May 27, 1969 A. THOMAS 3,446,301

LOAD MOVING STRIDING DEVICE

Filed Jan. 12, 1967 Sheet 1 of 3

Fig. 2

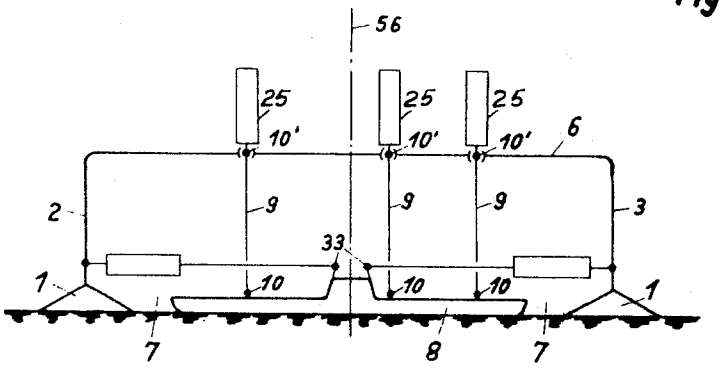
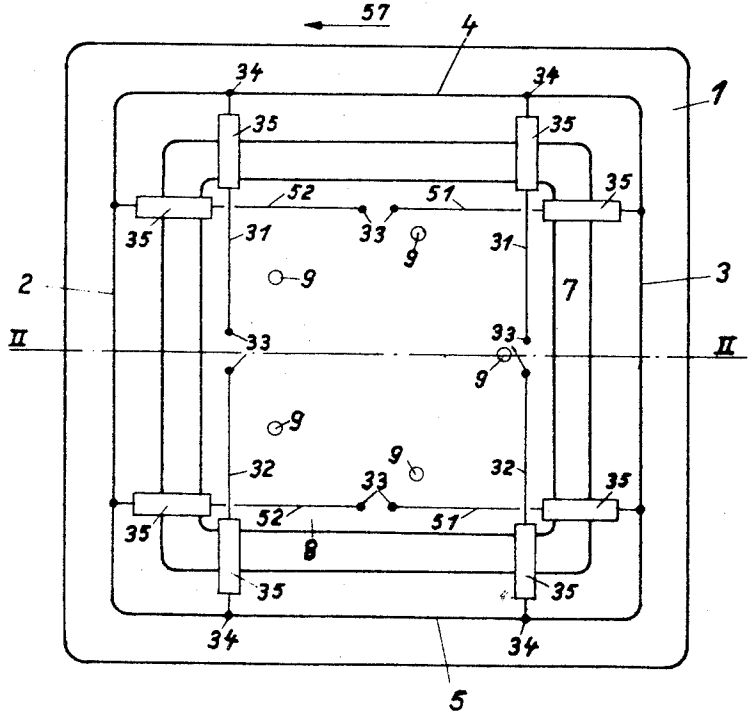


Fig. 1



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Fig. 3

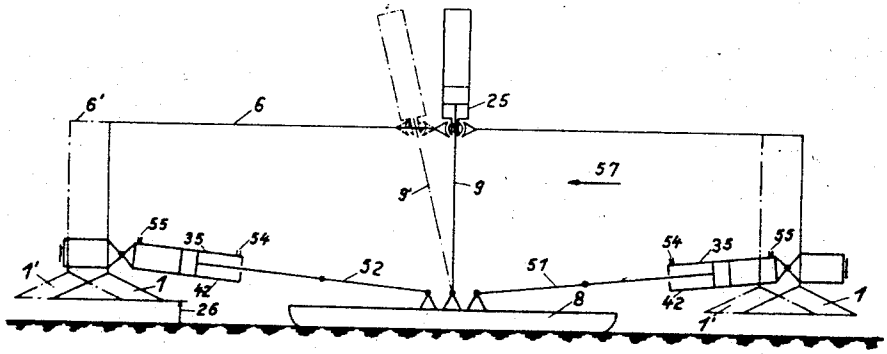
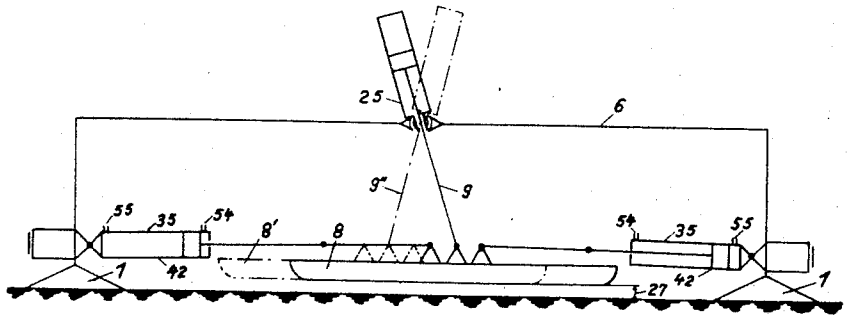


