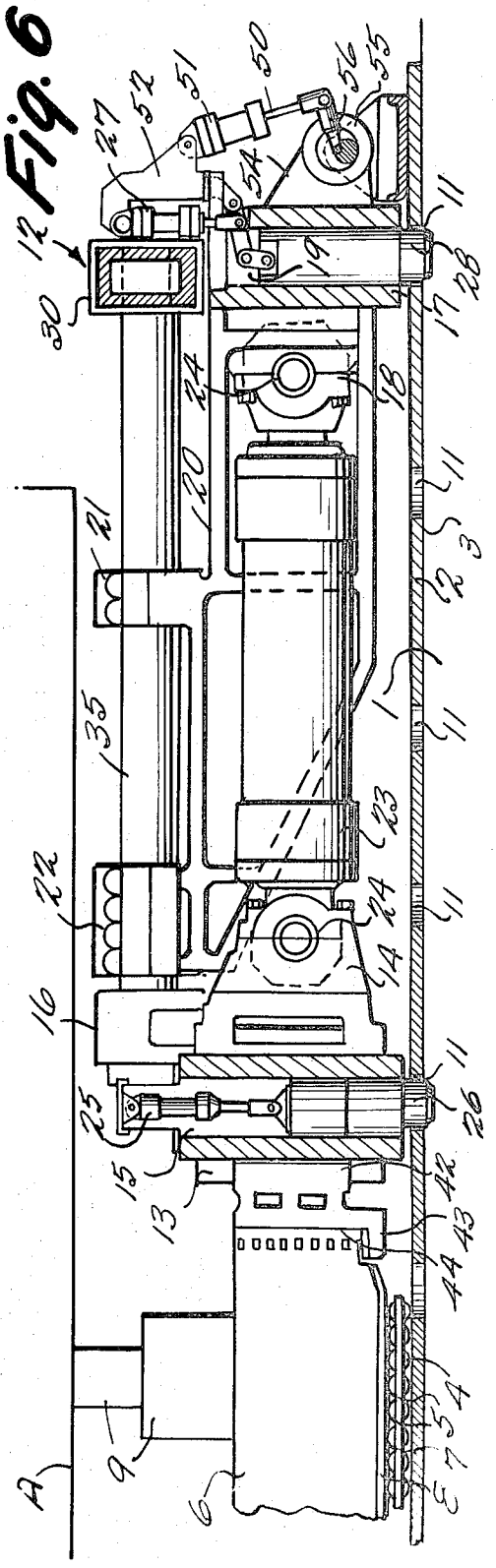


Fig. 6

THRUSTING DEVICE

BACKGROUND OF THE INVENTION:

1. Field of the Invention

This invention relates to a thrusting device for shifting large-sized structures such, for example, as a structure unit of ship hull a predetermined distance stroke by stroke intermittently along a horizontal or substantially horizontal fixed bed.

2. Description of the Prior Art:

In conventional ship building methods, namely in building a ship on an inclined building berth set on the ground, it has been usual to assemble hull blocks one after another on blocks and place the weight of the hull on a launching way for the first time at the point when the entire hull structure has been completed, for launching it therefrom, and in building a ship on a building berth set within a dry dock, it has been customary to construct and assembly the blocks of the ship hull directly on the fixed building berth and launch the completed ship hull by pouring water into the dry dock.

In recent years, there is the tendency that ships to be built are becoming larger and larger in size, and such tendency is in increasing trend. Under such circumstances, the conventional ship building methods described above are being subjected to many changes because, in the conventional methods using an on-the-ground building berth or a dry dock, an elongated building berth must be used over an extended period, so that the working efficiency of the berth is poor and further, at some locations, ship building by use of the building berth is impossible or uneconomical if not, due to the conditions of the locations.

For instance, a new ship building method is considered and about to be put in practical use, which comprises dividing a ship hull longitudinally into a plurality of blocks in the design stage, building the respective blocks at specific locations, and shifting the completed blocks in one direction to join them together one after another, or in other words, a method in which each of the completed blocks is shifted a predetermined distance stroke by stroke on a fixed bed such as a building berth and thereby all of the completed blocks are joined together to form a ship hull.

