# United States Patent

**Lichti**

[15] **3,656,608**

[45] **Apr. 18, 1972**


## [54] GUIDE MECHANISM FOR VERTICAL STORAGE DEVICE


[72] Inventor: **Robert D. Lichti**, P.O. Box 2788, Santa Fe Springs, Calif. 90670



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[21] Appl. No.: **47,764**

[52] **U.S. Cl.** ..... **198/138**, 246/379

[51] **Int. Cl.** ..... **B65g 15/00**

[58] **Field of Search** ..... 198/158, 137, 138; 214/16.1; 246/349; 248/15



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*Primary Examiner*—Evon C. Blunk
*Assistant Examiner*—Hadd S. Lane
*Attorney*—Beehler & Arant



[57] **ABSTRACT**

A vertical storage device has a number of storage platforms carried by a pair of endless chains which move the platforms from a lowermost loading and unloading station to various storage positions on one side or the other of the device. On each end of each platform is a v-shaped yoke with a traveler at the free end of each leg of the yoke. A pair of semi-circular tracks carried by a track guide serve the bottom and top of the device, at each end, one track being receptive of one of the travelers and the other track being receptive of the other traveler. The tracks cross each other midway between opposite ends forming an open intersection so that a traveler which is on the inside of path crosses over upon a reversal of direction and becomes the outside traveler. A pair of interconnected switch tongues at the intersection is moved to one position or another when pressed against by the first traveler to reach the intersection making certain that each traveler travels in the right track.

The tracks at each location are mounted on a guide and the guide has a limited floating attachment to the frame, held in a normal position by springs, in order to relieve the strain during operation and to minimize wear.


**11 Claims, 26 Drawing Figures**

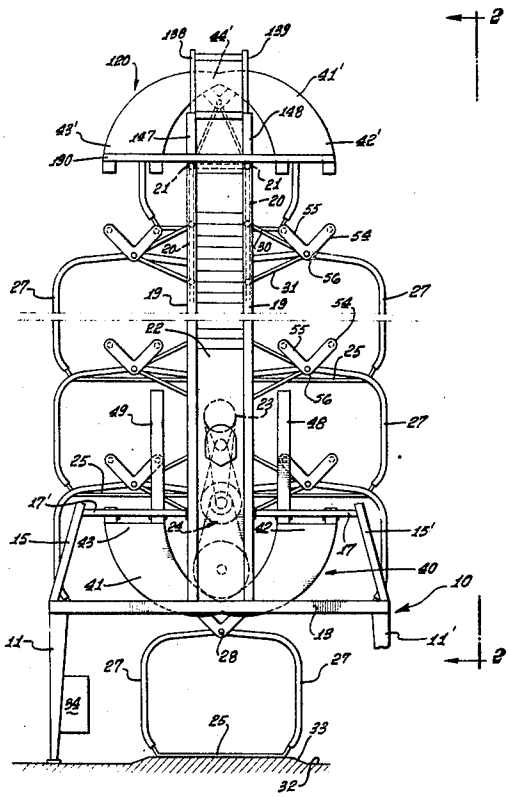

FIG. 1.