Fig. 4



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Fig.5

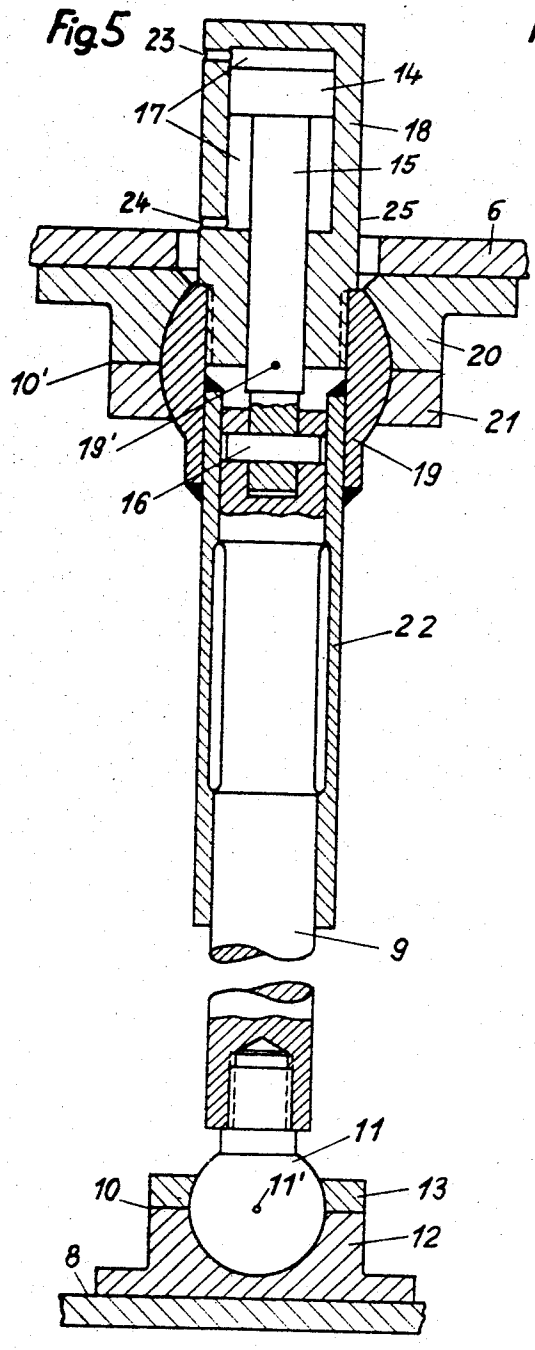
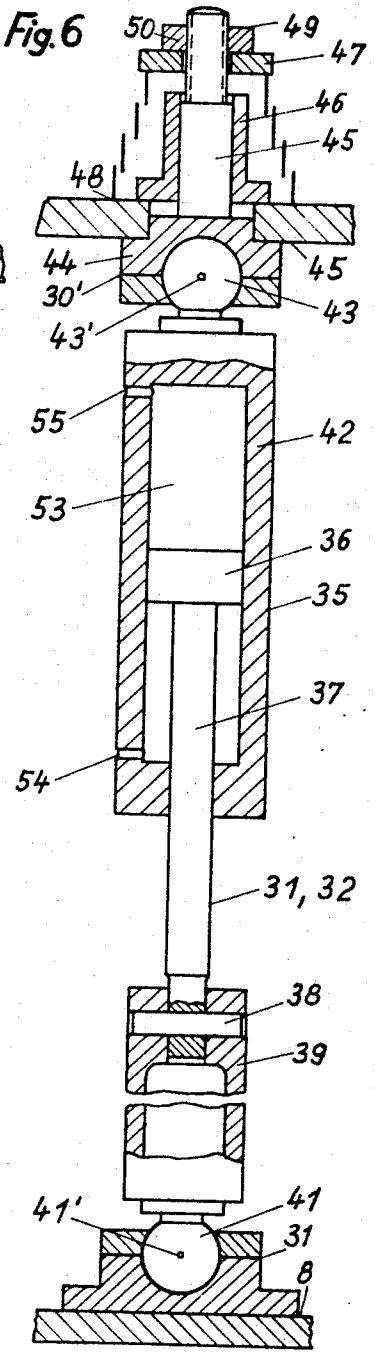


Fig.6



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3,446,301

LOAD MOVING STRIDING DEVICE

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Int. Cl. B62d 57/02
U.S. Cl. 180—8 17 Claims

ABSTRACT OF THE DISCLOSURE

The present disclosure relates to a striding device for rigidly supporting and moving heavy loads, for example 100 tons. The device comprises basically a frame for rigidly supporting the load on the ground and a striding foot assembly connected to the frame by both horizontally acting and vertically acting control power operators for changing the vertical and horizontal relative positions of the frame and stride foot so that the stride foot may selectively engage the ground to lift the frame off of the ground and move relative to the frame to horizontally shift the frame with respect to the ground. Thereafter, the frame is lowered to engage the ground and the stride foot is moved out of engagement with the ground and advanced to a suitable position with respect to the frame. The device provides for the movement of the frame in any horizontal direction with simple controls for fluid power cylinders. The horizontally acting power cylinders are designed to act only in tension and the vertically acting power cylinders are arranged outside of the connecting distance between the frame and stride foot so that bending moments will not interfere with the operation of the power cylinder and will allow a simpler, more economical construction.

Background of the invention

There are many environments in which a very heavy load must be supported and movably mounted. For example, stone quarries require heavy crushing and transportation devices to be rigidly mounted closely adjacent to the stone pile produced by demolishing side walls of the stone quarry; this position changes with the advancement of the working face of the stone quarry so that the equipment must periodically be moved to maintain its close position to the stone pile. The crushing and transportation equipment may weigh more than 100 tons, particularly when processing and classifying devices are included. It is most desirable that the device be constructed to provide a rigid foundation for the heavy equipment and at the same time move in any direction.