However, such a ship building method calls for a device by which each hull block of a large size and heavy weight is shifted a predetermined distance intermittently, safely and positively.

SUMMARY OF THE INVENTION

The present invention has been achieved in view of the above, for the purpose of materializing a thrusting device which is simple in construction, operation and handling and capable of shifting, safely and positively and very effectively, large-sized, heavy-weight structures, such as a ship hull structure, a predetermined distance stroke by stroke, intermittently with the necessary minimum pressure, and which yet is small in size and can be produced at a low cost.

The characteristic feature of the thrusting device according to the present invention lies in that a front block and a rear block connected with each other by a hydraulic cylinder in such a manner that they are movable alternately relative to each other like an inch worm are set on a fixed rail plate on which an article is to be shifted. The plate is formed with equally spaced pin holes along the center line thereof. The blocks are operated rearwardly of the article while fixing them alternately to said fixed rail plate and thrusting intermittently the article by the front block.

According to the present invention there can be obtained a thrusting device, simple in construction and easy to operate, utilizing hydraulic pressure as driving force. By moving the front block and rear block of the device alternately intermittently on the fixed rail plate, it is possible to shift the article stroke by stroke on said fixed rail plate, so that the thrusting device of the invention is well adapted for use in the rational ship building by the hull block thrusting method.

The device of the invention is particularly advantageous in that, since hydraulic cylinder is used as drive source for each constitutional member, the operation is very easy and in addition, the stroke of movement of the front block or rear block can be limited simply by fixing the other one of them to the rail plate or, more specifically, by providing the pin holes in the rail plate and providing a pin member on each of said blocks, which are engageable and disengageable in and from said pin holes, so that the production is simple and the operation is easy and further the stroke of each block can be limited positively, there being no chance of erroneous operation.

It is also to be noted that, since in the present invention, the front block and rear block are movable along the fixed rail plate on which the article is to be shifted and further, they are operated by one hydraulic cylinder, the entire device can be provided in a relatively small size. This is advantageous in that the device can be placed beneath the hull in the event when the entire device is used for thrusting a hull block, ensuring a positive and safe thrusting operation without inteferring with other operation.

Further, in the device of the invention, pusher blocks are provided at the forward end of the front block, which are connected to said front block through universal joints at all four sides of the forward end face of said block, and can be fixed in their positions or movable relative to said block as desired. Therefore, the thrust of the thrusting device can be effectively transmitted to the article to be shifted, through the pusher blocks which are applied to said article with a uniform pressure, and thus, local concentration of the thrust can be avoided and hence breakage of the constituent members of the device can also be avoided.

Further, in the device of the invention, a braking coupling member is provided on the front block, which is engageable with the article to be shifted and said article, during shifting, is always coupled with the front block through said braking coupling member. Therefore, runaway of the article can be prevented without using any complicated braking means which has been required heretofore. The present invention will be described by way of example in greater detail hereunder with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing breifly the state in which a ship hull block is being shifted by an embodiment of the thrusting device according to the invention;

FIG. 2 is a top plan view showing the details of one thrusting unit of the thrusting device;

FIG. 3 is a front elevational view of the thrusting unit;

FIGS. 4 and 5 are end views of the thrusting unit, looking forwardly and rearwardly respectively; and

FIG. 6 is a sectional view taken on the line VI-VI of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

First of all, the construction of the thrusting device of the invention will be described with reference to FIGS. 1 through 6.

In the drawings, reference numeral 1 designates a foundation and 2 designates a plurality of equally spaced parallel fixed rail plates fixedly mounted on the foundation 1 each through the intermediary of a cushion rubber plate 3. On each of the fixed rail plates 2 are provided rollable steel balls 4, 4 .... which are arranged in a plurality of rows spaced from each other by a predetermined interval and retained by retainers 5, 5 .... respectively.

A slide bed 6 is mounted on the steel balls 4, 4 ...., which has a rail plate 8 attached to the underside thereof through a cushion rubber plate 7 and a block 9 provided at the upper side thereof for supporting a hull block A. This slide bed 6 slides on the fixed rail plate 2, with the hull block A mounted thereon. A plurality of the slide blocks 6, 6 .... may be coupled together by couplings according to the size of the hull block A.

