Aug. 27, 1963 F. S. PEARNE 3,101,852

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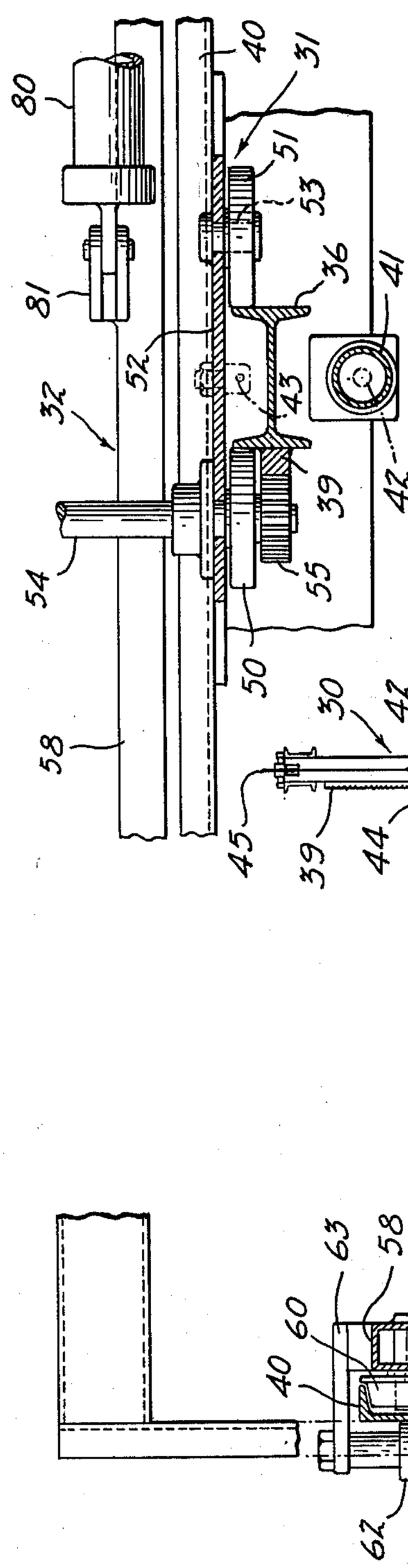

Fig. 2

Fig. 1

Fig. 3

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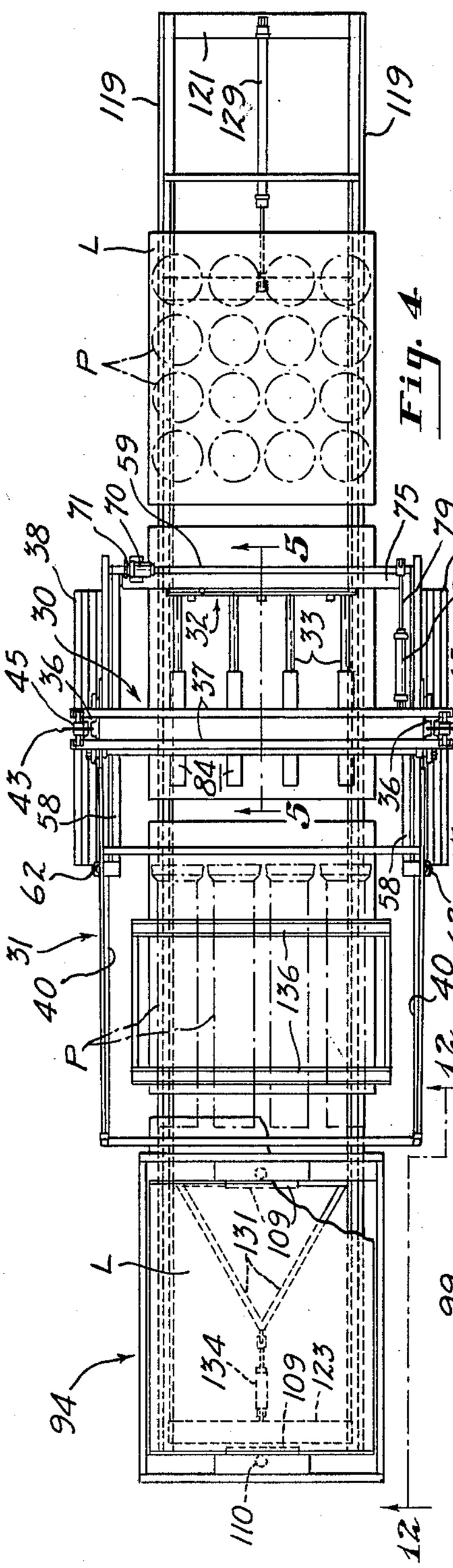

Fig. 4

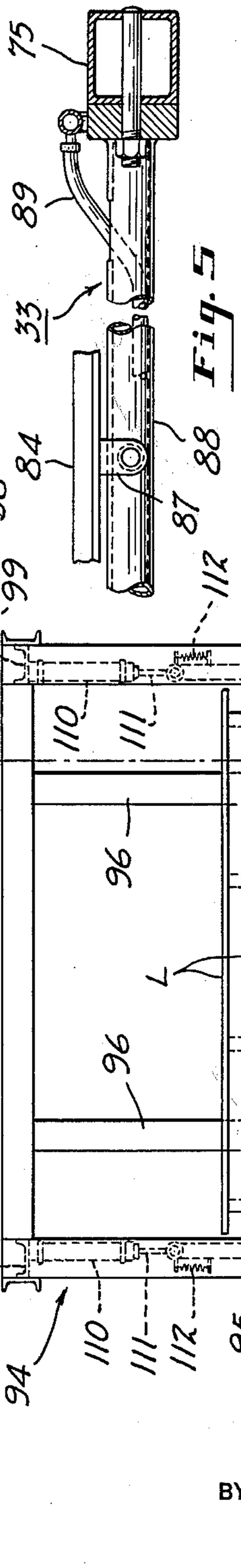

Fig. 5

Fig. 12

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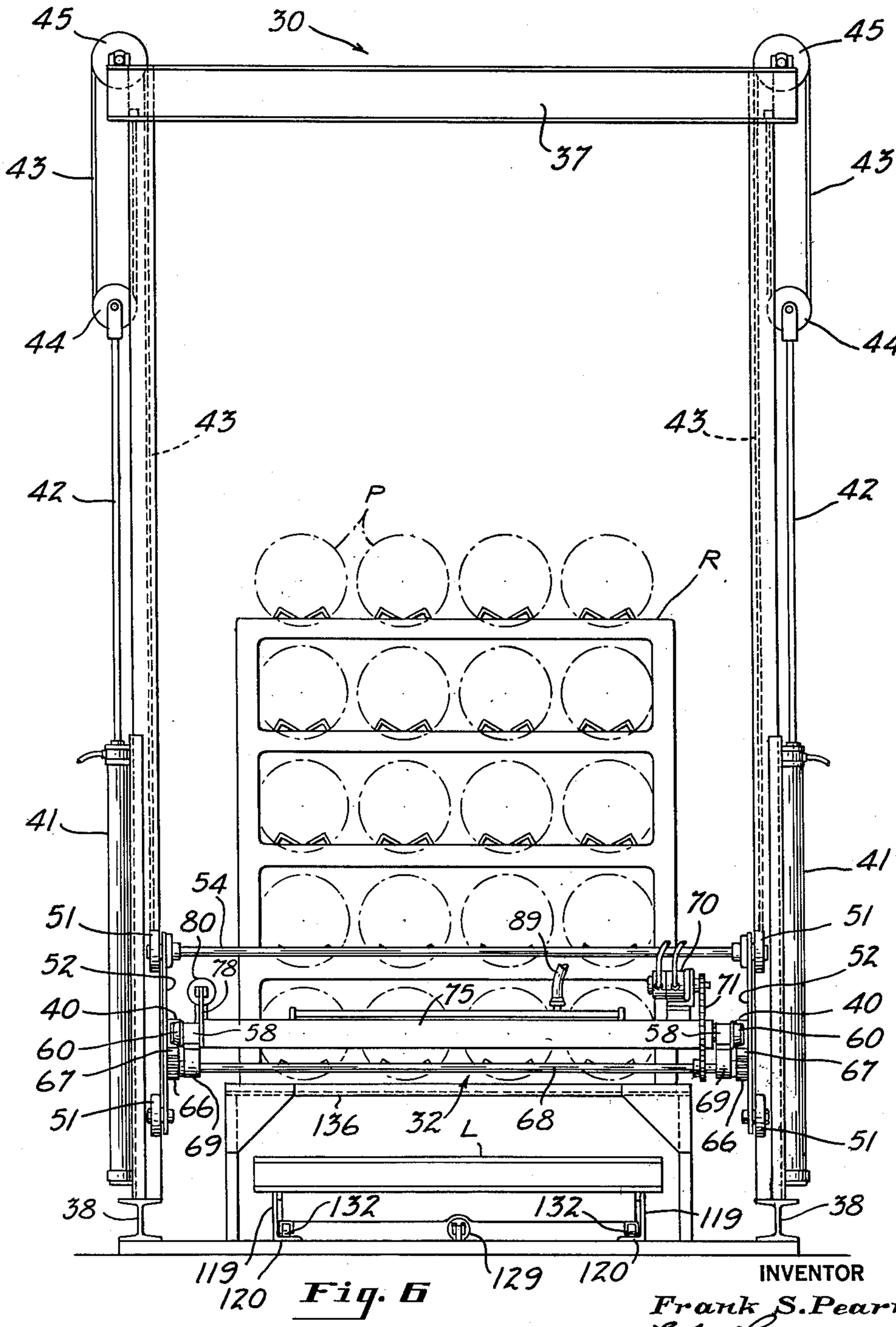