Crawler type tractors are usually not suitable for such extremely heavy loads, particularly in view of the heavy additional loads and vibrations produced by the operating equipment when handling large amounts of stone.

There are known types of striding devices, for example, provided with three or more striding feet. These devices may accomplish movement in any direction with a relatively high stride velocity from point to point. However, such devices require extremely large numbers of adjusting elements which have to be controlled either simultaneously or consecutively in certain time periods so that manual operation is no longer possible, which requires extremely complicated automatic control devices that unduly increase the cost of mauufacture, maintenance and operation while increasing the chance of errors.

Brief description of the invention

The stride foot assembly of the present invention is considerably simplified in that it employs a rigid frame

for supporting the construction equipment and provides a single stride foot for moving this frame relative to the ground. The single stride foot is connected to the frame by means of perpendicularly and oppositely arranged hydraulic cylinders and vertically acting hydraulic cylinders for engaging the stride foot with the ground, lifting the frame so that it is supported on the stride foot, moving the frame horizontally with respect to the stride foot and ground, lowering the frame in its new position to engage the ground, raising the stride foot out of engagement with the ground, and horizontally advancing the stride foot to another position with respect to the ground.

Hydraulic power cylinders are very simple, economical and will handle extremely large loads in the present environment so that their use is preferred; however, it is contemplated according to the broad aspects of the present invention that other power transmitting means may be employed, for example, spindles, worm gears, gear tooth drives, pneumatic power cylinders and electromechanical drive systems.

The present invention is designed to provide an extremely rigid support and limited movement of this support in all horizontal directions, which may occur only a few times a day in order to keep up with the rock pile formed in the demolition area of the quarry.

The horizontally acting control means for relatively moving the frame and stride foot are constructed to be stressed exclusively in tension by simple acting power transmitting hydraulic cylinders so that the elements do not have to be constructed extremely massive for preventing buckling effects in the connecting links. The vertically acting control power transmitting hydraulic cylinders are arranged to act in both compression and tension for raising and lowering the stride foot relative to the rigid frame; the piston-cylinder mechanism is double acting and is effective outside of the connecting distances between the frame and stride foot so that it is not subject to bending stresses caused by column effects, which might produce a canting of the piston in the cylinder to decrease the effectiveness or prevent their operation. To provide for movement in any horizontal direction, pairs of horizontally acting power cylinders are arranged on opposite sides of the stride foot in one horizontal direction and on opposite sides of the stride foot in the horizontal direction substantially perpendicular to the previously mentioned horizontal direction. With regard to oppositely arranged pairs, the power cylinders on one side will horizontally adjust the relative position between the stride foot and frame in one horizontal direction by acting only in tension; the oppositely arranged power cylinder pairs will serve to relatively adjust the stride foot frame in the opposite direction while acting only in tension. In each case, the relatively inactive power cylinders will be tensioned to hold or maintain their relative positions except for the power cylinders directly opposite to the actuated power cylinders, which will yield. An actuator is provided for the horizontally acting power cylinders in one direction and a separate actuator is provided for the horizontally acting power cylinders in the perpendicular direction. When fluid is being supplied to the power cylinders on one side of the stride foot, the actuator withdraws the same quantity of fluid from the horizontally acting power cylinders on the opposite side of the stride foot. Also, a separate single manual operator may be provided for the vertically acting control power cylinders so that the entire operation of the striding device may be accomplished by one man in a simple effective manner.

The device is further simplified by providing only a single centrally located stride foot having a large support surface for engaging the ground, and by providing the rigid base frame as a closed, substantially annular

element surrounding and normally uniformly spaced from the single stride foot. The horizontally acting control elements are connected at their outer ends to the frame and at their inner ends to the stride foot by means of universal joints.

Three or more, preferably five, vertically acting control elements are arranged uniformly, particularly in a circle, between the single stride foot and an abutment plate mounted above the stride foot and rigidly attached to the frame. The vertically acting control members are attached at their outer ends to the abutment plate by means of universal joints and attached at their inner ends by means of universal joints to the stride foot. The universal joints may be Cardan joints, ball and socket joints, or the like. With this arrangement, each of the substantially vertically acting control members is provided with a piston and cylinder above the universal joint connecting it to the abutment plate, particularly with the cylinder being rigidly fastened to the ball portion of the preferred ball and socket universal joint. A guide sleeve for the control member may be attached to the end of the ball that is opposite from the cylinder for guiding the inner portion of the piston rod that is connected to the stride foot. This arrangement substantially prevents the power cylinder from being effected by the column bending stresses.

It is an object of the present invention and characteristic of the above described preferred embodiment that a simple and economical striding or walking device for heavy loads is provided for movement in one horizontal direction or at right angles thereto by means of a one handed control, or for movement in every desired direction by simultaneous operation of two manual actuators with both hands. A single manual one handed actuator is provided for controlling the operation of the horizontally acting control members in one horizontal direction, a separate manual one handed actuator is provided for controlling the operation of the horizontally acting control members in a perpendicular horizontal direction and a separate third manual one handed actuator is provided for controlling the operation of the vertically acting control members. All of the vertically acting control members are arranged parallel to each other; all of the horizontally acting control members in one horizontal direction are parallel to each other; and all of the remaining horizontally acting control members are arranged parallel with each other.