Specific ones of the fixed rail plates 2, 2....., i.e., two fixed rail plates 2, 2 at such locations where the slide bed 6, 6 resting thereon will maintain the hull block A in a balanced position during shifting of said hull block, are each formed with substantially equally spaced pin holes 11, 11 ..... along the longitudinal center line thereof. The foundation 1 is also formed with holes therein in a suitable depth at locations corresponding to the locations of said pin holes 11, 11 .... .

A thrusting unit 12 is provided striding over the fixed rail plates 2, 2 having the pin holes 11, 11 .... , for movement in the longitudinal direction of said rail plates. The detailed construction of the thrusting unit 12 is shown in FIGS. 2 through 6. Namely, the major components of the thrusting unit 12 are arranged symmetrically with respect to the longitudinal center line between the fixed rail plates 2, 2.

Now, the construction of the thrusting unit 12 will be described practically with reference to FIGS. 2 through 6. The thrusting unit 12 includes a front block 13 striding over the fixed rail plates 2, 2 and being movable along said fixed rail plates. This front block 13 has a forked coupling portion 14 at a location corresponding to the center line between the two fixed rail plates 2, 2, a vertically extending pin hole 15 and bearing portions 16, 16 at two locations of the intermediate portion thereof.

The thrusting device of the invention also include a rear block 17 which forms a pair with the front block 13 and similarly strides over the fixed rail plates 2, 2 for movement along said fixed rail plates. This rear block 17 is formed with a forked coupling portion 18 at a location corresponding to the coupling portion 14 of the front block, a vertically extending pin hole 19 and arms 20, 20 projecting forwardly from the intermediate portion of the front face thereof. The arms 20, 20 are respectively provided with bearing portions 21, 21 and 22, 22, corresponding to the bearing portions 16, 16 of the front block 13 connected to said arms 20, 20.

A hydraulic cylinder 23 is disposed between the front block 13 and rear block 17, with the opposite ends thereof rotatably connected to the coupling portion 14 of said front block and the coupling portion 18 of said rear block through coupling pins 24, 24 respectively, and in the embodiment illustrated in FIG. 6 the positions of connection of both ends of said hydraulic cylinder are at the same level.

In another embodiment (not shown), the position of connection between said hydraulic cylinder and rear block is lower than that of connection between said hydraulic cylinder and front block so that the inner stress in the guide members 35, 35 may be reduced.

A front pin cylinder 25 is disposed in the pin hole 15 of the front block 13, and a front pin 26 is slidably disposed in said pin hole 15 below the pin cylinder 25, with the upper end thereof connected to said front pin cylinder so that the lower end thereof may be engaged in each of the pin holes 11, 11 .... formed in the fixed rail plate 2. The rear block 17 is provided with a rear pin cylinder 27, and a rear pin 28 is slidably disposed in the pin hole 19 of said rear block. The rear pin 28 is connected at its upper end to the rear pin cylinder 27 through a linkage, so that the lower end thereof may be engaged in each of the pin holes 11, 11 .... formed in the fixed rail plate 2.

Auxiliary frame beds 29, 29 are provided extending between the opposite ends of the front block 13 and rear block 17, with the front ends thereof connected to the opposite ends of said front block 13, and bearing portions 30, 30 corresponding to the bearing portions 16, 16 of the front block 13 are provided at fixed positions of the rear ends of said auxiliary frame beds integrally therewith.

Wheels 31, 31 .... are rotatably supported on the underside of the front and rear end portions of the auxiliary frame beds 29, 29 through bearings 32, 32 respectively. A high torque motor 33 is provided for each front wheel 31 to drive the same through a transmission mechanism 34 including a sprocket and a chain.

Guide beams 35, 35 are respectively slidably supported at their central portions by the bearing portions 21, 21 and 22, 22 of the rear block 17, with the opposite ends thereof journaled in the bearing portions 16, 16 of the front block 13 and the bearing portions 30, 30 of the auxiliary frame beds 29, 29, and held in positions by means of fixed nuts 36, 36 ..... .