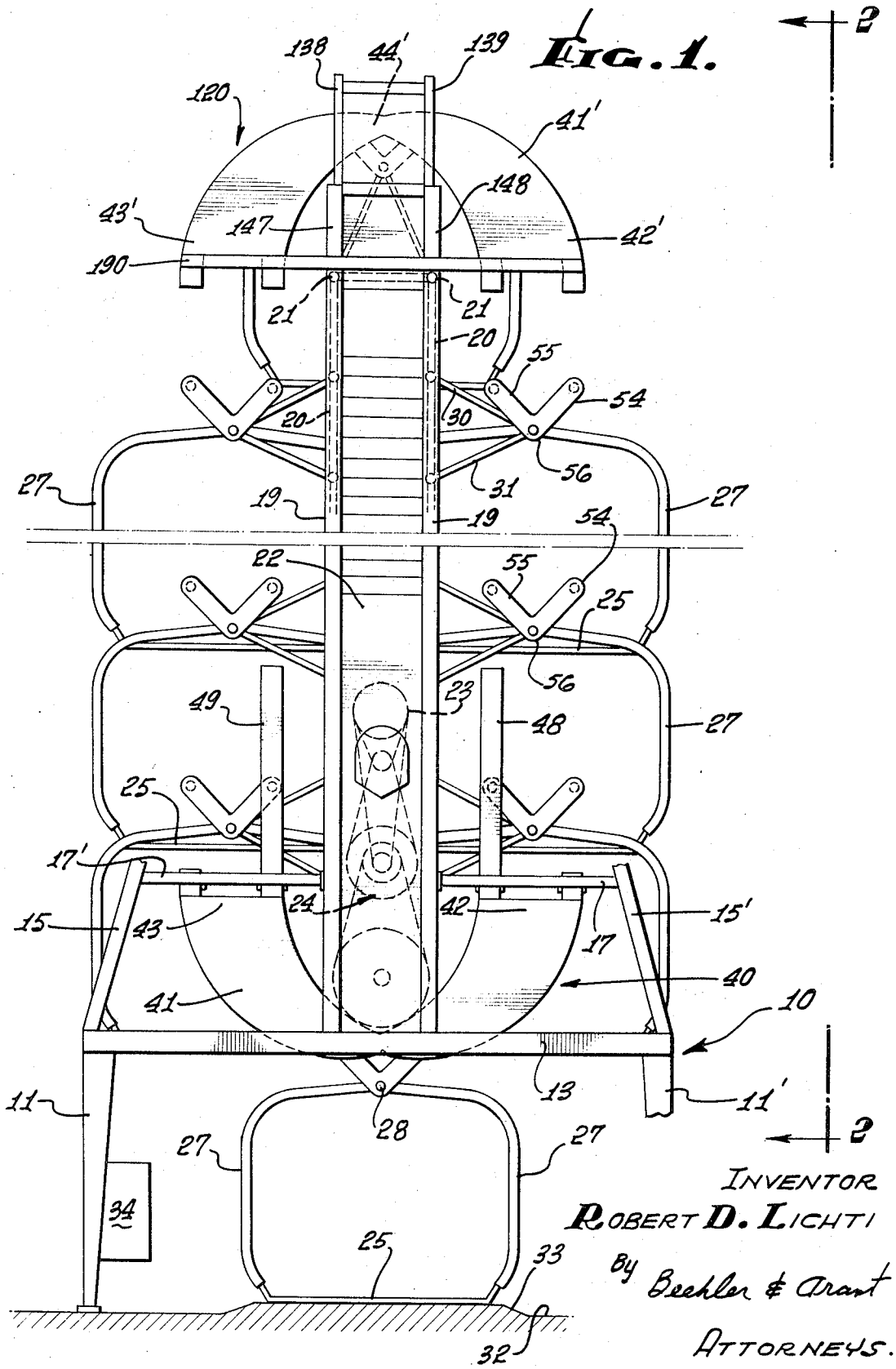


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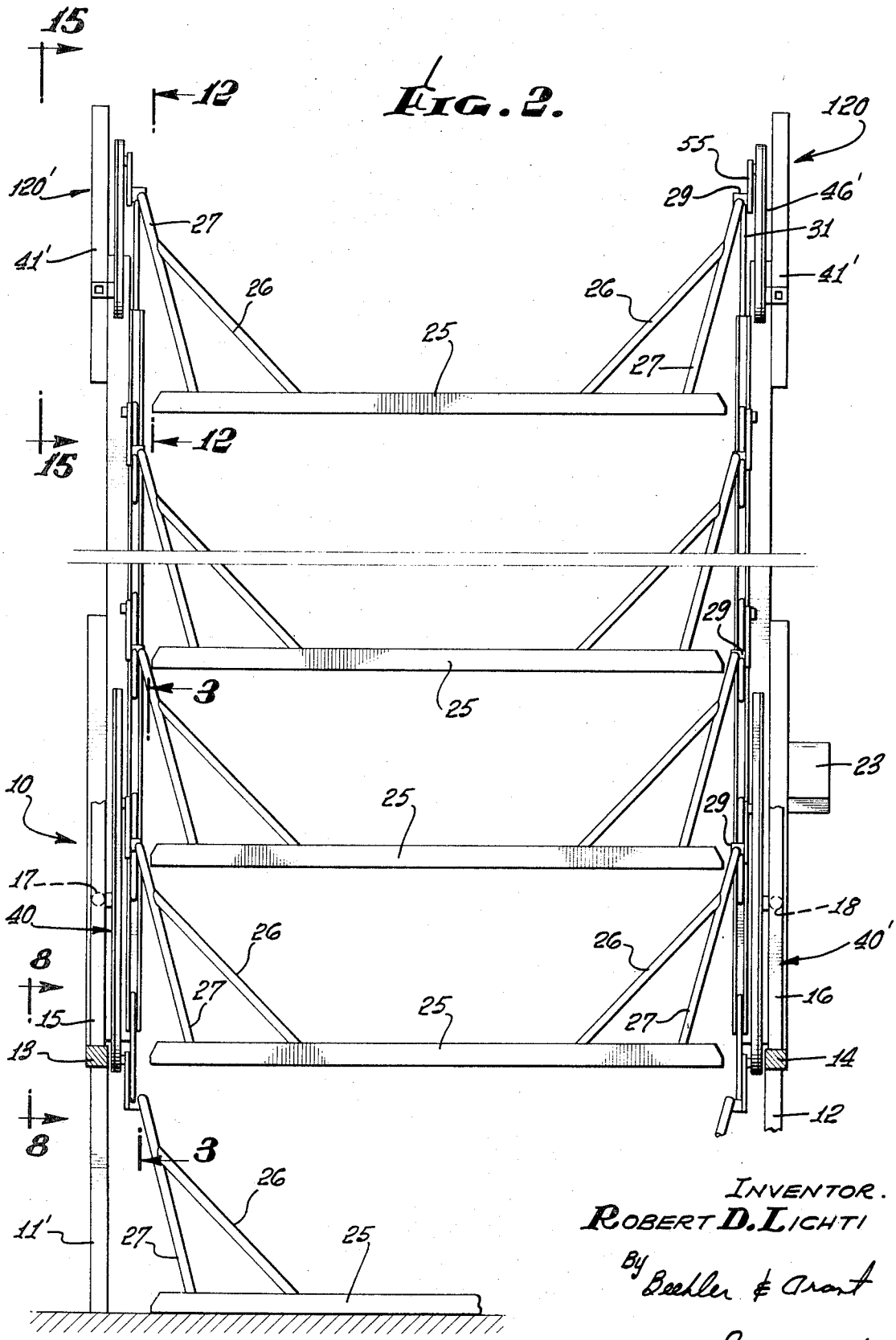
FIG. 2.

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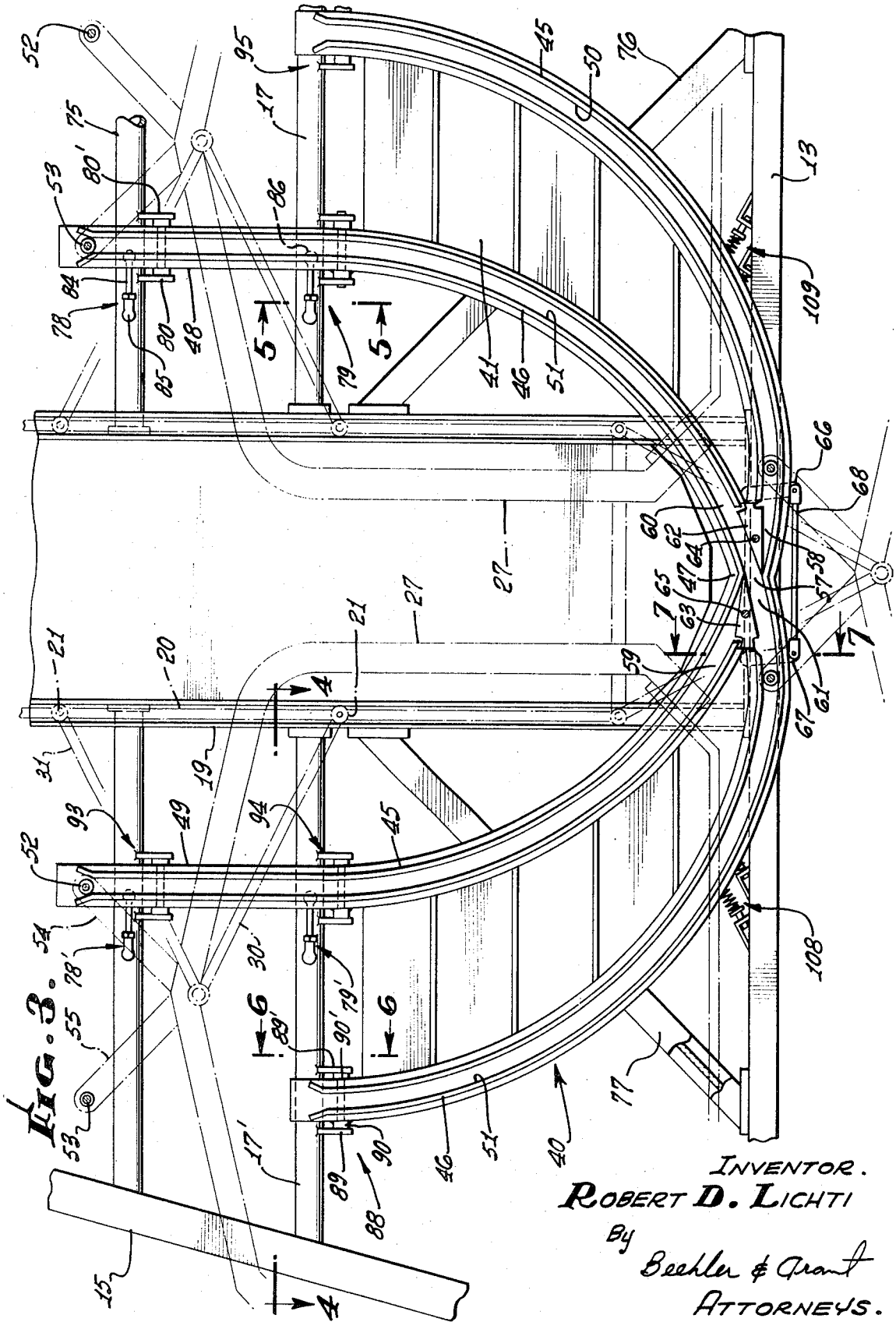