Further features, objects, variations, embodiments, and advantages of the present invention will become more apparent from the following description of a single preferred embodiment shown in the attached drawing.

Brief description of the drawing

FIGURE 1 is a schematic top plan view of the striding device according to the present invention.

FIGURE 2 is a schematic partial cross-sectional view taken along line II—II of FIGURE 1;

FIGURES 3 and 4 are illustrations similar to FIG. 2 showing different operative positions and operations of the striding device;

FIGURE 5 is a partial cross sectional view showing one vertically acting control member and its universal joint connection with the frame abutment plate, its universal joint connection with the stride foot and its piston cylinder power transmitter; and

FIGURE 6 is a partial cross sectional view similar to FIGURE 5, but showing one of the horizontally acting control members, its piston cylinder power transmitter and universal joints for connecting it to the frame and stride foot, with both FIGS. 5 and 6 being on an enlarged scale.

Detailed description of the drawing

As shown in FIGURES 1 and 2, the preferred embodiment of the striding device according to the present invention has a base frame **1** that includes four rigid ground engaging sides **2**, **3**, **4** and **5**. The sides **2–5** are rigidly connected together to form a closed base or an annular base. The top portions of all of the sides **2–5** are connected together by means of a rigid abutment plate **6**. The rigid frame **1** engages the ground around its annular periphery and supports the heavy loads, for example, rock crushing, classifying and transporting equipment, on the abutment plate **6**.

The base frame surrounds and defines an interior opening or space **7** for receiving the ground engaging stride fooot **8**; thus, an annular space of uniform thickness is formed between the centrally mounted stride foot **8** and the side walls **2–5** of the base frame **1**. At least three and preferably five vertically acting control members **9** are arranged symmetrically with respect to the base frame, preferably in a circle, for supportingly connecting the stride foot **8** to the base frame **1**.

Each of the lower or inner ends of the vertically acting control members **9** is connected to the stride foot **8** by means of a universal joint **10**, which will allow pivoting in all directions as shown in FIGURES 2 and 5. Although the preferred embodiment of the present invention employs a ball and socket type of universal joint, other types of universal joints may be employed according to the broader aspects of the present invention, for example, Cardan joints. As shown in FIGURE 5, the ball joint **10** includes a ball member **11** rigidly screwed into the bottom end of the vertically acting control member **9** for mounting within the socket member **12**, which is rigidly attached to the stride foot **8**; a screw collar ring **13** is rigidly mounted on top of the socket member **12** to hold the ball within the socket and complete the universal joint.

The upper end of each vertically acting control member **9** includes a piston **14** having a rigidly attached piston rod **15**. The piston rod **15** is rigidly attached by means of a transverse bolt **16** to the upper end of the rod that is connected at its lower end to the ball **11**. The plunger **14** is mounted for reciprocation within the cylinder **17** to provide a power transmitting fluid pistton-cylinder arrangement for selectively changing the connecting distance between the stride foot **8** and the base frame **1**, that is for selectively changing the length of its vertically acting conrol element **9** for raising and lowering the stride foot **8** with respect to the frame **1**. The lower end of the cylinder **17** is screwed into the ball member **19** of the upper universal joint **10'**; the ball member **19** is pivotally mounted within the socket member **20**, which is closed by means of the screw collar ring **21**. The socket member **20** is rigidly mounted on the lower surface of the abutment plate **6** by means of welding or the like. A sleeve **22** is telescopically inserted within the ball member **19** and rigidly attached, for example by welding, to the lower end of the ball member **19**. The sleeve **22** extends downwardly for guiding at its lower end the rod that is connected to the ball member **11**. The cylindrical wall **18** of each cylinder **17** is provided at its upper and lower ends with fluid communicating openings **23**, **24** each for supplying and exhausting pressurized fluid. The piston member **14**, the cylinder **17**, **18** and the openings **23**, **24** constitute the power transmitting means **25** that was mentioned above for operating each of the vertically acting control members **9**.

In the central position of the stride foot **8**, the vertically acting control members **9** are each perpendicular with respect to the abutment plate **6**, the stride foot **8** and the ground, and each have the same length. All of the vertically acting control members **9** remain parallel with respect to each other and will maintain equal spacing of the universal joint centers **11'** and **19'** with respect to each other, as viewed in a horizontal plane, regardless of the pivotal motion they undergo about their universal joints **10** and **10'**.

During striding movement, the vertically acting control members **9** will have the following operation and move-

ment stages for moving the base frame **1** and stride foot **8** with respect to each other;

(1) For purposes of illustration, it will be assumed that the striding device is resting on a horizontal portion of ground with its stride foot in the central ground engaging position of FIGURES 1 and 2. Fluid under pressure is introduced into each of the inlet openings **23** to enter the working chamber between the piston member **14** and the cylinder member **17**; this forces the cylinders **18**, the balls **19**, the sockets **20**, the abutment plate **6** included within the base frame **1**, and the load carried by the base frame upwardly for a stroke distance **26** as shown in FIG. 3 and out of engagement with the ground so that all of the above mentioned elements are supported only by means of the stride foot **8**. In this position, it is seen that the base frame **1** and its supported load may be moved horizontally with respect to the stride foot **8** and the ground, which will be accomplished by means to be described later.

(2) The inlet openings **23** (FIG. 5) are connected to the return line or exhaust line of the means for supplying the pressurized fluid so that the base frame **1** is lowered to the ground under the action of its own weight and the load carried thereby in a manner controlled by the release rate of fluid from the working chamber above the piston member **14**.