On the auxiliary frame beds 29, 29 are respectively mounted main hydraulic pumps 37, 37 and auxiliary hydraulic pumps 38, 38 which are respectively connected directly with the hydraulic cylinder 23, the front pin cylinder 25 and the rear pin cylinder 27 to operate the same. Also mounted on the auxiliary frame beds 29, 29 are drive motors 39, 39 which are respectively connected directly with the main hydraulic pumps 37, 37 and auxiliary hydraulic pumps 38, 38. Reference numerals 40, 40 .... designate oil tanks provided on the auxiliary frame beds 29, 29 respectively.

Hydraulic valve means 41, 41 are provided on the auxiliary frame beds 29, 29 respectively for controlling flow of oil between the oil tanks 40, 40 ..... and the respective cylinders through the main hydraulic pumps 37, 37 and auxiliary hydraulic pumps 38, 38.

Provided on the front face of the front block 13 is a pusher block 42 which is connected to said front block

so as to be pivotable in a horizontal plane and provided at its front lower end with an engaging portion 43 for engagement with the lower portion of the confronting end of the slide bed 6. The front face of the pusher block 42 is in contact with the confronting end face of the slide base 6 through the intermediary of a cushion rubber 44.

Coupling arms 45, 45 are pivotally connected at their rear ends to the opposite sides of the pusher block 42 by means of pins 47, 47, and the front ends of said coupling arms 45, 45 are respectively formed with holes 46, 46 for engagement with connecting rods 48 projecting from the slide bed 6. Each of the arms 45, 45 is provided with a stopper pin 49 which is connected to the central portion of said arm by way of a chain. This stopper pin 49, when the arm 45 is engaged with the connecting rods 48, 48 is inserted into holes formed in the projecting ends of said rods 48, 48.

The rear block 17 is provided at the center of its rear end with anti-stumble menas 50. The rear block 17 is also provided with a fixing main hydraulic cylinder 51 which has one end supported by a bracket 52 provided on said rear block, a fixing block 53 supported through an eccentric pin 55 by a bracket 54 also provided on said rear block and an auxiliary fixing hydraulic cylinder 56 having one end supported by the piston of said main hydraulic cylinder 51 and the other end connected fixedly to said eccentric pin 55.

An operation control compartment 57 having an actuation board and a control board therein is provided at one side of one of the auxiliary frame beds 29, and electric means 58 comprising a power cable winding and unwinding reel is also provided at one side of the one of the auxiliary frame beds 29, as shown in FIG. 2.

In the construction of the embodiment of the invention described in detail hereinbefore, the hydraulic cylinder 23, the front pin cylinder 25, the rear pin cylinder 27, the main hydraulic pumps 37, 37, the auxiliary hydraulic pumps 38, 38, and further, the fixing main hydraulic cylinder 51, the fixing auxiliary hydraulic cylinder 56 and the oil tanks 40, 40 are respectively connected with each other through the hydraulic valve means 41, 41 by suitable conduits though not apparent in the drawings, so that operating oil may be supplied thereto or discharged therefrom. Further, the drive motors 39, 39 are electrically connected with the electric means 58 by a suitable electrical wiring not shown. All of these elements are controllably operated from the operation control compartment 57.

In the construction described above, the interval of the pin holes 11, 11 .... formed in the fixed rail plates 2, 2 is determined by the desired stroke of movement of the hull block A at each intermittent movement of said hull block. This stroke has a direct relation with the stroke of the thrusting hydraulic cylinder 23 of each thrusting unit 12. In the embodiment shown, the stroke of the thrusting hydraulic cylinder 23 is set at 1 meter and accordingly, the interval of the pin holes 11, 11 .... is 1 meter.

The stroke of the front pin cylinder 25 and rear pin cylinder 27, respectively provided in the front block 13 and rear block 17, is so selected that the front pin 26 and rear pin 28, respectively connected to the lower ends of said front and rear pin cylinders, any be inserted sufficiently deep into the pin holes 11, 11 .... in the fixed rail plates 2 as shown in FIG. 5.

Now, the operation of the thrusting device of the invention will be explained hereunder: As stated, the slide beds 6, 6 .... having the hull block A mounted thereon are placed on the fixed rail plates 2, 2 .... with the steel balls 4, 4 .... interposed therebetween.