Fig. 6

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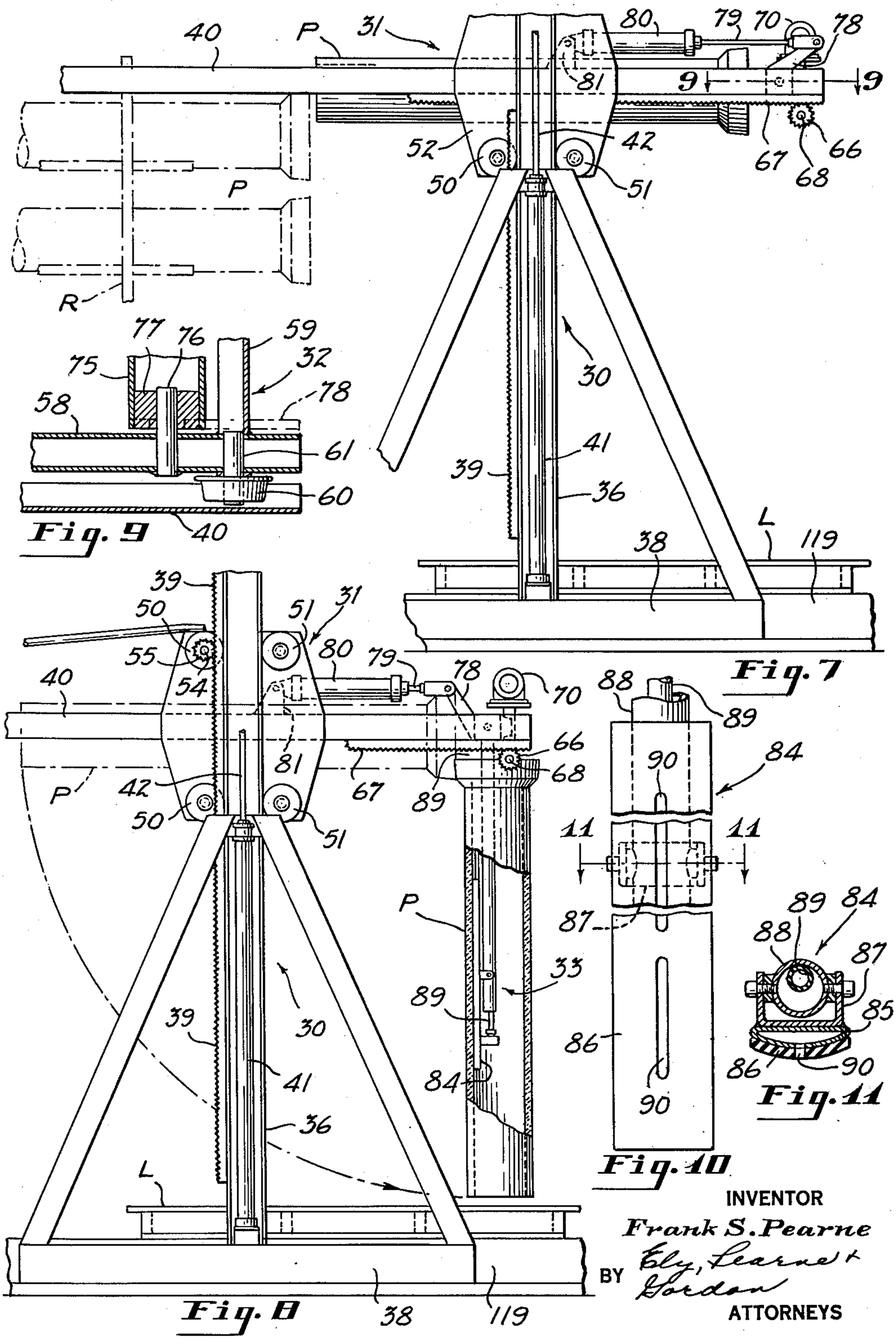

Fig. 9

Fig. 7

Fig. 11

Fig. 10

Fig. 8

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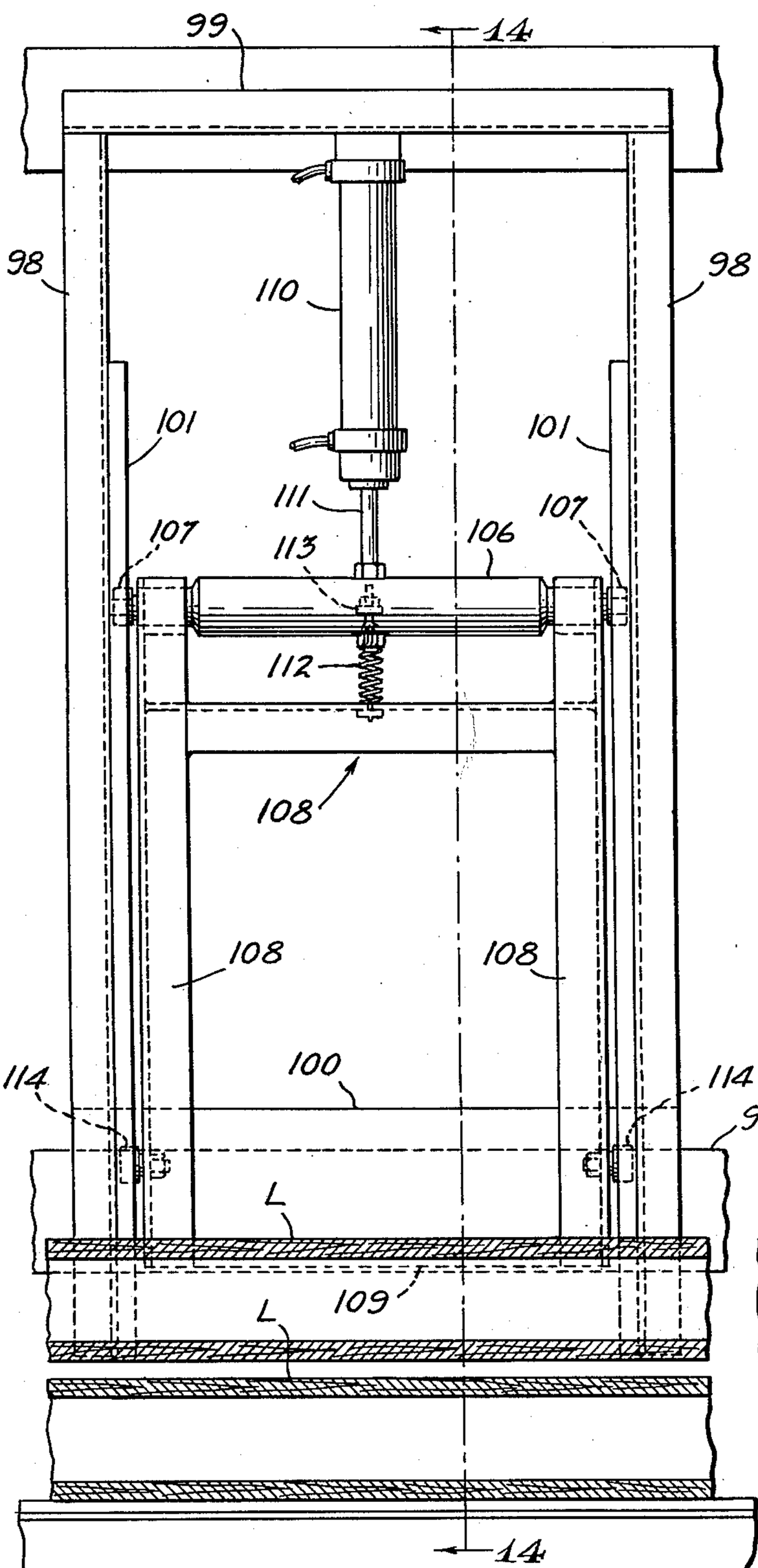