FIG. 3.

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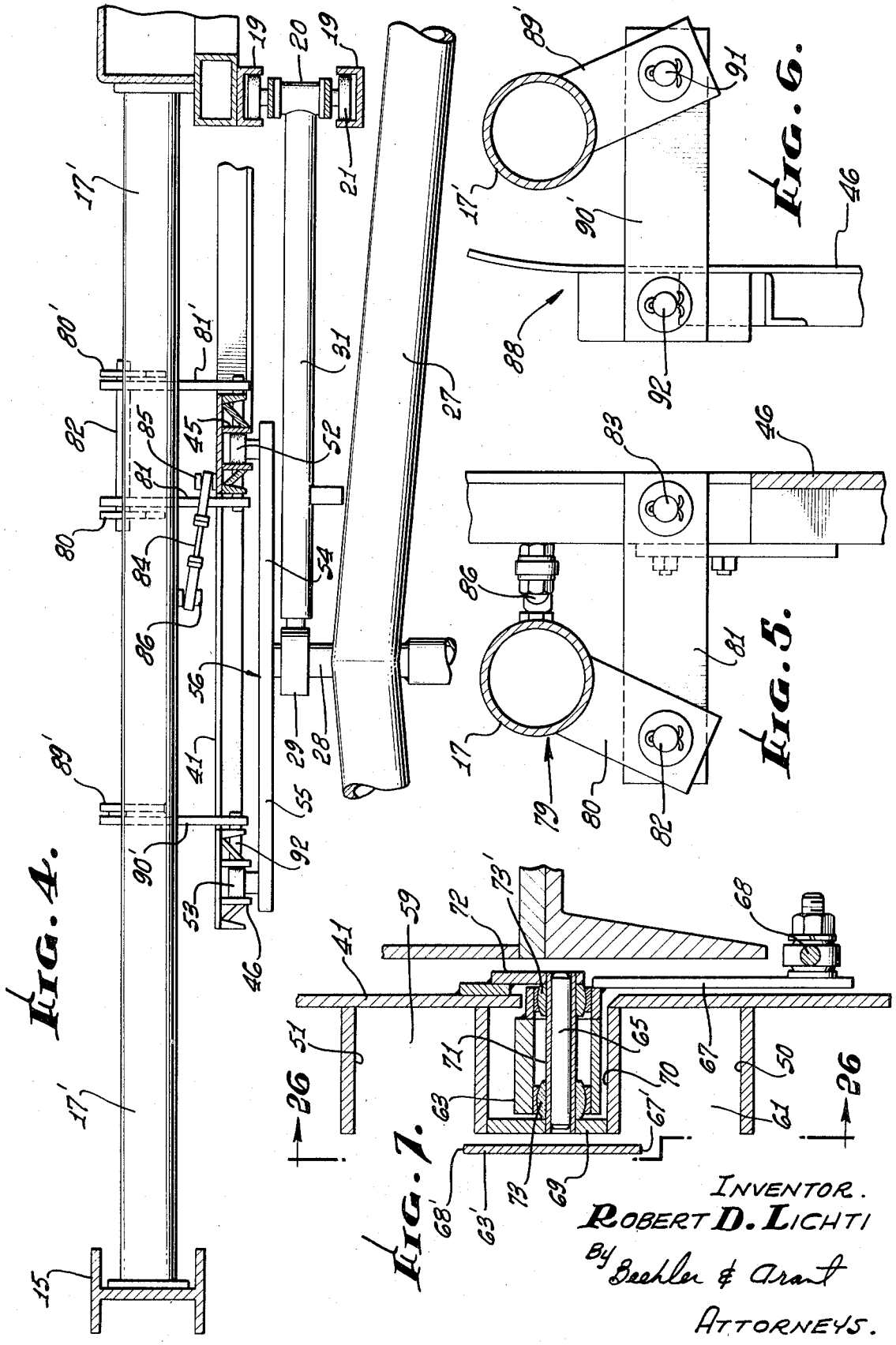
FIG. 4.
FIG. 5.
FIG. 6.
FIG. 7.
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FIG. 10.

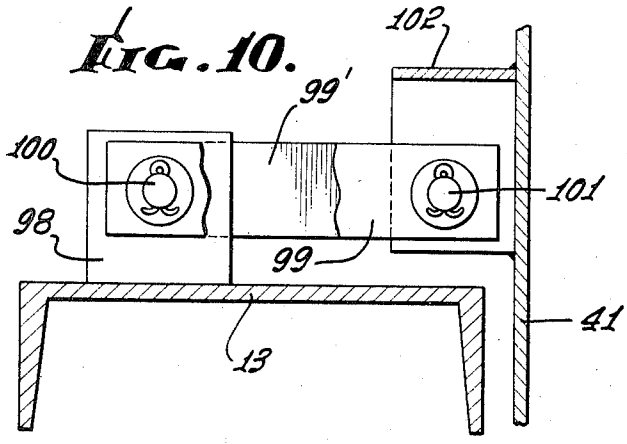



FIG. 11.

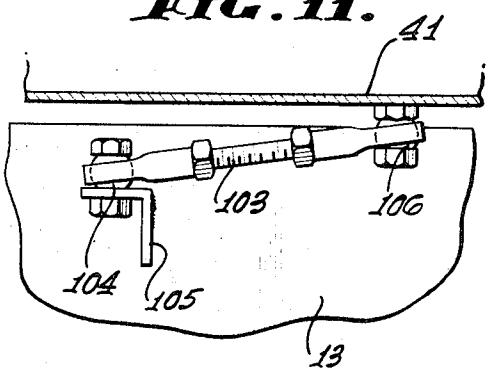



FIG. 9.