(3) If the pressure source is connected to the opening **24** (FIG. 5) so that the pressurized fluid enters the working chamber below the piston member **14**, the piston member **14** will be driven upwardly, with respect to the ground together with the piston rod **15**, transverse pin **16**, the rigid rod connected between the piston rod **15** and the ball member **11**, the universal joint **10**, and the stride foot **8** for a stroke distance **27** as shown in FIG. 4. When the stride foot **8** is lifted in this manner, it assumes a position underneath the base frame **1** and spaced from the ground so that the stride foot **8** may be laterally or horizontally adjusted with respect to the base frame **1** and ground in a desired manner by a means to be described hereinafter.

(4) If the cylinder openings **24** are disconnected from the power source so that the fluid within the working chamber below the piston members **14** is exhausted, the stride foot **8** will be lowered under the action of its own weight until it engages the ground; it is also contemplated that fluid pressure may be introduced into the upper working chamber above the fluid piston member **14** through the opening **23** so that the stride foot **8** will be driven down into engagement with the ground if its own weight is insufficient for this purpose. Thus, the stride foot **8** is returned to its position as shown in FIG. 1 so that the above mentioned cycle may be repeated, if desired.

During the above described movements of the vertically acting control members **9**, a plurality of horizontally acting control members, to be described later, are connected horizontally between the frame **1** and the stride foot **8** to balance the base frame **1** (FIGURE 3) or the stride foot **8** (FIG. 4) by simultaneously and in pairs effecting a pull or tension force of substantially equal magnitude on all sides. It is seen that during the above described sequence of operations for the vertically acting control members the portion of each vertically acting control member **9** that is disposed between the balls **11** and **19** is compressively stressed so that it will tend to buckle, whereas the power transmitting members **14**, **18** are mounted outside of this buckling zone so that they will not be effected by bending stresses that may cant or lock the members with respect to each other during overloading of the device, for example. That is, if the piston-cylinder arrangement were placed between the pivoting centers **19'**, and **11'**, they would be subjected to bending stresses during overload buckling so that the piston may become canted within its cylinder to prevent relative reciprocation and further operation of the device; whereas with the present invention, the piston-cylinder arrangement is mounted outside of the buckling zone between the pivoting centers **19'** and **11'** so that the above described canting of the piston **14** within the cylinder **17** will not occur under overloading even though the portion of the device between the centers **10'** and **11'** buckles.

To provide for relative lateral or horizontal adjustment between the base frame **1** and the stride foot **8** in the desired directions, two groups of horizontally acting control members are provided that are essentially effective in a horizontal plane in respective directions that are substantially perpendicular with respect to each other. The horizontally acting control members of each group are arranged in opposing pairs on opposite sides of the stride foot **8** so that each individual horizontally acting control member of each pair acts in opposition to the remaining individual horizontally acting control member of the pair.

As shown in FIG. 1, one group of horizontally acting control members includes two parallel horizontally acting control members **31** on one side of the stride foot **8** for acting in opposition with two individual horizontally acting control members **32** so that two pairs of members are formed. The inner ends of the members **31** and **32** are connected to the stride foot **8** at points **33** (FIG. 1) by means of universal joints **30** (FIG. 6); the outer ends are pivotally connected to the frame **1** at points **34** (FIG. 1) on the side walls **4** and **5**, respectively, by means of universal joints **30'** (FIG. 6). Each of the control members **31** and **32** are provided with a power transmitting piston-cylinder member **35**. As shown in FIG. 6, each member **35** is provided with a piston **36** having a piston rod **37** which is connected by means of a cross bolt **38** with a tube **39**. The tube **39** is rigidly fastened to the ball member **41** of the universal joint **30**. The ball member **41** is carried within a suitable socket that is rigidly secured, for example by welding, to the corresponding inner end of the stride foot **8**. The piston **36** reciprocates within a cylinder **42**, which is rigidly connected at its outer end to the ball member **43** of the universal joint **30'**. The ball member **43** is mounted within the socket member **44**, which has a bolt-like extension **45** extending through an opening in the corresponding side wall of the base frame **1**. A bearing sleeve **46** is rigidly attached to the corresponding side wall of the base frame **1**, for example, by welding, and slidingly receives the bolt-like extension **45** for relative reciprocation. The outer end of the bolt-like extension **45** is provided with a reduced diameter threaded portion that carries a stop washer **47**; a compression spring **48** is compressed between the stop washer **47** and the corresponding side wall **4** or **5** for urging the socket member **44** into engagement with the corresponding side wall **4** or **5**. The amount of compression of prestressing of the spring **48** is adjusted by turning the adjusting nut **50** which is threaded onto the reduced diameter threaded portion **49** of the bolt-like extension **47** for moving the stop washer toward and away from the corresponding side **4** or **5**.

In a corresponding manner and perpendicular to the pairs of control members **31**, **32** (FIG. 1), there are provided additional horizontally acting control members **51**, **52**. The members **31**, **32**, **51**, **52** are mounted in substantially the same horizontal plane. The control members **51**, **52** have their outer ends mounted on the side walls **3**, **2**, respectively of the base frame **1**; their inner ends are each mounted on the stride foot **8**. Each of the control members **51**, **52** is provided with a power transmitting piston-cylinder arrangement **34** and is constructed in an identical manner as the control members **31** and **32**; that is, a cross section through the control members **51** and **52** would be substantially identical to the cross section through the control members **31**, **32** as shown in FIG. 6.