Fig. 13

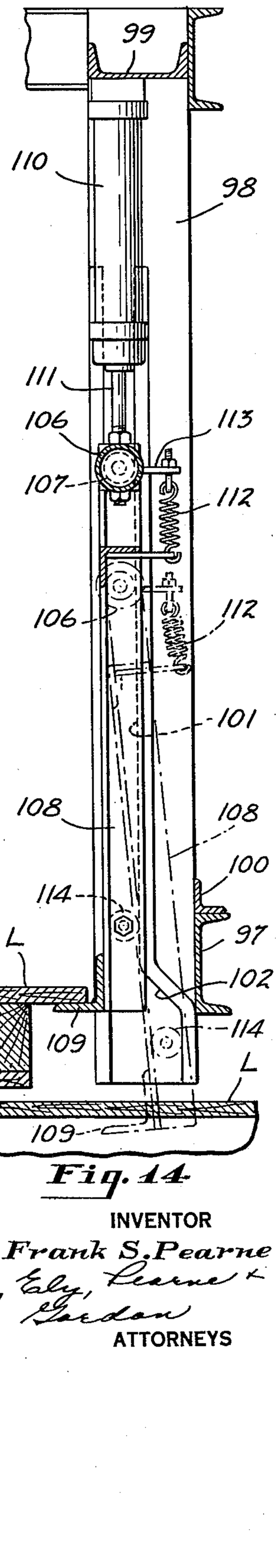

Fig. 14

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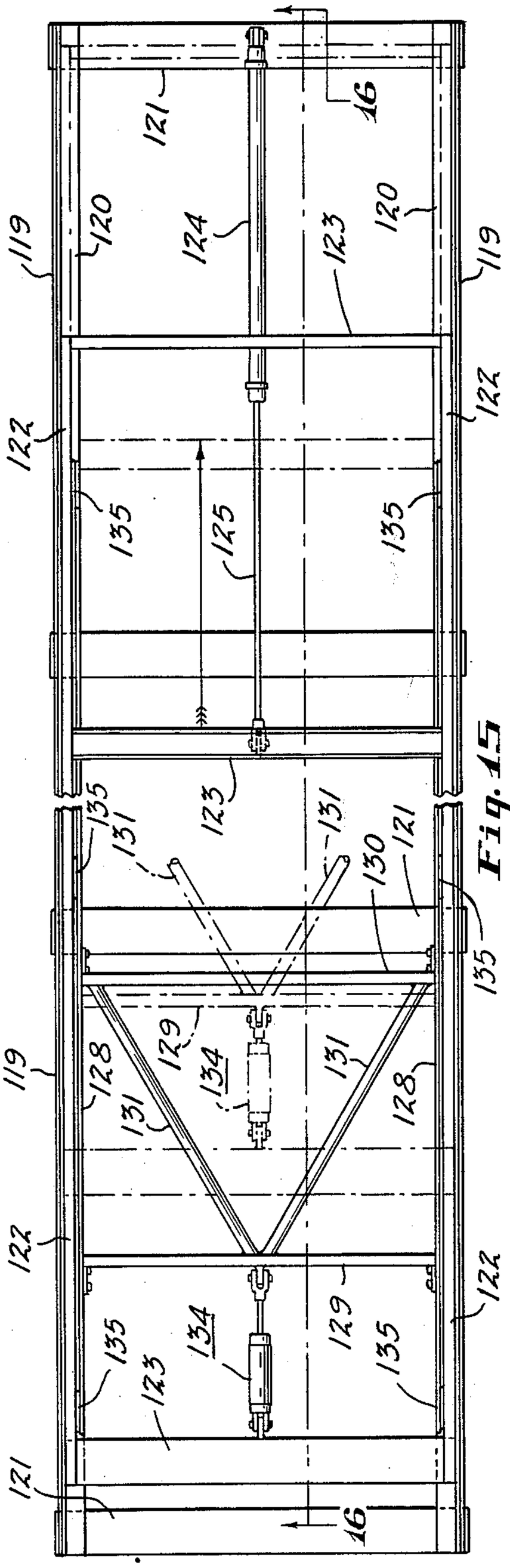

Fig. 15

Fig. 16

Fig. 17

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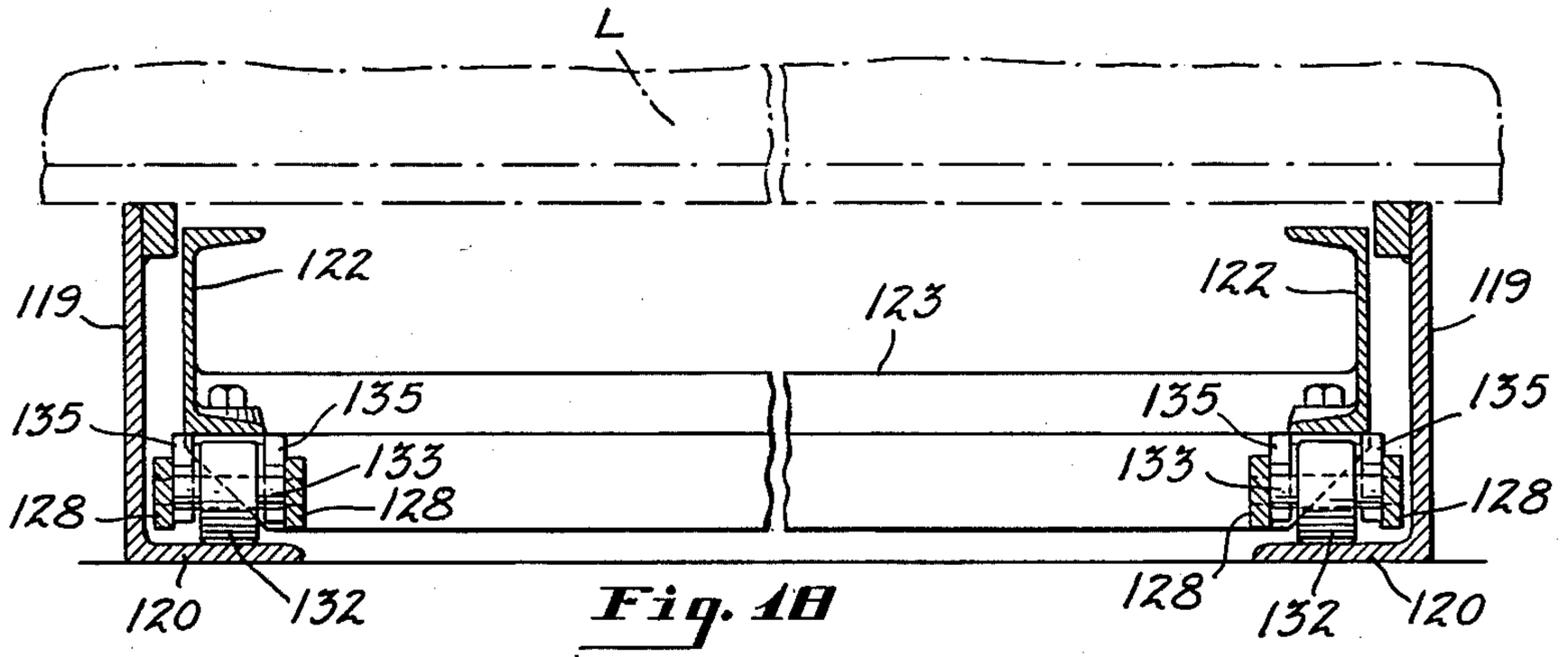