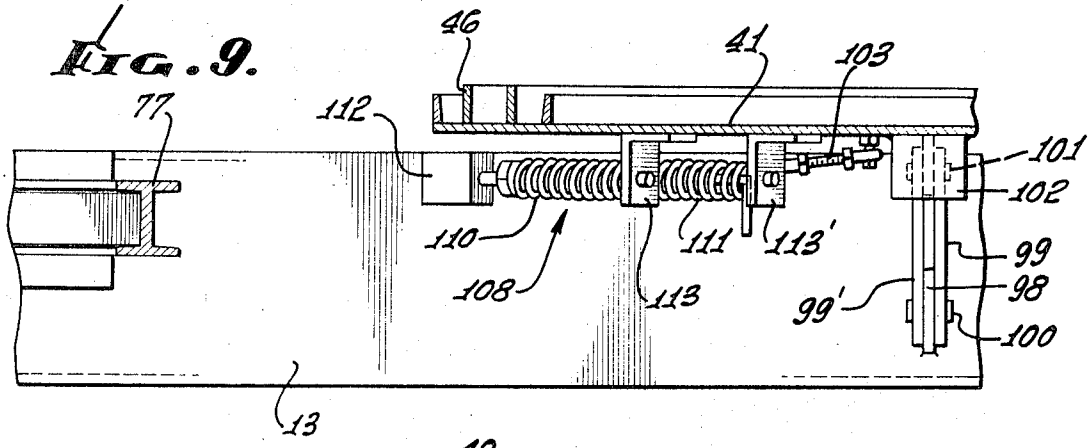
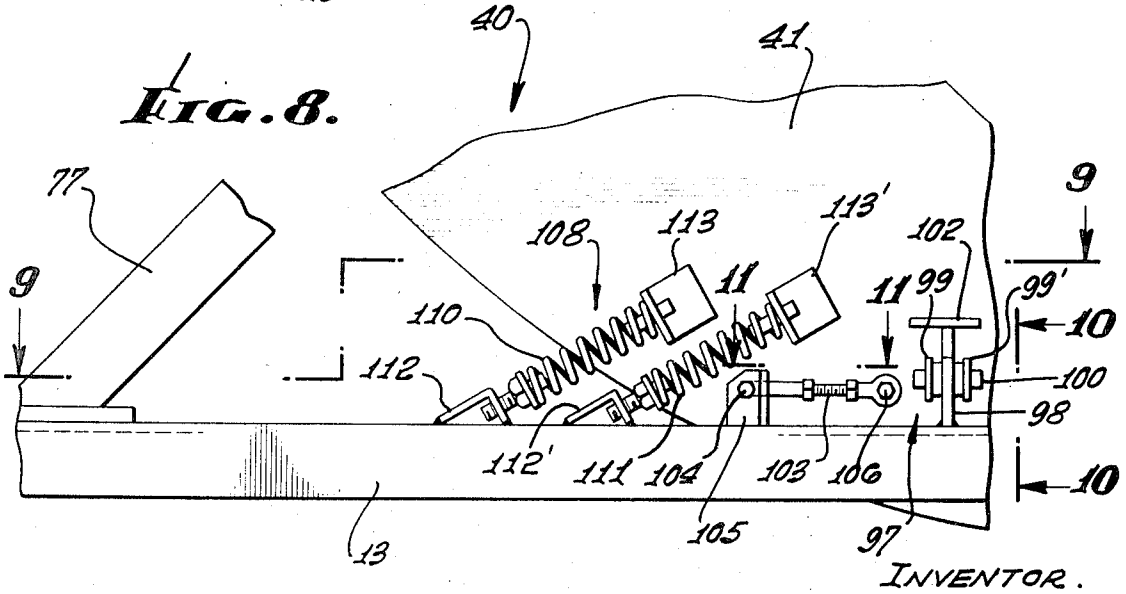



FIG. 8.

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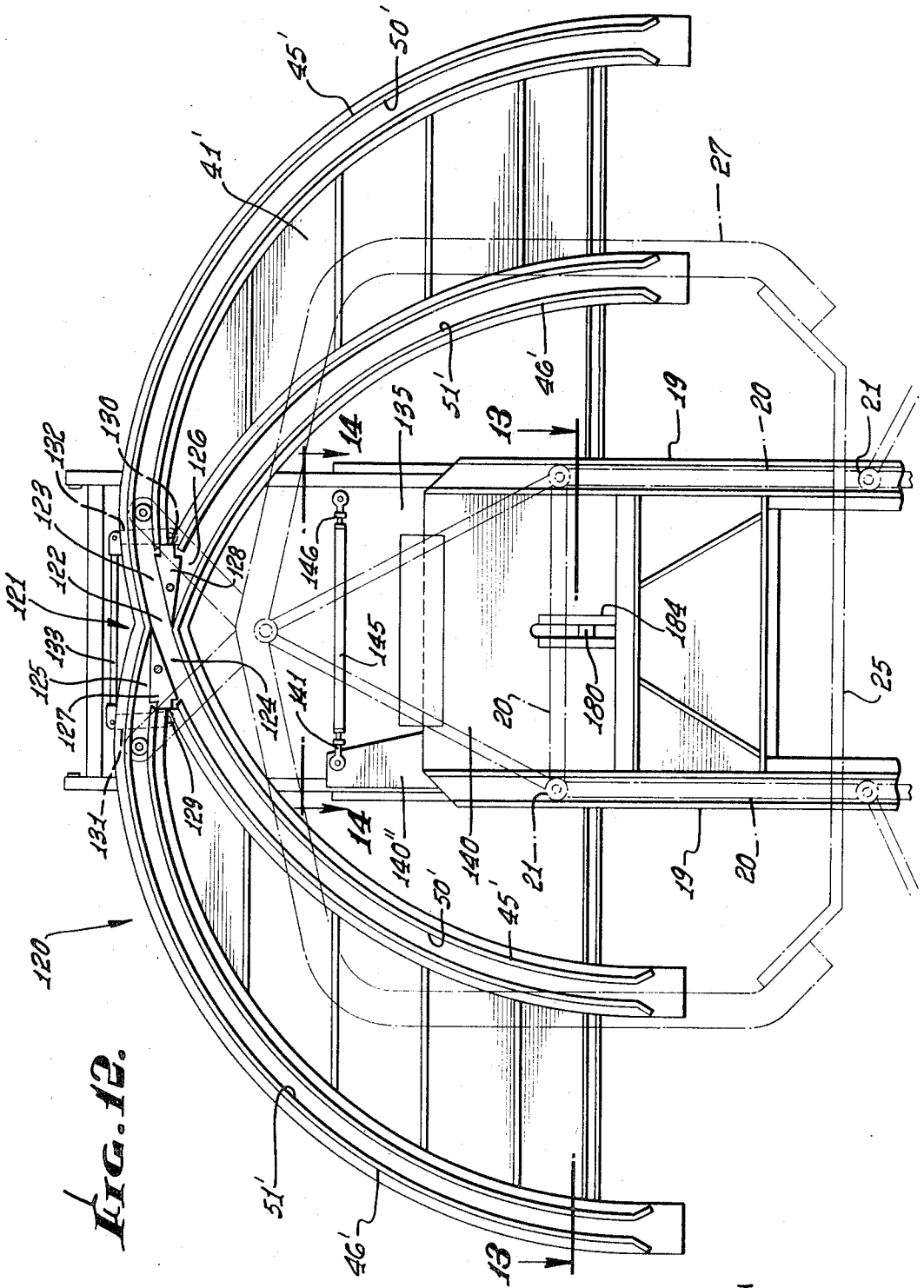


FIG. 12.