When the hull block A has been completed and the time has come when the completed hull block is to be shifted forward, the thrusting units 12, 12 are placed on those of the fixed rail plates 2, 2 .... on which said thrusting units are to be operated.

Namely, the high torque motors 33, 33 of each thrusting unit 12 are set in motion under such condition that the front block 13 and the rear block 17 of said thrusting unit are in their closest positions to each other, to drive the wheels 31, 31 .... of said thrusting unit and to place the thrusting unit in a position to stride over the fixed rail plate 2, at the rear portion of said rail plate.

Thereafter, each thrusting unit 12 is advanced slowly along the fixed rail plate 2 until it abuts against the rearmost one of the slide beds 6, 6 carrying the completed hull block thereon. Then, the engaging portion 43 of the pusher block 42 of each thrusting unit 12 is engaged with the associated slide bed 6 and the cushion rubber 44 at the front face of said pusher block is contacted with said slide bed 6.

The arms 45, 45 at the opposite ends of the pusher block 42 are pivotally turned and engaged with the connecting rod 48, 48 provided on the slide bed 6 and the stopper pins 49, 49 are inserted into the holes at the projecting ends of said connecting rods, whereby the pusher block 42 is coupled with the slide bed 6.

After all of the thrusting units 12, 12 have been coupled with the associated slide beds 6, 6 respectively in the manner described, the hydraulic valve means 41, 41 of each thrusting unit 12 are adjusted and the drive motors 39, 39 thereof are set in motion, to supply pressurized oil through the auxiliary hydraulic pumps 38, 38 to the rear pin cylinder 27, the fixing main hydraulic cylinder 51 and fixing auxiliary hydraulic cylinder 56 of the rear block 17, to actuate the same, whereby the rear pin 28 is engaged in the pin hole 11 of the fixed rail plate 2 and concurrently, the fixing block 53 is depressed against the fixed rail plate 2 to secure the rear block 17. In this case, the front pin 26 of the front block 13 of each thrusting unit 12 is held retracted into the pin hole 15.

Upon completion of the above operation, the hydraulic valve means 41, 41 are operated and the drive motors 39, 39 of each thrusting unit 12 are set in motion, whereupon the thrusting hydraulic cylinders 23 of all thrusting units 12, 12 are actuated all at once through the respective main hydraulic pumps 37, 37 and thereby the front blocks 13 of said thrusting units 12, 12 are moved forward relative to the fixed rear blocks 17, with the pusher blocks 42 at the front ends thereof pushing the respective slide beds 6, 6 .... . The slide beds 6, 6 .... thus pushed slide on the steel balls 4, 4 ....., carrying the hull block A mounted thereon forwardly along the fixed rail plates 2,2 ... .

Since the stroke of the thrusting hydraulic cylinders 23 is set at 1 meter, the slide beds 6, 6 ... are shifted 1 meter by the above-described operation and accordingly the hull block A is shifted also 1 meter.

Upon completion one stroke of the shifting operation by the thrusting hydraulic cylinders 23 of the respective thrusting units 12, 12 described above, said thrusting

hydraulic cylinders 23 stop their operation, so that the front blocks 13 stop their forward movement and the pusher blocks 42 thereof also stop. The slide beds 6, 6 are held stationary by the arms 45, 45 coupling said slide beds 6, 6 whith the pusher blocks 42, and concurrently, the shifting of the hull block A is ended.

Now, the position of the hydraulic valve means 41, 41 of each thrusting unit 12 is shifted and pressurized oil is supplied to the front pin cylinder 25 of the front block 13, to operate the same, whereby the front pin 26 is inserted into the pin hole 11 of the fixed rail plate 2. On the other hand, the rear pin cylinder 26 of the rear block 17 is actuated to move the rear pin 28 off the pin hole 11. At the same time, the fixing main hydraulic cylinder 51 and fixing auxiliary hydraulic cylinder 56 of the anti-stumble means 50 are actuated to disengage the fixing block 58 from the fixed rail plate 2 and thereby to provide for movement of the rear block 17 along the fixed rail plate 2.