Fig. 18

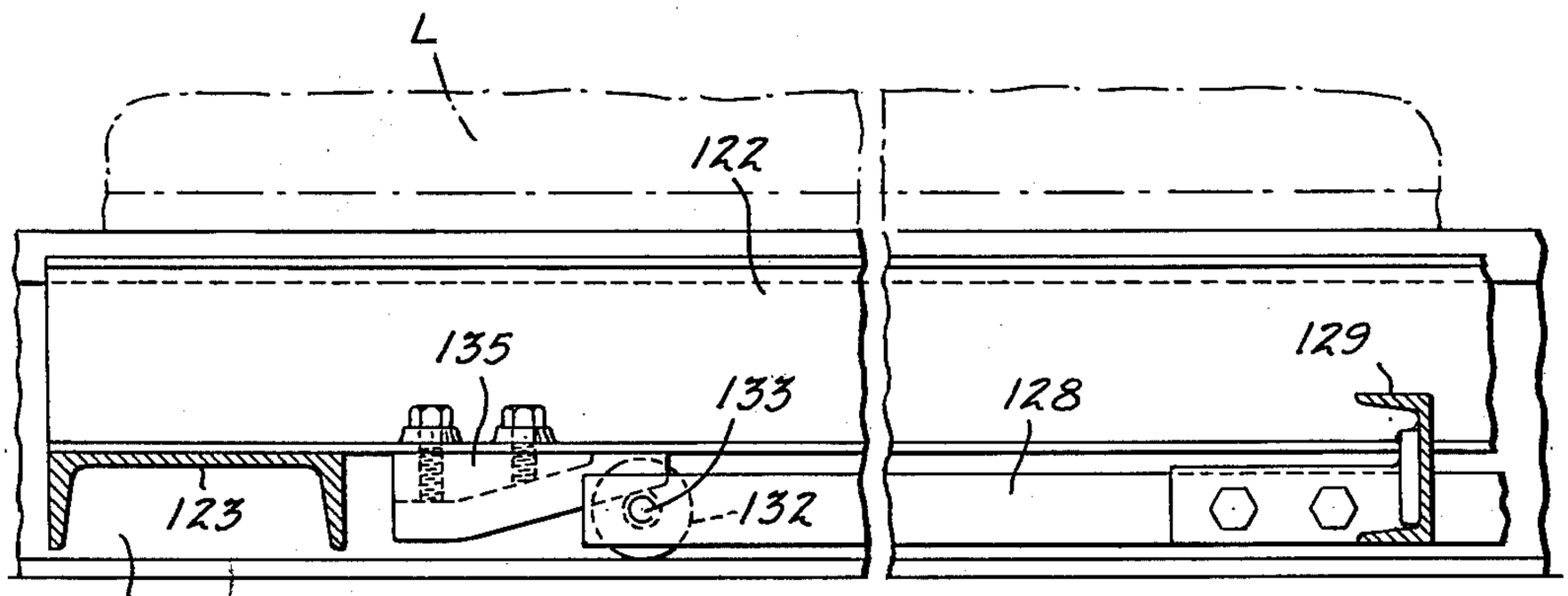

Fig. 19

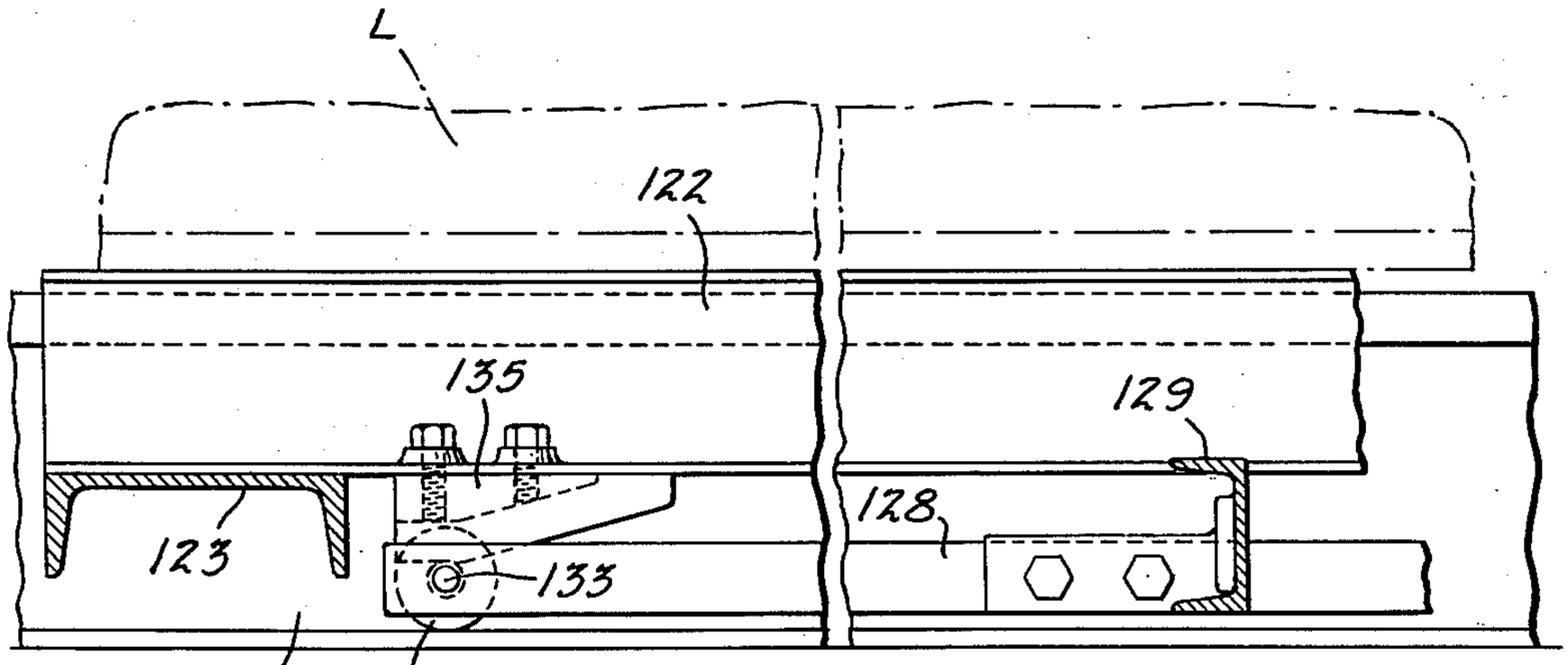

Fig. 20

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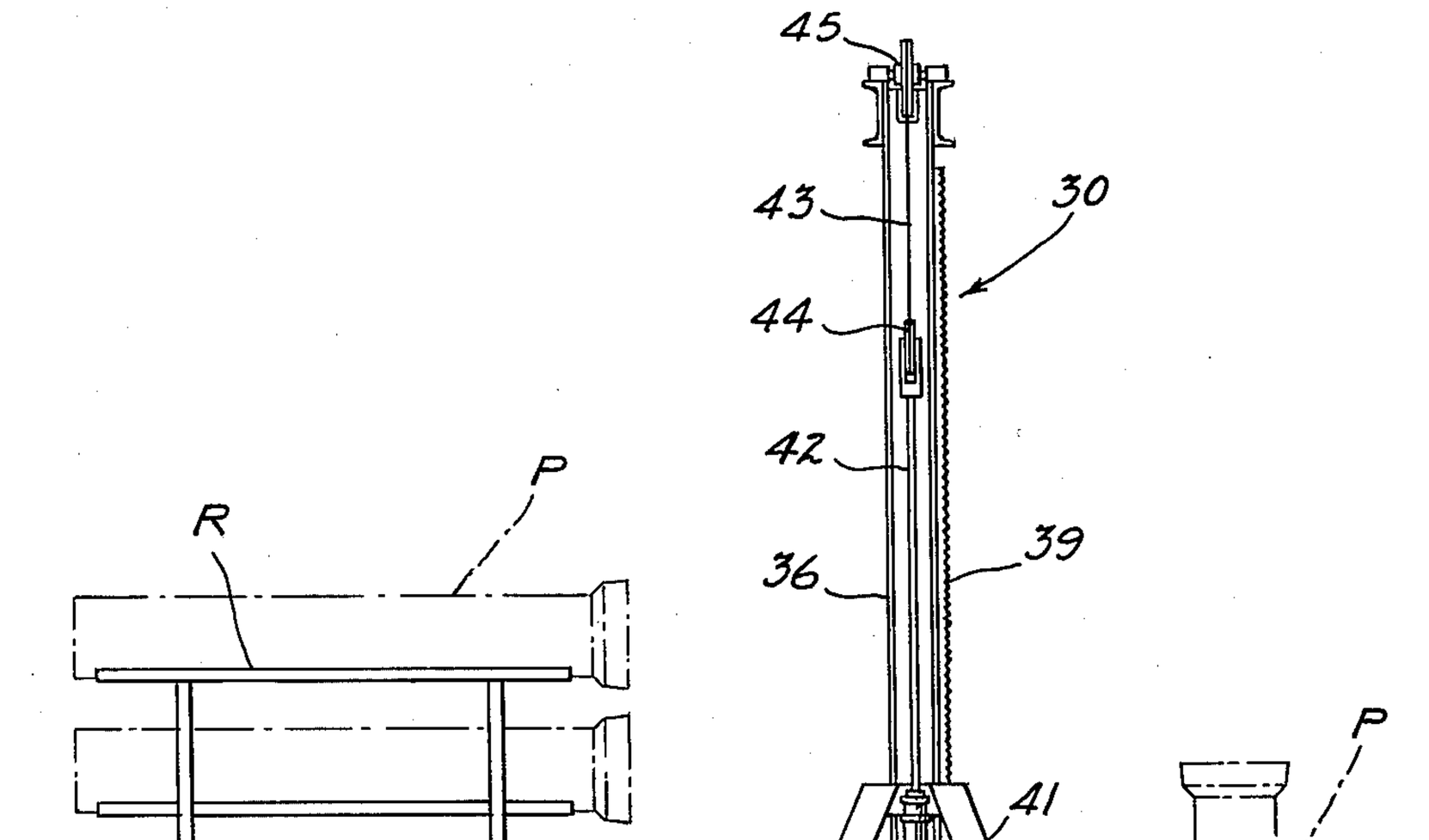