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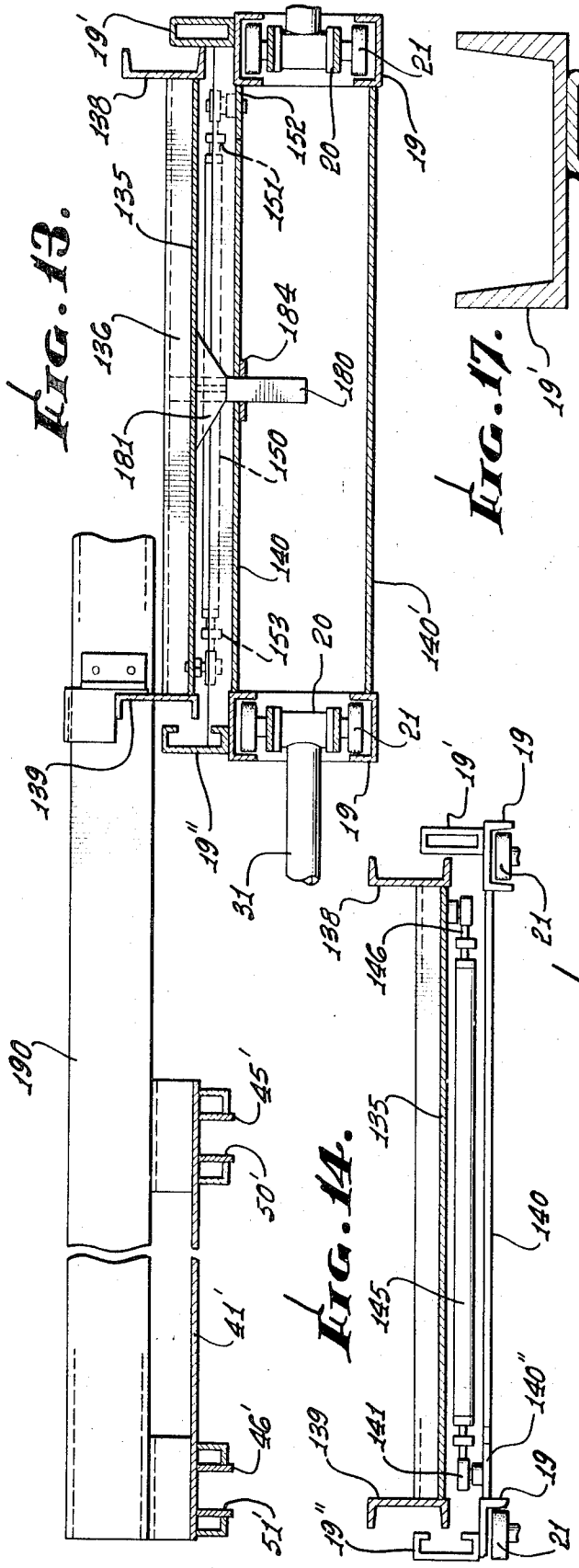
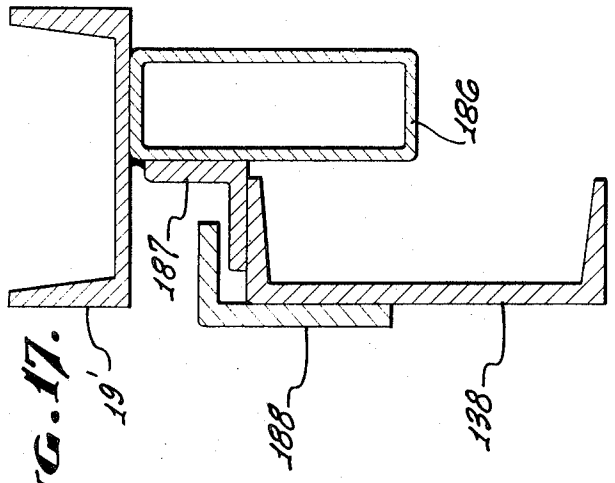



FIG. 13.

FIG. 14.

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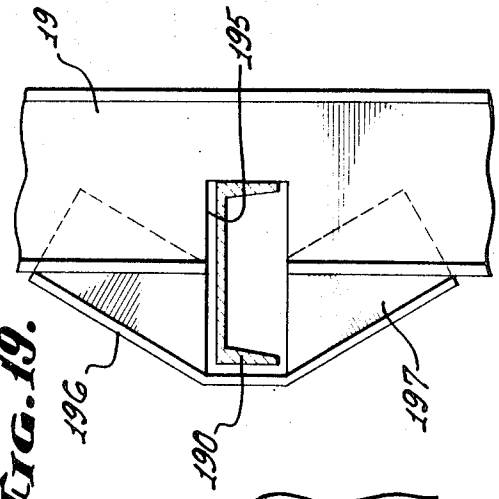


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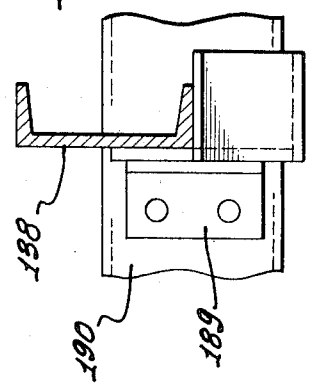


FIG. 18.

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FIG. 15.