As shown in FIG. 6, each of the horizontally acting control members is provided with a fluid opening **54** for providing fluid to and exhausting fluid from the working chamber between the inner side of the piston **36** and the

cylinder 42; a fluid opening 55 is provided in a like manner for supplying and exhausting fluid from the cylinder space 53 between the cylinder 42 and the outer end of the piston 36. By suitably providing and exhausting fluid into and from the openings 55 and 54, the horizontally acting control members 31, 32 and 51, 52 may relatively adjust the horizontal positioning of the frame member 1 and its load with respect to the stride foot 8 with a device in the positions as shown in either FIG. 3 or FIG. 4. The horizontally acting control members 31, 32 and 51, 52 will hold the base frame and its load on the stride foot during raising of the base frame to the position as shown in FIG. 3 and its lowering from this position; a similar function will be performed in regard to the raising and lowering of the stride foot 8 as shown in FIG. 4. During operation, pressurized fluid is only provided in the working chambers on the inner sides of the pistons 36 so that the horizontally acting control members 31, 32 and 51, 52 are stressed exclusively in tension and there will be no binding between the piston 36 and cylinder 42, because there will be no bending or buckling stresses caused by overloading even though the power transmitting members 35 are arranged between the universal joint centers 33, 34 (FIG. 1) 41', 43' (FIG. 6).

Although portions of the operation and function of various elements have ben set forth in detail above, the complete operation will be briefly described below. It will be assumed that the striding device is in the starting position of FIGURES 1 and 2, wherein the stride foot 8 is symmetrically arranged with respect to the base frame 1 and each is symmetrically arranged with respect to the perpendicular line 56 (FIGURE 2); the stride foot 8 and base frame 1 are resting on the ground, the vertically acting control members 9 are exactly perpendicular with respect to the ground, and the horizontally acting control members 31, 32; 51, 52 are arranged exactly horizontally with respect to the ground. It will be assumed that it is desired to move the striding device in the direction of the arrow 57 (FIG. 1). Fluid is admitted through opening 23 of each vertically acting control member 9 so that the base frame 1 is raised into the solid line position of FIG. 3. Thereafter, fluid pressure is admitted into the opening 54 of the right hand (as viewed in FIG. 3) power transmitting piston-cylinder member 35 and fluid is allowed to discharge from the opening 54 in the left hand power transmitting element 35; thus, the right-hand side power ment plate 6 to the left by a half step into the position cylinder 42 moves with the base frame 1 and the abutshown by the dot-dash lines 1', 6', and the vertically acting control members 9 move into the dot-dash line position of 9'.

Next, the base frame 1 is lowered into engagement with the ground by allowing the pressurized fluid to exhaust from the upper chamber of the vertically acting control members 9 and the stride foot 8 is raised out of engagement with the ground by providing fluid pressure in the lower chambers of the vertically acting control members 9 until the striding device assumes the full line position of FIGURE 4. Next, fluid pressure is introduced into the fluid openings 54 in the left hand power transmitting elements (as seen in FIG. 4) and fluid is allowed to discharge from the fluid openings 54 in the right hand transmitting elements 35 until the stride foot assumes the position as shown in dot-dashed lines at 8' and the vertically acting control elements 9 assume the position as shown in dot-dashed lines 9''. It is thus seen that throughout all of the above steps, the horizontally acting control members are only stressed in tension. FIGURES 3 and 4 are only schematic illustrations wherein only a single vertically acting control member and opposite horizontally acting control members are illustrated for simplicity; the actual number of vertically acting and horizontally acting control members of the preferred embodiment are shown in FIGS. 1 and 2. Since all of the corresponding control members undergo identical or similar operations, only those necessary for purposes of illustration have been shown in FIGURES 3 and 4.

Next, the stride foot is lowered into engagement with the ground by introducing fluid into the opening 23 (FIG. 5) of cylinder 18. Thereafter, the base frame 1 is raised by the stroke distance 26 (FIG. 3) by introducing additional pressurized fluid into the openings 23. Thus, the base frame 1 will again be supported solely by the stride foot 8. From this position, the base frame 1 may be moved to the left a full striding step length by introducing pressurized fluid into the fluid openings 54 of the right hand power transmitting elements 35 (as seen in FIG. 4) and by allowing a corresponding amount of pressurized fluid to discharge from the fluid openings 54 of the left hand power transmitting elements 35.

The step like striding movement is continued by lowering the base frame 1, raising and adjusting the stride foot 8 to the left by full stride step as set forth above, engaging the stride foot with the ground to lift the base frame from the ground, moving the base frame a full stride step to the left and again lowering the base frame into engagement with the ground; these steps are repeated until the desired position of the striding device is obtained in the direction of the arrow 57.

It is understood that during all of the above described operations, the fluid openings 55 of the horizontally acting control members will be vented whenever hydraulic pressure is introduced through the fluid openings 54, when the base frame 1 and stride foot 8 are moved relative to each other.