Successively thereafter, the drive motors 39, 39 of each thrusting unit 12 are operated under the condition described above and pressurized oil is supplied through the main hydraulic pumps 37, 37 to thrusting hydraulic cylinder 23 in a direction reverse to the case of thrusting operation, whereby said thrusting hydraulic cylinder 23 operates to move the rear block 17 toward the front block 13. In this case, the stroke of movement of the rear block is 1 meter, same as the stroke of forward movement of the front block 13.

When the rear blocks 17 of all of the thrusting units 12, 12 have moved 1 meter toward the front blocks 13, the operation of the thrusting hydraulic cylinders 23 is terminated, so that the rear blocks 17 stop their movement.

Thereafter, the rear pin cylinder 27 provided on the rear block 17 of each thrusting unit 12 is actuated again to insert the rear pin 28 into the next pin hole 11 of the fixed rail plate 2 to fix said rear block 17 in its position. At the same time, the front pin cylinder 25 provided in the front block 13 is actuated to pull the front pin 26 off the pin hole 11 of said fixed rail plate 2, providing for movement of the front block. Then, all of the slide beds 6 are thrusted all at once by the front blocks 13 through the pusher blocks 42 in the same manner as described previously, upon actuating the thrusting hydraulic cylinders 23 of the respective thrusting units, whereby the hull block A is advanced another 1 meter.

When the hull block A has been shifted 1 meter, the rear block 17 of each thrusting unit 12 is set free from the fixed rail plate 2 by the same operation as described above, and now the front block is secured to said rail plate, and the rear block is pulled toward said front block.

With the thrusting device of the invention, the hull block A is shifted 1 meter by one meter intermittently along the fixed rail plates 2, 2 ..... by repeating sequentially the steps of selecting the position of the hydraulic valve means 41, 41 of each thrusting unit 12; driving the drive motors 29, 29; to supply pressurized oil from the oil tanks 40, 40 through the auxiliary hydraulic pumps 38, 38 alternately to the front pin cylinder 25 and to the rear pin cylinder 27, the fixing main hydraulic cylinder 51 and the fixing auxiliary hydraulic cylinder 56, thereby to engage the front pin 26 and rear pin 28 alternately in the pin holes 11, 11 ... of the fixed rail plate 2; and secure the front block 13 and rear block 17 alternately to said fixed rail plate, said rear block 17 being secured to said fixed rail plate by the fixing block 58 which is depressed against the rail plate surface while said rear pin 28 is being engaged in said pin hole 11; and driving the drive motors 39, 39 while said rear block 17 is being secured to said rail plate 2 to supply pressurized oil from the oil tanks 40, 40 through the main hydraulic pumps 37, 37 to the thrusting hydraulic cylinder 23 thereby to actuate said thrusting hydraulic cylinder 23 and thrust the slide bed 6 forward by said front block 13 through the pusher block 42.

In the thrusting operation of the device of this invention, the auxiliary frame beds 29 of each thrusting unit 12 and various elements mounted on said auxiliary frame beds, the guide beams 35, 35, the operation control compartment 57 and the electric means 58 move along with the front block 13.

Further, in the thrusting operation, the front block 13 and rear block 17 of each thrusting unit 12 move always straight along and in a direction parallel to the associated fixed rail plate 2 when said front block is pushed forward or said rear block is pulled toward said front block, because both of said blocks 13, 17 are coupled together by the thrusting hydraulic cylinder 23 interposed therebetween and the two guide beams 35, 35 in sliding engagement with said blocks.

After the hull block A has been moved 1 meter by 1 meter over a desired distance on the fixed rail plates 2, 2 ..... by repeating the above-described operation, the drive motors 39, 39 of each thrusting unit 12 are set in motion to actuate the respective cylinders so as to pull the front pin 26 of the front block 13 and the rear pin 28 of the rear block 17 off the pin holes 11, 11 of said fixed rail plates 2, 2 and put said front and rear block together.

Then, the pusher block 42 of each thrusting unit 12 is disengaged from the associated slide bed 6 by disconnecting the arms 45, 45 from said slide bed.

Thereafter, the high torque motors 33, 33 of each thrusting unit 12 are set in motion to drive the wheels 31, 31 of said thrusting unit and return said thrusting unit to the original starting point.