Fig. 21

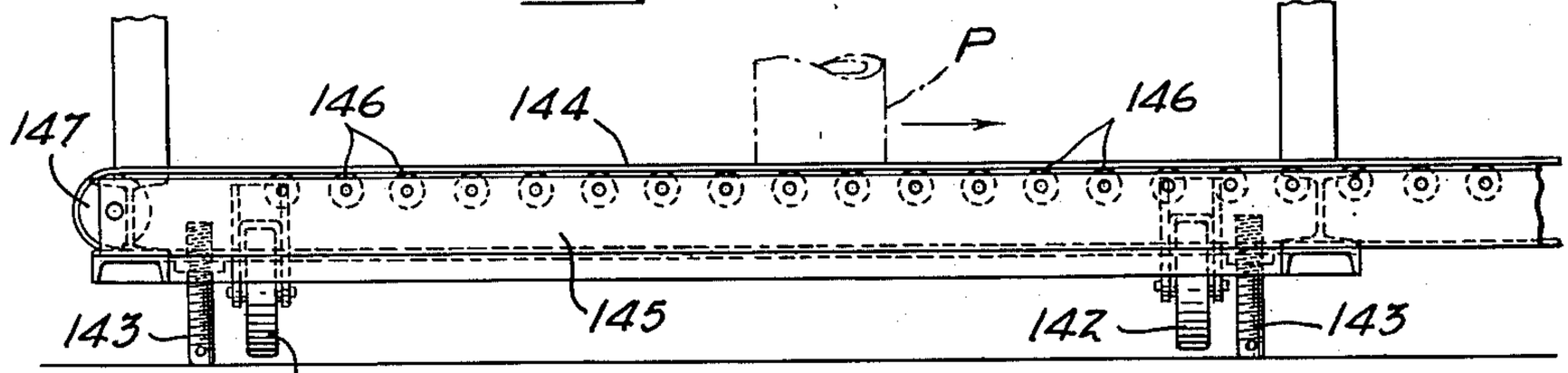

Fig. 22

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United States Patent Office

3,101,852

Patented Aug. 27, 1963

3,101,852
RACK UNLOADER

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Filed June 14, 1960, Ser. No. 35,956
9 Claims. (Cl. 214—7)

This invention relates generally to unloading apparatus, and, more specifically, to apparatus for unloading elongated hollow objects from racks in which the objects are disposed in superimposed rows.

The invention is particularly concerned with the provision of an apparatus for expeditiously unloading pipe, for example, clay pipe, from pipe racks which such as disclosed in my copending application, Serial No. 10,903, filed February 25, 1960. As disclosed in that application, green clay pipe discharged from extruding and finishing machines are loaded into suitably constructed racks so that the pipe may be conveniently transported to and dried in a drying kiln. This invention is directed to an apparatus for simultaneously removing an entire row of dried or cured horizontally disposed pipe from the racks, and for placing the pipe vertically on a conveying mechanism which is used to carry the pipe to any designated area, as for example, a burning or firing kiln.

As will hereinafter be disclosed in detail, a modified embodiment of the invention is mobile so that the apparatus may be moved from one firing kiln to another, such mobility being of particular advantage in outdoor installations. While all embodiments of the invention have been disclosed as being used for unloading cylindrical pipe from racks, it is to be understood that the invention also may be used to load pipe into racks, and that it is equally adapted to the handling of other substantially hollow objects of varying shapes and sizes.

An object of the invention is the provision of an apparatus for unloading racks of substantially hollow objects of various sizes and shapes, and for transporting these objects to a desired location.

A more specific object is the provision of an apparatus for unloading elongated hollow objects arranged in axially aligned, superimposed horizontal rows in racks, and for vertically positioning the pipe on a conveyor mechanism.

Still another object of the invention is to provide an unloading apparatus, such as described in the previous paragraph, wherein the apparatus includes means for unloading entire rows of horizontal pipe from the racks and for swinging the pipe to a vertical position.

Other objects and attendant advantages of the invention will become apparent as the same are considered in conjunction with the following detailed description and the accompanying drawings wherein:

FIGURE 1 is a side elevation of a preferred embodiment of the invention.

FIGURE 2 is a fragmentary sectional view taken in the plane of line **2—2** of FIG. 1.

FIGURE 3 is a fragmentary sectional view taken in the plane of line **3—3** of FIG. 1.

FIGURE 4 is a plan view of the embodiment of the invention shown in FIG. 1.

FIGURE 5 is a fragmentary sectional view taken in the plane of line **5—5** of FIG. 4.

FIGURE 6 is an end elevational view of the preferred embodiment of the invention.

FIGURE 7 is a fragmentary view of a portion of the same apparatus.

FIGURE 8 is a fragmentary view similar to FIG. 7, but showing the illustrated parts in a different operative position.

FIGURE 9 is a fragmentary sectional view taken in the plane of line **9—9** of FIG. 7.

FIGURE 10 is a fragmentary view of another portion of the apparatus.

FIGURE 11 is a sectional view taken in the plane of line **11—11** of FIG. 10.

FIGURE 12 is a side elevational view of a portion of the apparatus taken in the plane of line **12—12** of FIG. 4.

FIGURE 13 is an end elevational view taken in the plane of line **13—13** of FIG. 12.

FIGURE 14 is a fragmentary view of a portion of the apparatus taken in the plane of line **14—14** of FIG. 13.

FIGURE 15 is a plan view of another portion of the preferred embodiment of the invention.

FIGURE 16 is a sectional view taken in the plane of line **16—16** of FIG. 15.

FIGURE 17 is a fragmentary sectional view taken in the plane of line **17—17** of FIG. 16.

FIGURE 18 is a fragmentary sectional view taken in the plane of line **18—18** of FIG. 16.

FIGURE 19 is a fragmentary view taken in the plane of line **19—19** of FIG. 17.

FIGURE 20 is a fragmentary view similar to FIG. 19, but showing the illustrated parts of the apparatus in a different operative position.

FIGURE 21 is a side elevational view of a modified embodiment of the invention.

FIGURE 22 is a fragmentary and elevational view of the modified embodiment taken in the plane of line **22—22** of FIG. 21.

Referring now to the drawings, the pipe unloading apparatus comprising the invention is shown in FIGS. 1 and 4 to consist generally of a frame **30**, an elevator **31** vertically reciprocable along the frame, and a tine carriage **32** movable on the elevator in a horizontal plane transverse to the path of movement of the elevator. The carriage **32** carries a plurality of pipe-engaging tines **33** corresponding in number to the number of horizontally aligned pipe P arranged in superimposed rows in a pipe rack R, the rack being positioned near one end of the elevator **31**. These tines **33** are rotatably connected to the carriage **32** in such a manner that they may be rotated in a 90 degree arc from a horizontal to a vertical position whereby combined actuation of the elevator **31** and the carriage **32** will cause the tines to enter the bell ends of the pipe in one of the superimposed rows and to withdraw the pipe from the rack, whereupon rotation of the tines and movement of the elevator will be effective to deposit the pipe in a vertical position on pallets carried by a suitable conveying mechanism.

As shown in FIGS. 1, 4, 6, 7 and 8, the frame **30** is formed by a pair of parallel, vertically extending posts **36** connected at their upper ends by a beam **37**, each post being secured at its lower end to one of a pair of spaced, horizontally disposed beams **38** which constitute a base for the frame. A rack **39** is fastened to a corresponding side face of each post **36** (FIGS. 7 and 8), and these racks extend approximately the full lengths of the posts.