It will be recognized that the horizontally acting control members 51, 52 will be pivoted about their ball joints 30' so that they will be slightly slanted relative to the horizontal ground plane whenever the stride foot 8 and base frame 1 are vertically moved with respect to each other; thus, there would be a tendency to change the connecting length of the horizontally acting control members and considerable tension will be created in the ball joints 30' connected to the side wall 2, 3 (FIG. 6). Also, further tensions will be created in the horizontally acting control members 51, 52 whenever relative adjustment of the stride foot 8 with respect to the base frame 1 in the horizontal direction is accomplished by means of the horizontally acting control members 31, 32, because the horizontally acting control members 51, 52 that are not actuated will be again pivoted about their universal joints into slanted positions so that there is a tendency to increase their connecting length. The springs 48, as seen in FIG. 6, will allow limited lost motion movement against their bias force between the universal joint 30' and the side wall 4, 5. Furthermore, it is contemplated that according to the broader aspects of the present invention a special fluid pressure compensating device may be employed to accomplish substantially the same purpose. A similar analysis of the control members 31, 32 would be substantially identical for actuation of the control members 51, 52; that is, when the horizontally acting control members controlling one direction of movement are actuated to relatively move the stride foot 8 and base frame 1, the horizontally acting control members controlling relative movement in the perpendicular direction will undergo the above described spring biased lost motion.

A single one-handed manual control is provided for the simultaneous actuation of all of the vertically acting control members 9. A single one handed manual control is provided for simultaneous operation of all of the horizontally acting control members 31, 32 that control relative movement in one horizontal direction. A third single one handed manual control is provided for simultaneous operation of all of the horizontally acting control members 51, 52 for controlling relative horizontal movement in the perpendicular direction. Thus, with one hand on the vertically acting control members manual control and the other hand on the desired horizontally acting control members control striding may be easily accomplished in

the corresponding one of the two perpendicular directions. If striding movement is desired at an angle between the two mutually perpendicular horizontal directions, the control for the members 9 is first actuated; thereafter, one hand is placed on each of the two controls for the horizontally acting control members and the horizontally acting control members are simultaneously actuated to obtain the desired advancing direction. In order to obtain any horizontal striding direction, it is not necessary to simultaneously actuate the control for the vertically acting control members and one of the controls for the horizontally acting control members. The only simultaneous actuation would involve the two manual controls for the horizontally acting control members. Thus, it is seen that the present invention provides simple two hand control of the striding of an extremely heavy frame. Furthermore, the striding mechanism is extremely stable, of minimum parts, simple, economical and rugged.

The above described striding device illustrated in the drawing has been set forth in detail only as a particularly desirable preferred embodiment of the persent broader invention; other embodiments, variations, and modifications are contemplated within the spirt and scope of the present invention.

I claim:

1. A striding device for supporting and moving heavy loads, comprising base frame means for carrying the load on the ground, stride foot means for engaging the ground and selectively supporting said frame means off of the ground and moving said frame means horizontally with respect to the ground, said stride foot means having a ground engaging stride foot, said stride foot means including substantially vertically-acting control means and substantially horizontally-acting control means for supportingly connecting said stride foot to said frame means, each of said control means having power transmitting means for selectively changing its connecting distance between said stride foot and said frame means, said horizontally-acting control means being stressed exclusively in tension by it power transmitting means, said power transmitting means for said vertically-acting control means being effective outside of the connecting distance between said frame means and said stride foot for substantially preventing bending stresses within said power transmitting means, said horizontally-acting control means including pairs of power transmitting means on opposite sides of said stride foot for changing the horizontal distance between said stride foot and said frame means solely by tension in their respective directions, wherein said power transmitting means are fluid piston-cylinder power assemblies and include actuator means for discharging substantially the same amount of fluid from one cylinder that is admitted to the opposite cylinder for producing only tension in its respective power transmitting means.

2. The device of claim **1**, said horizontally-acting control means including additional pairs of power transmitting means on opposite sides of said stride foot and at substantially right angles to said first mentioned pairs of power transmitting means.

3. The device of claim **2**, wherein only a single stride foot having a relatively large surface is provided and said frame means is constructed to engage the ground in a closed frame surrounding said stride foot; and each power transmitting means for said horizontally-acting control means includes a universal joint connecting at its outer end to said frame means and a universal joint connecting it at its inner end to said stride foot.

4. The device of claim **3**, wherein at least one of said universal joints includes spring biased lost motion means for allowing limited increase in its respective connecting distance against a bias force.

5. The device according to claim **4**, wherein at least three substantially vertically-acting control means are symmetrically arranged with respect to said stride foot; said frame means including a rigid abutment plate above said stride foot; said substantially vertically-acting control means each having a universal joint at its outer end connecting it to said abutment plate and having a universal joint at its inner end connecting it to said stride foot.

6. The device of claim **5**, wherein said power transmitting means for said vertically-acting control means includes a fluid piston member and a cooperating fluid cylinder member; said last mentioned outer universal joint including a socket rigidly attached to said abutment plate and a ball member operatively mounted within said socket and rigidly attached to said cylinder member; each of said vertically-acting control means including piston rod means connected between said piston member and said last-mentioned inner universal joint; a guide sleeve rigidly attached to said ball member and slidingly guiding said piston rod means over a substantial portion of its length; said piston member and said cylinder member being arranged above said last mentioned outer universal joint and above said abutment plate.

7. The device of claim **6**, said horizontal power transmitting means for each of said horizontally-acting control means being effective between the centers of pivoting action of the corresponding universal joints.