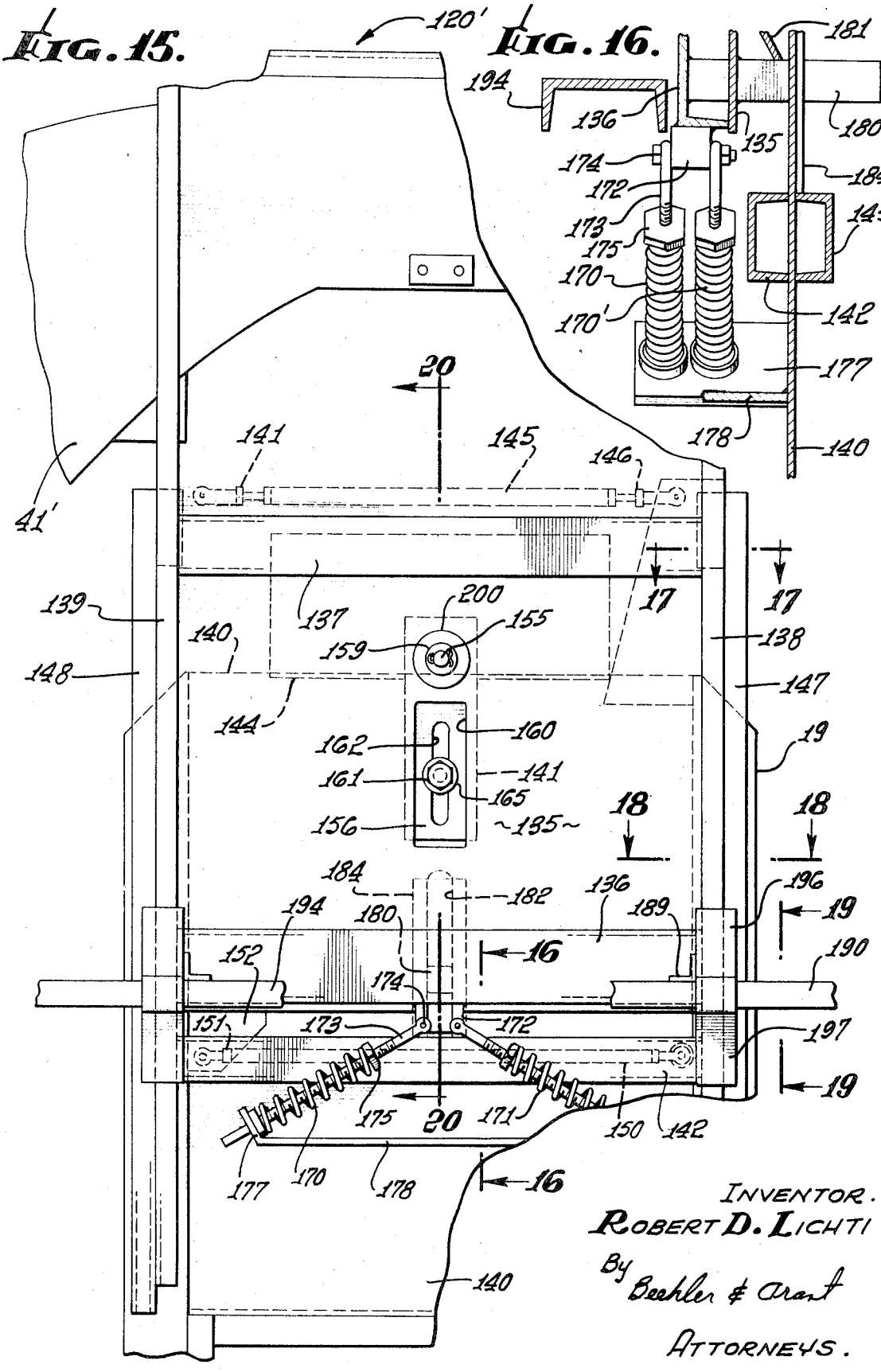


FIG. 16.




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FIG. 20.

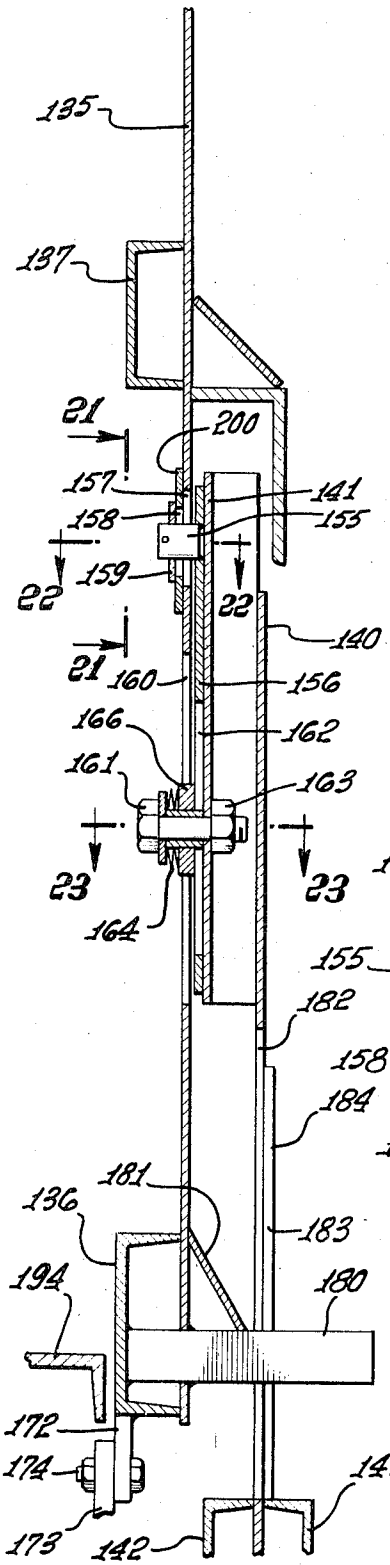


FIG. 21.

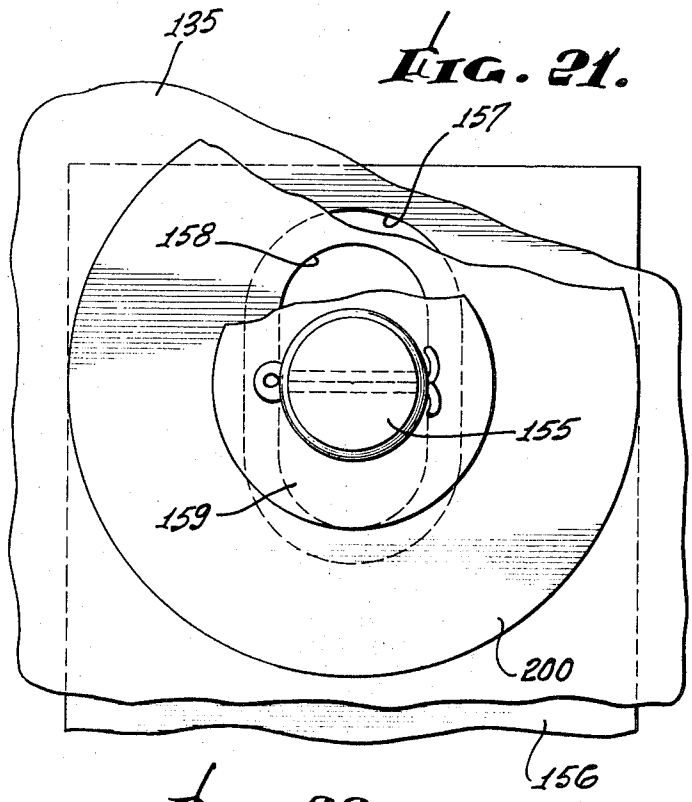


FIG. 22.