The elevator **31**, which is vertically reciprocable along the frame **30**, is an open rectangular framework comprising a pair of side channel members **40** connected at their ends. The width of this framework is slightly less than the distance between the posts **36** so that the elevator framework can be situated within the frame **30** with its sides **40** adjacent the inner surfaces of the posts. In the illustrated embodiment, the elevator is raised and lowered by two piston-cylinder mechanisms, the cylinders **41** of which are fixedly secured to the posts **36** adjacent the outer wall surfaces thereof with the piston rods **42** being operable toward and away from the top of the frame **30**. The piston rods **42** are connected by cables **43** to the sides **40** of the elevator so that extension of the piston rods will lower the elevator and retraction of the piston rods will raise the elevator. To this end, each of

these cables 43 has one end connected to an end of the beam 37 of the frame 30, and passes around a sheave 44 carried by one of the piston rods and around a corresponding sheave 45 journalled on the top of the beam 37 (FIG. 6). The other end of each cable 43 is connected to one of the side members 40 of the elevator. Suitable fluid connections (not shown) may be made to the cylinders 41 so that the two cylinders can be actuated simultaneously.

The elevator 31 is guided for movement along the frame 30 by two pairs of opposed rollers 50 and 51 on each side of the frame. The rollers of each pair embrace the frame post 36 in rolling engagement with opposite side wall surfaces thereof. As shown in FIGS. 1 and 2, the rollers of each pair are arranged in vertically spaced relationship, and all four rollers on one side of the frame 30 are carried by a plate 52 attached to the side member 40 of the elevator. Three of the four rollers are connected to the plate 52 by stub shafts 53, and the fourth is mounted near the end of a transverse shaft 54, which extends between the plates 52 from one side of the elevator to the other.

In order to prevent the elevator from cocking or tilting as it is moved, rack gears 55 are provided which mesh with the racks 39 carried by the posts 36. As shown in FIG. 2, these rack gears are mounted on the ends of the shaft 54 adjacent the rollers 50 thereon. The rack gears are maintained in meshing engagement with the racks by the rollers 50 and 51 which are effective to prevent endwise movement of the elevator. Obviously, many equivalent mechanical devices may be used to move and guide the elevator 31 for the purposes described.

The tine carriage 32 is mounted for movement on the elevator 31 in a horizontal plane. This carriage is formed by a pair of side bars 58 which extend parallel to the sides 40 of the elevator, and which have a length approximately one-half that of the elevator. These side bars are connected at their rear ends by a cross beam 59 (FIGS. 1, 4 and 6–9).

Trolley wheels 60 are provided at each end of each side bar 58, and these wheels are rollingly engaged in the channel-shaped side members 40 of the elevator so as to support and guide the carriage for reciprocating movement. As most clearly shown in FIGS. 3 and 9, these wheels 60 are journalled on shafts 61 which are fixed in the sides 58 of the tine carriage. In addition to the wheels 60, each side bar 58 carries at its forward end a roller 62 which rollingly engages the outer surface of the adjacent side 40 of the elevator. These rollers 62 are supported by brackets 63 and serve the function of maintaining the wheels 60 in rolling engagement in the channels of their respective side bars 40.

Movement is imparted to the carriage 32 by two rack gears 66, each of which meshes with one of a pair of racks 67 fixed to the underside of the sides 40 of the elevator 31 (FIGS. 1, 3, 4 and 8). These rack gears 66 are fixed on the ends of a shaft 68 which is journalled below the carriage 32 in brackets 69 depending from the rear ends of the sides 58 of the carriage (FIG. 6). The shaft 68 is driven by a reversible motor 70 which is fixedly mounted on the cross beam 59 of the carriage and is connected by a chain and sprocket drive mechanism 71 to the shaft 68.

As most clearly shown in FIG. 4, the carriage 32 is provided with a plurality of pipe-engaging tines 33 corresponding to the horizontally aligned pipe in one of the rows in the pipe rack R. These tines are arrayed in spaced parallel alignment, and have their rear ends fastened to a beam 75 (FIG. 5). This beam extends across the carriage 32 and is rotatably connected thereto by pins 76 which project inwardly from the sides 58 of the carriage through journal blocks 77 carried in the ends of the beam, as shown in FIG. 9.

The beam 75 is adapted to be rotated on the pins 76 so that the tines 33 can be moved from a horizontal to a

vertical plane. To this end, an angularly upwardly extending rocker arm 78 is fixed to the top of the beam. This rocker arm is pivotally connected to the end of a piston rod 79 of a piston-cylinder mechanism, the cylinder 80 of which is secured by a bracket 81 to one of the sides 58 of the carriage (FIG. 2). Taking FIGS. 7 and 8 in conjunction, it will be seen that retraction of the piston rod 79 is effective to rotate the tines 33 through an arc of 90 degrees from a horizontal position (FIG. 7) to a vertical position (FIG. 8). Suitable fluid connections (not shown) are provided for operating the piston-cylinder mechanism, and for locking the piston rod in an extended position so that the tines 33 are capable of supporting a row of horizontally aligned pipe as the carriage 32 is moved.

In order that each of the tines 33 can hold a length of pipe in a vertical position, the tines are provided on their pipe-engaging outer ends with vacuum saddles 84, the construction of which is most clearly shown in FIGS. 5, 10 and 11. Referring to FIG. 11 in particular, these saddles are shown as including an elongated metal envelope 85 which is faced with an arcuate pad 86 formed of rubber or of a similar material which will not abrade the pipe with which it comes in contact, and which is effective to form a vacuum seal. This envelope 85 is carried on a yoke 87 which is fastened to the tube 88 forming the main body of each tine. Suction is created in the envelope 85 by suction conduits 89 which extend through the tubes 88 to a suitable vacuum source (not shown). The pads 86 and the envelope 85 are formed with corresponding suction slots 90 so that, when a vacuum is created in the envelopes, the pipe will be held on the saddles. It will be apparent that the particular construction of the vacuum saddles 84 herein disclosed is subject to many modifications and variations, the only limitation being that the saddles are capable of supporting and holding pipe as the tines are swung from a horizontal to a vertical position.

In the preferred embodiment of the invention, the pipe unloading apparatus includes a pallet supply structure 94 and an associated pallet conveying mechanism for serially locating the pallets L beneath the rear end of the carriage 32 so that tines 33 can vertically position the pipe thereon. This arrangement is generally shown in FIG. 1. The pallet conveying mechanism may be used to convey the loaded pallets to a station where the pallets are removed by a lift truck or the like.

The detailed construction of the pallet supply structure 94 is most clearly shown in FIGS. 12, 13 and 14. Referring to these figures, reference numeral 95 designates the posts of a main rectangular frame formed of suitable structural members, the frame being of a convenient size to receive a stack of pallets L. One side of this frame includes vertically depending braces 96 for holding the stack of pallets in vertical alignment, the other side being open so that the pallets can be easily positioned within the frame. The posts 95 are braced near their lower ends by channel bars 97 extending across the ends of the frame.

Separate sub-frames are positioned at opposite ends of the main pallet holding frame, and these sub-frames are comprised of vertical posts 98 connected at their upper ends by cross beams 99 and near their lower ends by angle bars 100 which are fixed to the outside surfaces of the posts. These bars 100 rest on the channel bars 97 of the main frame, and thus support the weight of the sub-frames. The posts 98 also may be bolted or otherwise secured to the posts 95 if desired. Each sub-frame additionally includes vertical cam tracks 101 on the opposed inner wall surfaces of the posts 98. Each of these cam tracks is enlarged at its lower end and is formed with an axially canted side wall portion 102.

Reference numeral 106 designates shafts or bars which extend across the full width of the sub-frames, the ends of these bars being provided with rollers 107 which ride

in the cam tracks 101. A pendulous frame 108 is swingably mounted on each bar 106, and each of these frames has an inwardly extending foot 109 which is engageable with an end edge of the lowermost pallet in the stack so as to support the stack of pallets within the main frame of the structure 94. Each of the frame structures 108 also includes, near its bottom, a cam roller 119 on each side face, and these cam rollers also are engaged in the cam tracks 101.

Each of the pendulous frames 108 is raised and lowered by an associated piston-cylinder mechanism, the cylinder 110 of which is secured to the cross beam 99 of the sub-frame and the piston 111 of which is secured to one of the shafts 106. When these piston-cylinder mechanisms are actuated to lower the associated frame 108, the rollers 107 and 114 will roll vertically in the cam tracks 101 until the lower cam rollers 114 reach the canted wall portions 102 of the tracks. At this point the frames 108 will swing away from the pallet stack under the biasing action of the springs 112 which have their ends connected to the horizontal arms 113 extending from the shafts 106 and the frames. As shown in dot-dash outline in FIG. 12, this movement of the frame 108 causes the associated feet 109 to pass out of engagement with the bottom pallet in the stack, thus releasing this pallet for subsequent conveying beneath the carriage 32. Reverse actuation of the piston-cylinder mechanisms and upward movement of the frames 108 causes the frames to be cammed inwardly toward the pallet stack so that the feet 109 are again positioned in supporting engagement with the bottom pallet. Suitable fluid connections (not shown) are made to the cylinders 110 so that the piston rods may be actuated simultaneously.