8. The device of claim **7**, wherein said control means includes one manually operable means for controlling the operation of said power transmitting means for said vertically-acting control means, a second manually operable means for controlling operation of said power transmitting means for said horizontally-acting control means in one horizontal direction, and third manually operable means for controlling the operation of said power transmitting means for said horizontally-acting control means in the horizontal direction at substantially right angles to said one horizontal direction.

9. A striding device for supporting and moving heavy loads, comprising base frame means for carrying the load on the ground, stride foot means for engaging the ground and selectively supporting said frame means off of the ground and moving said frame means horizontally with respect to the ground, said stride foot means having a ground engaging stride foot, said stride foot means including substantially vertically-acting control means and substantially horizontally-acting control means for supportingly connecting said stride foot to said frame means, each of said control means having power transmitting means for selectively changing its connecting distance between said stride foot and said frame means, wherein only a single stride foot having a relatively large surface is provided and said frame means is constructed to engage the ground in a closed frame surrounding said stride foot, and each power transmitting means for said horizontally-acting control means includes a universal joint connecting it at its outer end to said frame means and a universal joint connecting it at its inner end to said stride foot.

10. The device of claim **9**, wherein at least one of said universal joints includes spring biased lost motion means for allowing limited increase in its respective connecting distance against a bias force.

11. A striding device for supporting and moving heavy loads, comprising base frame means for carrying the load on the ground, stride foot means for engaging the ground and selectively supporting said frame means off of the ground and moving said frame means horizontally with respect to the ground, said stride foot means having a ground engaging stride foot, said stride foot means including substantially vertically-acting control means and substantially horizontally-acting control means for supportingly connecting said stride foot to said frame means, each of said control means having power transmitting means for selectively changing its connecting distance between said stride foot and said frame means, wherein only a single stride foot is provided, and at least three substantially vertically-acting control means are symmetrically arranged with respect to said stride foot, said frame means including a rigid abutment plate above said stride

foot, said substantially vertically-acting control means each having a universal joint at its outer end connecting it to said abutment plate and having a universal joint at its inner end connecting it to said stride foot.

12. The device of claim **11**, wherein said power transmitting means for said vertically-acting control means includes a fluid piston member and a cooperating fluid cylinder member; said last-mentioned outer universal joint including a socket rigidly attached to said abutment plate and a ball member operatively mounted within said socket and rigidly attached to said cylinder member; each of said vertically-acting control means including piston rod means connected between said piston member and said last-mentioned inner universal joint; a guide sleeve rigidly attached to said ball member and slidingly guiding said piston rod means over a substantially portion of its length; said piston member and said cylinder member being arranged above said last-mentioned outer universal joint and above said abutment plate.

13. A striding device for supporting and moving heavy loads, comprising base frame means for carrying the load on the ground, stride foot means for engaging the ground and selectively supporting said frame means off of the ground and moving said frame means horizontally with respect to the ground, said stride foot means having a ground engaging stride foot, said stride foot means including substantially vertically-acting control means and substantially horizontally-acting control means for supportingly connecting said stride foot to said frame means, each of said control means having power transmitting means for selectively changing its connecting distance between said stride foot and said frame means, wherein each of said horizontally-acting control means includes a universal joint at its outer end connecting it to said frame means and a universal joint at its inner end connecting it to its stride foot, said power transmitting means for each of said horizontally-acting control means being effective between the centers of pivoting action of the corresponding universal joints.

14. A striding device for supporting and moving heavy loads, comprising base frame means for carrying the load on the ground, stride foot means for engaging the ground and selectively supporting said frame means off of the ground and moving said frame means horizontally with respect to the ground, said stride foot means having a ground engaging stride foot, said stride foot means including substantially vertically-acting control means and substantially horizontally-acting control means for supporting connecting said stride foot to said frame means, each of said control means having power transmitting means for selectively changing its connecting distance between said stride foot and said frame means, wherein said control means includes one manually operable means for controlling the operation of said power transmitting means for said vertically-acting control means, a second manually operable means for controlling operation of said power transmitting means for said horizontally-acting control means in one horizontal direction, and third manually operable means for controlling the operation of said horizontally-acting control means in the power transmitting means in the horizontal direction at substantially right angles to said one horizontal direction.

15. A striding device for supporting and moving heavy loads, comprising base frame means for carrying the load on the ground, stride foot means for engaging the ground and selectively supporting said frame means off the ground and moving said frame means horizontally with respect to the ground, said stride foot means having a ground-engaging stride foot, said stride foot means including a plurality of substantially vertically-acting displacement means for supportingly connecting said stride foot to said frame means, each of said displacement means including power transmitting means for selectively changing its connecting distance between said stride foot and said frame means, each of said displacement means being connected, at its respective ends, by means of ball and socket joints, with said base frame means and said stride foot, respectively, the distance between the centers of the balls at the two respective ends of all displacement means being substantially identical, all of said displacement means being oriented in a substantially parallel relationship at all times, said stride foot means further including horizontally-acting displacement means having two portions acting in two opposite directions, a first portion causing relative displacement between said base frame means and said stride foot, and a second portion adapted for balancing said base frame means or said stride foot when one of these is elevated, all of said displacement means being designed to act only in tension.

16. A device according to claim **15**, wherein said power transmitting means, in the form of hydraulic jacks, are arranged outside of the connecting distance between the two ball and socket joints of said vertical displacement means.

17. A device according to claim **15**, wherein said power transmitting means for said horizontally-acting displacement means are double-acting.

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