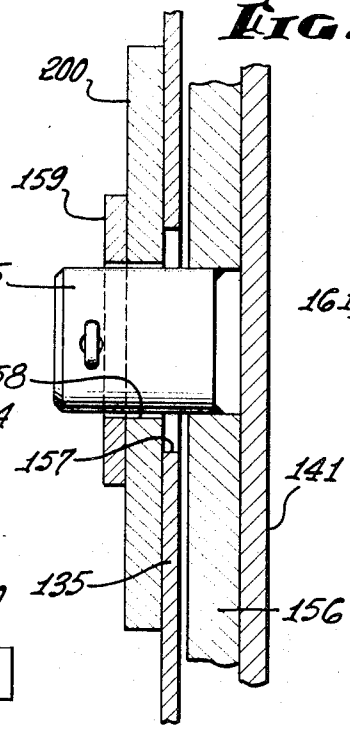


FIG. 23.

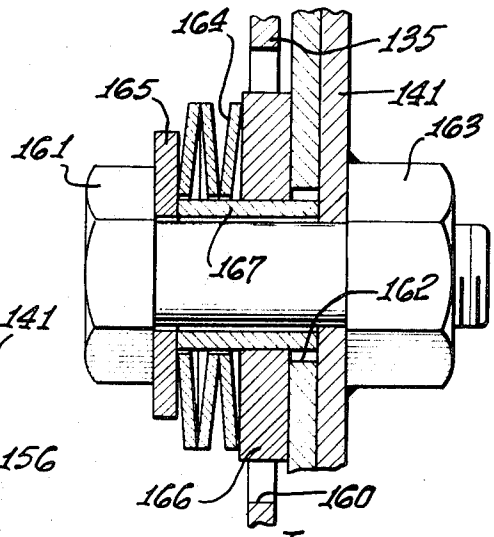


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FIG. 24.

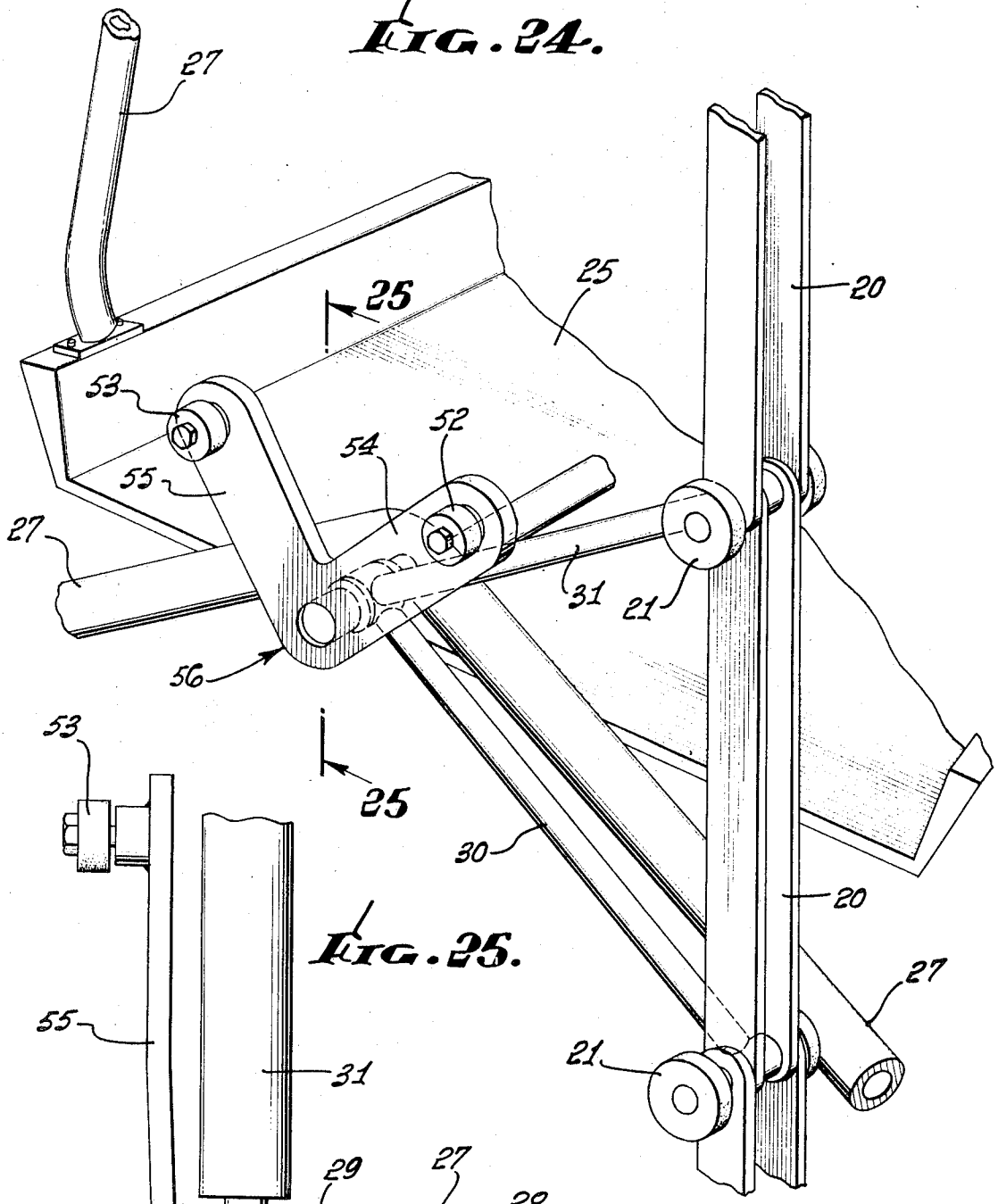


FIG. 25.