As each pallet L is released from the pallet supply 94 in the manner described, it is received by a pallet conveying mechanism which carries the pallets in spaced alignment to a position below the carriage 32 where the pipes are deposited on their spigot ends in rows on each pallet, as generally shown in FIGS. 1 and 4.

Referring to FIGS. 4 and 15–20, the pallet conveying mechanism is shown to consist of a pair of spaced, parallel beams 119 which extend from beneath the pallet supply 94, through the posts 36 of the frame 30, to a point beyond the rear end of the carriage 32. These beams 119 have inwardly projecting flanges 120 on their bottoms which serve as roller tracks, and are connected together at spaced points along their length by cross beams 121. The upper surfaces of the beams 119 serve as the principal support for the pallets, as indicated in FIG. 18.

A pallet moving frame is positioned between the beams 119 for reciprocation between the beam ends. This moving frame is formed by a pair of spaced, parallel channel irons 122 which are connected at their ends and at spaced, intermediate points by suitable cross beams 123. The height of the channel irons 122 is less than the height of the beams 119, while the length of these members are substantially the same. Reciprocating movement is imparted to the pallet moving frame by a piston-cylinder mechanism, the cylinder 124 of which is mounted on the end across beam 121 between the beams 119 and the piston rod 125 of which is connected to a cross beam 123 between the channels 122.

The upper surfaces of members 122 are adapted to be intermittently raised above the level of the beams 119 into supporting engagement with the pallets so that when these members 122 are reciprocated, the pallets will be moved relative to the beams. To this end, there is disposed between the beams 119 a pallet lifting frame which is formed by a pair of straps 128 extending parallel to and below each channel iron 122. The two pairs of straps are connected together at the end of the beams 119 opposite from the cylinder 124 by cross members 129 and 130. These cross members may be braced by braces 131 if desired. Rollers 132 are carried on shafts 133 between

the straps 128 of each pair at spaced points along their length, and these rollers roll on the flanges 120 of the beams 119 so that the straps can be reciprocatingly moved relative to the beams and to the channel irons 122. This reciprocating movement is imparted to the straps by a piston-cylinder mechanism 134 connected between the end cross member 122 of the pallet moving frame and the cross member 129 of the pallet lifting frame.

The channel irons 122 are provided on their undersides with a plurity of cam blocks 135 corresponding in number and approximate position to the rollers 132. Taking FIGS. 19 and 20 in conjunction, it will be seen that movement of the straps 128 in one direction causes the shafts 133 supporting the rollers 132 to come into camming contact with the cam blocks 135 and to thus raise the channel irons 122 so as to liftingly support the pallets L above the beams 119. Reverse movement of the straps causes the shafts to move out of contact with the cam blocks and to lower the beams 119 onto the cross members 121 between the beams. When the pallet moving frame has been raised in the manner described and when the pallets are out of contact with the beams 119, the cylinder 124 is actuated to pull the moving frame along the beams and to thus index the pallets. During this indexing movement, the piston-cylinder mechanism 134 is held in a locked position so that the stranps 128 will also be moved with the shafts 133 remaining in contact with the cam blocks 135. When the pallets have been thus indexed as indicated in dot-dash outline in FIG. 15, the piston-cylinder mechanism 134 is actuated to lower the pallets onto the beams 119. Subsequently, the cylinder 124 is actuated to move the now lowered moving frame beneath the pallets back to its original position.

The combined operation of the several elements of the rack unloader comprising the preferred embodiment of the invention is as follows. A loaded pipe rack R is positioned on the platform 136 between the elevator frame 30 and the pallet supply 94 with the bell ends of the pipe facing the tines 33. With the pipe rack thus positioned, the elevator 31, with the tines in a horizontal position, is moved along the posts 36 of the frame 30 until the tines are axially aligned with the top row of pipe. When at that positon, movement of the elevator is stopped and the carriage 32 is moved forward on the elevator toward the bell ends of the pipe until the tines extend a substantial distance within the pipe. With the tine carriage 32 in its forward position, the elevator is raised slowly to lift and free the pipe from engagement with the pipe trays of the rack R, whereupon the vacuum is turned on to apply suction to the saddles 84 and the carriage is retracted to the rear of the elevator 31. The elevator is then positioned on the frame 30 so that the cylinder 80 may be actuated to rotate the tines and supported pipe to a vertical position. With the pipe in a vertical plane, the elevator 31 and associated carriage 32 is lowered until the pipe are gently positioned on the pallet board. The vacuum is then released so that the saddles 84 may be disengaged from the vertically positioned pipe, at which time the elevator is raised to withdraw the tines 33 and the tines are rotated back to a horizontal position. This operation is repeated until the entire rack has been unloaded.

Between the time when one row of pipe has been positioned on a pallet and the time that the elevator and carriage are positoned to withdraw another row of pipe from a rack R, the piston-cylinder mechanism 134 is actuated to raise the beams 122 into lifting engagement with the pallets. Thereupon, the piston-cylinder mechanism 124, 125 is actuated to index the pallets as explained above. The normal extent of this indexing movement is such that the pallets are moved a distance equal to the axial spacing betwen adajacent rows of pipe on the pallet board being loaded.

After the last row of pipe has been positioned on a

pallet to fully load it, the cylinders 110 of the pallet supply structure 94 are actuated to cause the pendulous arm frames 108 to release a pallet from the pallet stack. At the time this pallet is released, the channel irons 122 of the pallet moving frame are in a raised position, thus, supporting all of the previously released pallets arranged along the length of the beams 119. After the released pallet has been placed on the members 122, the moving frame is indexed as required to place the next succeeding pallet below the carriage in a pipe-receiving position.

It will be apparent that the movements of the carriage, elevator, and pallet conveying mechanism, and the actuation of the vacuum saddles and of the pallet releasing arms 84 can be automatically controlled, as by suitably positioned limit switches. For example, a series of such switches could be spaced along the posts 36 of the frame 30, along the length of the elevator 31 and on the pallet conveying mechanism, and these switches could be connected to the various cylinders and motors heretofore described. Thus, when the elevator is moved to the top of the frame 30, it would trip one of the switches on the posts 36 causing the tines to be rotated to a horizontal position and causing the pallet moving frame to be raised and indexed as herein described. As soon as the moving frame reaches its indexed position, it would strike a switch located on one of the beams 119, which could be connected to lower and return the moving frame and to actuate the cylinders 41 to lower the elevator, with the tines in a horizontal position, to the top row of pipe in the rack. Another switch on one of the posts 36 could then be tripped to stop the elevator and to actuate the motor 70 to drive the tine carriage forward until the tines are within the pipe. When the carriage reaches its forward position, it could trip a switch arranged on the elevator and connected to the cylinders 41 to thus raise the elevator a few inches, whereupon another switch on one of the posts 36 could be tripped to turn on the vacuum and to start the carriage back. When the carriage reaches its retracted position, it would trip a switch on the elevator to start the elevator up. As the elevator goes up, it could strike another switch on one of the posts 36 to decelerate its movement, whereupon another switch could be tripped to stop upward travel of the elevator and to rotate the tines to their vertical position. When the tines are vertical, they would strike a switch to start the elevator down, and the elevator would continue down until it trips a switch on one of the posts 36 to stop its movement and to turn off the vacuum. As soon as the vacuum is dropped, a vacuum-actuated switch could be closed to start the elevator back to the top of the frame 30, thus, completing the cycle of operation.

Referring now to FIGS. 21 and 22, there is shown a modification of the invention in which the elevator frame is mobile and is associated with a belt-type conveyor. This embodiment is of particular utility as an outdoor installation for unloading the dried pipe from the racks and then transporting the pipe by means of the conveyor into firing kilns. Because of its mobility, the unloading apparatus can be readily moved so that the conveyor may be associated with a plurality of kilns. In each instance, the mobile frame is positioned adjacent the entrance to the kilt with the belt conveyor projecting into the kiln. Thus positioned, racks of dried clay pipe may be unloaded at a position near the entrance of the kiln placed vertically on the conveyor belt, whereupon the pipe are conveyed into the kiln for placing on kiln cars preparatory to firing.

The structure of the elevator 31, the carriage 32, the pipe-engaging tines 33, and the operation of these elements are the same as disclosed in connection with the preferred embodiment of the invention. In this modification, however, the frame 30 is vertically secured to a mobile base 140. Likewise, the platform 141 upon which

the loaded racks R are positioned for the unloading operation is secured to the base 140 below and within the confines of the forward end of the elevator 31. The underside of the base 140 is provided with castor-type wheels 142 and with extensible elements 143 near each wheel. These elements 143, which may be threaded shafts as shown, or jacks or the like, are extended to support the weight of the base 140 and associated structure when the apparatus has been positioned in the desired location.