With all of the thrusting units 12, 12 having thus been returned to their original positions, another hull block A is constructed on the slide beds 6, 6 and the completed hull block A is transported a predetermined distance along the fixed rail plates 2, 2 .... by the thrusting units 12, 12 respectively connected with the rearmost ones of the slide beds 6, 6 and operated in the same manner as descirbed above.

According to the construction of the thrusting device of the invention, there can be materialized a novel thrusting unit 12 which is simple in construction, easy to manufacture and small in size and hence requires a small space and which can be movable by making use of the fixed rail plate 2, and it becomes possible to transport a heavy hull block A more safely and simply than heretofore.

Namely, the thrusting units 12, 12 of the thrusting device according to the invention each comprises one front block 13 and one rear block 17 respectively striding over a fixed rail plate 2, one thrusting hydraulic cylinder 23 coupling said front and rear blocks with each other, one front pin 26 provided in said front block 13 and one rear pin 28 provided in said rear block 17, one front pin cylinder 25 provided on said front block 13 to operate said front pin 26 and one rear pin cylinder

27 provided on said rear block 17 to operate said rear pin 28, a fixing block 53 provided on said rear block 17 and a hydraulic cylinder provided on said rear block 17 to operate said fixing block 53, and each of these constituent members is of a relatively simple shape and construction and very easy to manufacture and assemble, and can be operated simply and easily.

In the operation of each thrusting unit 12 according to the invention, the front block 13 and the rear block 17 are moved forward alternately by the action of the thrusting hydraulic cylinder 23 while alternately being secured to the fixed rail plate 2 by the front pin 26 and by the rear pin 28 and fixing block 53, so that a large thrust can be obtained simply effectively and shifting of the heavy weight hull block A can be achieved easily.

Particularly when the front block 13 is moved forward by the action of the thrusting hydraulic cylinder 23, with the rear block 17 being fixed to the fixed rail plate 2, the reaction of the thrust of said hydraulic cylinder is taken by said fixed rail plate 2 through the rear pin 28 and fixing block 53. Owing to such arrangement, a rotational movement of the rear block 17 can be prevented highly effectively and at the same time, the cost of manufacture of the thrusting unit can be substantially reduced as the fixed rail plate 2 is effectively utilized.

It should also be noted that the wheels 31, 31 during the hull block thrusting operation are not subjected to an unreasonably large force since the reaction of thrust is taken by the fixing block 53, and thus breakage of said wheels can be avoided.

In the thrusting operation, the pusher block 42 of each thrusting unit 12, which is connected to the front block 13 in a manner to be pivotable in a horizontal plane, is applied to the rear end face of the slide bed 6. Therefore, it is possible to transmit the thrust of the thrusting hydraulic cylinder 23 uniformly to the slide bed 6.

The slide bed 6 and the pusher block 42 of the front block 13 are firmly engaged with each other at the lower portions thereof and, therefore, there is no fear of said slide bed and pusher block slipping relative to each other during the thrusting operation. Since the hull block A having a large weight is mounted on the slide bed 6 and the rear block 17 of each thrusting unit 12 is firmly engaged with the fixed rail plate 2 and further the thrusting hydraulic cylinder 23 is arranged such that its thrust acts forwardly, none of the constituent members of the thrusting unit undergoes an unreasonably large force during the thrusting operation and hence breakage or rotational movement of said thrusting unit can be positively prevented.

The construction of the thrusting units 12, 12 proper is so simple as may be seen from the drawings that the entire thrusting units can be disposed beneath the hull block A for carrying out the thrusting operation, and the other operations are not adversely affected by the thrusting units. This is advantageous also in avoiding the breakage of the thrusting units which would otherwise be caused by articles dropping onto said thrusting units.

The front block 13 and rear block 17 are interconnected by the two guide beams 35, 35, fixed to said front block 13, in such a manner that said blocks may be movable independently of each other. Therefore, the front and rear blocks are always restrained by each other from movement or rotation in a direction other than the thrusting direction. This ensures accurate and positive movement of both blocks by the thrusting hydraulic cylinder 23 and enables the thrust of said thrusting hydraulic cylinder to be transmitted in the correct direction to the slide bed 6 and the hull block A to be effectively thrusted.

In the thrusting operation, each of the slide beds 6 carrying the hull block A thereon is coupled with the pusher block 42 of each thrusting unit 12 by means of the coupling arms 45, 45, so that, when the sliding bed 6 is thrusted forward by said thrusting unit the movement of said sliding bed more than a predetermined distance under the influence of acceleration created therein is restricted by said thrusting unit through said coupling arms 45, 45 and thus runaway of the hull block A can be positively prevented. This eliminates the necessity for providing a special, large-scaled braking menas which has been provided in the conventional devices and is very effective in preventing runaway of the hull block even when the fixed rail plates 2, 2 .... have a gradient.

Although the present invention has been described and illustrated herein in terms of a specific embodiment thereof, it should be understood that the invention is not restricted only to the embodiment shown but many changes and modifications are possible to the detailed construction of the embodiment without deviating the technical scope of the invention. It should also be understood that the application of the thrusting device of the invention is not restricted only to the thrusting of ship hull blocks but to the thrusting of many other articles.

What is claimed is:

1. A thrusting device comprising a plurality of fixed rail plates for shifting an article to be shifted thereon, each of said fixed rail plates being formed therein with substantially equally spaced pin holes arranged substantially along the center line thereof, and at least one thrusting unit striding over a selected one of said fixed rail plates and comprising running wheels provided at the bottom thereof for running along said fixed rail plate, one front block and one rear block arranged in opposed relation to each other, one thrusting hydraulic cylinder having one end connected to said front block and the other end to said rear block for thrusting said front block with said other end bearing against said rear block, supporting means for securing both of said blocks alternately to said fixed rail plate through said pin holes, two guide beams each having one end fixed to said front block and the central portion slidably supported by a bearing portion formed integrally with said rear block, and anti-stumbling means connected to said rear block rearwardly of said supporting means.

2. Apparatus for shifting a heavy object across a substantially horizontal surface, by a plurality of successive increments of forward movement, comprising:

plate means extending on said surface and possessing at least one row or regularly spaced upwardly open openings, said row longitudinally extending in the direction of said forward movement;

carriage means for bearing the heavy object thereupon;

rolling support means provided between the plate means, flanking said at least one row, and the carriage means;

a frame having rolling support means for rolling across said surface in said direction;

a front block provided with a generally vertically directed, downwardly extensible and upwardly retractable pin for insertion into and withdrawal from successive ones of said upwardly open openings;

a rear block provided with a generally vertically directed, downwardly extensible and upwardly retractable pin for insertion into and withdrawal from successive ones of said upwardly open openings;

a hydraulic piston and cylinder arrangement extending generally longitudinally, horizontally on said frame, the forward end thereof being connected to the front block and the rear end thereof being connected to the rear block;

hydraulic system means for extending and retracting said hydraulic piston and cylinder arrangement;

a pair of longitudinally slidable guide members respectively transversally offset from the hydraulic piston and cylinder and having the forward ends thereof fixed to the front block;

guide bearings on the frame and fixed to the rear block for supporting the hydraulic piston and cylinder arrangement, front block, rear block and guide members with respect to the frame, the guide members being slidably received in the guide bearings for essentially longitudinal sliding;

connector means for securing the carriage means to the front block,

whereby the heavy object, supported on the carriage means may be shifted across the surface in said direction, by

extending the pin of the rear block down into an upwardly open opening while said hydraulic piston and cylinder arrangement is retracted and said connector means is connected and the pin of the front block is retracted, operating the hydraulic system to extend said hydraulic piston and cylinder arrangement and thus thrust the front block, carriage and heavy object forwardly, extending the pin of the front block down into an upwardly open opening and retracting the pin of the rear block from the opening into which it had been extended, operating the hydraulic system to retract said hydraulic piston and cylinder arrangement and thus recover the rear block toward the front block to prepare for the next increment of forward movement.

3. The apparatus of claim **2** further including surface engaging means rigged by hydraulic piston and cylinder means to trail the rear block and means for extending the last-mentioned piston and cylinder means when the heavy object is being moved an increment forwardly to maintain the apparatus in a generally level condition with respect to the surface, countering a tendency of the rear block to be pushed downward by the rear end of the first-mentioned piston and cylinder arrangement.

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