The conveyor belt 144 is mounted in brackets 145 at the end of the base 140 opposite from the platform 141, and it extends across the full width of the base and projects beyond a side edge thereof. When the projecting portion of the conveyor is of substantial length, it may be desirable to support it by suitable castors or wheels (not shown) or by other means. In instances where the conveyor is of a relative short length, it may be simply supported in cantilever fashion by the base 140. The conveyor also may be detachably mounted in the brackets 145 so that the mobile base can be moved without carrying the conveyor, and so that a number of fixed position conveyors may be associated with one unloading frame structure.

As shown, the conveyor 144 includes an endless belt supported along its upper surface by a plurality of spaced, small rollers 146. The bights of the endless conveyor belt are formed around larger end rollers 147, only one of which has been shown in FIG. 22. Either of the rollers 147 may be driven by a fluid motor, or by some other suitable driving mechanism (not shown). While the conveyor has been shown as being a belt-type conveyor, it will be evident that many other types may be used for the purposes herein disclosed. It also will be evident that the specific construction of the conveyor assembly is subject to wide mechanical variation.

In operation, the driving mechanism for the conveyor 144 is synchronized by suitably disposed limit switches to the operation of the elevator 31 and the tine carriage 32 in the manner discussed in connection with the operation of the preferred embodiment of the invention. Thus, the belt of the conveyor may be moved the required distance to progress one group of pipe deposited thereon (by movement of the tines 33 to their discharging positions) out of the way of the next group of pipe to be similarly deposited at the same discharging positions of the tines, whereupon the belt may be stopped to receive the next group of pipe. Alternately, the controlled operation of the conveyor may be such that each group of pipe received thereon is moved to the end of the conveyor before the conveyor is stopped to receive the next group. Obviously, other modes of operating the conveyor may be resorted to by simply readjusting the limit switches which are connected to the driving mechanisms.

It will be apparent that the disclosed operation of both embodiments of the invention could be reversed, that is, the apparatus could be employed to load racks instead of to unload racks. When so used, the conveyor mechanism is actuated in a reverse direction from that described above.

Many variations and modifications of the embodiments of the invention will be apparent to those skilled in the art in the light of the above teachings. It is, therefore, to be understood that the invention is not to be limited to the structures shown and described, but is to include all modifications and variations within the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. Pipe handling apparatus comprising a vertical frame, an elevator vertically reciprocable on said frame, pipe-carrying means on said elevator, said pipe carrying means including internal pipe holding fingers for entering and holding a plurality of parallel, laterally spaced, horizontally aligned pipe, said pipe-carrying means being

mounted on said elevator for reciprocating movement in a direction transverse to the vertical path of movement of said elevator, and said pipe-holding fingers being mounted on said pipe-carrying means for rotation about a horizontal axis transverse to said direction of reciprocating movement of the pipe-carrying means, and means for actuating said elevator and said pipe-carrying means to position said pipe-holding fingers in substantial axial alignment with said plurality of pipe and to enter and hold said plurality of pipe, and means for rotating said pipe-holding fingers to rotate the axes of said plurality of pipe through an angle of 90° to vertical positions for deposit on a receiving surface.

2. Apparatus according to claim 1, including a pallet conveyor fixed to said frame for moving a series of pallets stepwise along a predetermined path selected for said pallets to sequentially provide said supporting surface at a predetermined location, and means associated with said conveyor for advancing pallets stepwise along said path in timed relationship with a predetermined program of operation of said means for actuating said elevator and said pipe-carrying means and said pipe-holding means.

3. Apparatus according to claim 1, including an endless belt conveyor fixed relative to said frame for travel along a predetermined path selected for the endless belt thereof to provide said supporting surface at a predetermined location, and means associated with said conveyor for advancing it stepwise along said path in timed relation with a predetermined program of operation of said means for actuating said elevator and said pipe-carrying means and said pipe-holding means.

4. Pipe handling apparatus comprising means for supporting pipe in horizontal rows at a plurality of elevations, a conveying mechanism, and pipe transfer means for removing a horizontal row of pipe from said supporting means and depositing the row of pipe on end on said conveying mechanism, said transfer means including a vertical frame adjacent said supporting means and extending above said conveying mechanism, an elevator vertically reciprocable on said frame, a carriage reciprocally mounted on said elevator for movement in a direction transverse to the path of movement of said elevator, pipe-gripping fingers for engaging and holding each pipe in one of said rows, means rotatably connecting said fingers to said carriage, and means for actuating said elevator, said carriage, and said rotatable connecting means to position said fingers in substantial axial alignment with the pipe in one of said rows, to cause said fingers to engage and remove said row of pipe from said supporting means and to rotate the axes of the pipe through an angle of 90°, and to deposit said row of pipe on said conveying means.

5. Rack unloading apparatus comprising a rack unloading station, adjacent means for conveying pipe away from said unloading station, and pipe transfer means for removing rows of parallel, horizontally disposed, transversely aligned pipe, one row at a time, from a rack at said unloading station and depositing said pipe vertically in the same relative alignment on said conveying means, said pipe transfer means including a vertical frame adjacent said unloading station and extending above the level of said conveying means, an elevator vertically reciprocable on said frame, said elevator having one end extending toward said unloading station and another end extending toward said conveying means, a carriage reciprocably mounted on said elevator for movement between said ends thereof, pipe-gripping fingers corresponding in number and relative arrangement to the pipe in one of said rows, said fingers having free ends normally horizontally extending toward said one end of said elevator and having their other ends rotatably connected to said carriage so that said fingers can be rotated between horizontal and vertical positions, means for actuating said elevator to position the normally horizontally extending fingers in axial alignment with pipe in one of the rows, means for actuating said carriage to position said fingers in gripping relation with said row of pipe and to thereafter withdraw the pipe from the rack, means for rotating said fingers to dispose the pipe in a vertical plane so that said row of pipe may be deposited on end on said conveying means when said elevator is lowered, and means for intermittently actuating said conveying means after each row of pipe has been deposited thereon.

6. Rack unloading apparatus as claimed in claim 5 wherein said pipe-engaging fingers comprise tubular shafts having vacuum saddles on said free ends.

7. Rack unloading apparatus as claimed in claim 5 wherein said conveying means comprises a pallet conveyor connected to said frame.

8. Rack unloading apparatus as claimed in claim 5 wherein said conveying means comprises an endless conveyor belt connected to said frame.

9. Pipe handling apparatus comprising a base, wheels on said base, an endless conveyor mounted on said base and running to a discharge location beyond said base, pipe supporting means secured to said base for supporting horizontal rows of pipe at a plurality of elevations with the pipe in each row being in laterally spaced, parallel alignment, and pipe transfer means acting between said endless conveyor and said pipe supporting means at each of said plurality of elevations thereon, said pipe transfer means including a vertical frame secured to said base adjacent said pipe supporting means, an elevator mounted for vertical movement along said frame to each of said elevations, a carriage reciprocably mounted on said elevator for movement to and from said supporting means, pipe-gripping fingers mounted on said carriage for rotation between a horizontal and a vertical plane, said fingers having free ends extending toward said base when said fingers are in a horizontal plane, actuating means for moving said elevator to place said fingers in axial alignment with the pipe at one of the elevations when the fingers are in a horizontal plane, actuating means for moving the fingers toward the pipe into gripping relation therewith and for removing the pipe from said supporting means, means for rotating said fingers to place the axes of said pipe in a vertical plane so that the pipe may be deposited on end on said endless conveyor, and means for actuating said conveyor after each row of pipe has been deposited thereon.

References Cited in the file of this patent

UNITED STATES PATENTS

1,414,998	Allen	May 2, 1922
1,457,639	Straight	June 5, 1923
2,275,433	Harold	Mar. 10, 1942
2,390,298	Glassner	Dec. 4, 1945
2,598,222	Cahners	May 27, 1952
2,696,920	Anjeskey	Dec. 14, 1954
2,703,182	Broberg	Mar. 1, 1955
2,706,060	Ferrario	Apr. 12, 1955
2,718,426	Nagy	Sept. 20, 1955
2,818,987	Krupp	Jan. 7, 1958
2,913,276	Collings	Nov. 17, 1959
2,944,687	Segur	July 12, 1960
2,956,696	Drakengren	Oct. 18, 1960
2,964,205	Ulinski	Dec. 13, 1960
2,973,856	Brooks	Mar. 7, 1961