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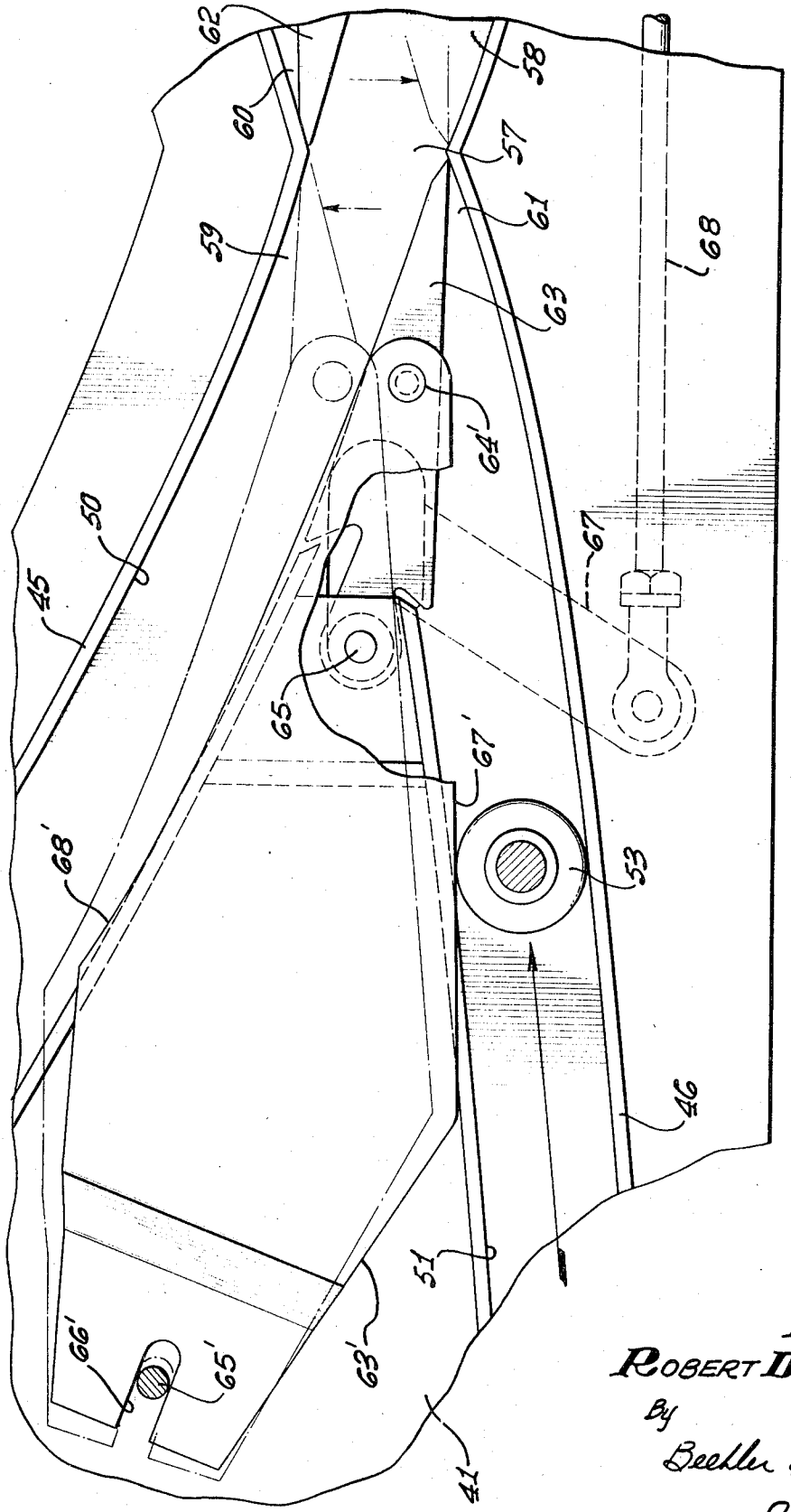


FIG. 26.

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# GUIDE MECHANISM FOR VERTICAL STORAGE DEVICE

The invention herein disclosed relates to vertical storage devices, the general concept and certain operating particulars of which are disclosed in U.S. Pat. No. 3,424,321 and in applicant's co-pending Applications, Ser. No. 737,647 filed June 17, 1968, now U.S. Pat. No. 3,547,281 and Ser. No. 873,358 filed Nov. 3, 1969.

The apparatus under consideration is one of substantial capacity such for example that it is capable of storing simultaneously 20 to 30 objects as big as automobiles, one above the other on separate platforms, the platforms in turn being mounted upon an endless chain power driven in a vertical direction, the arrangement being such as to be capable of placing one platform at ground level where it can be loaded and then moving it upwardly out of the way when another platform is to be moved to ground level for loading or, on the contrary, for unloading. The device is adapted to move in either direction so as to bring any selected platform to either a loading or unloading position irrespective of its initial location in storage position.

In devices of the size and capacity mentioned as evidenced for example by the prior devices made reference to above, certain problems are encountered which impair to a degree continued smooth working operation over a maximum period of time and with a minimum of servicing problems. Platforms which hold heavy loads in suspension high in the air do not always hold steadily in a desired position either because of unequal loading on the different platforms, or because of wind effect on both loaded and unloaded portions of the structure, and because of the need for rapid intermittent operation, bracing has been a problem for suspended platforms of the type herein used in that each one needs to be slung like a cradle on some outwardly extending portion of the endless chain and movement of the cradle, either endwise or sidewise, must be restrained to a degree either because of the character of the load on the platform or merely for safety reasons especially when the platform is at the top of the stack.

In addition because devices of this kind stand in the open where they are subject to all kinds of weather through out the year continued general deterioration and wear is bound to take place which, little by little, impairs the operating efficiency and, ultimately, the safety of the device for the heavy use expected of it.

Still further, in devices of this kind where pairs of tracks may be made use of for the guidance of travelers intended to steady the platform especially when it is traveling in either direction of operation, either at the top or the bottom of the device, guides must cross each other when the vertical direction is reversed, if the platform is to continue to be slung in a proper position so that the location of travelers becomes transposed with every change in the vertical direction of movement of the platform, this creating a problem in making certain that when the travelers cross over from one side to another they will be directed to a proper location for motion in the opposite direction.

It is therefore among the objects of the invention to provide a new and improved vertical storage device which is provided with a special guide mechanism for travelers attached to the respective platforms which makes certain that the travelers pass smoothly along their guide-tracks from one side of the operation to the other without possibility of any of the travelers being diverted to a track in which it does not belong.

Another object of the invention is to provide a new and improved guide mechanism for a vertically operating storage device wherein two separate switch tongues are provided and interconnected in such fashion that when the position of one of the switch tongues is shifted automatically, by action of one of the travelers, the position of the other switch tongue is simultaneously changed to a new position clearing the way for traveler movement.

Still another object of the invention is to provide a new and improved guide mechanism for a vertical storage device wherein the guide-tracks are mounted as assemblies, the entire assembly having a floating attachment to the main or stationary frame whereby to promote a smoothness in operation which might not otherwise occur because of parts not being made all to exactly the correct size and which will automatically either minimize or compensate for wear due to continued operation over long periods of time.



Still another object of the invention is to provide a new and improved guide mechanism for a vertical storage device the operation of which appreciably reduces the cost of building such a piece of machinery in that by allowing for a certain limited motion in the guiding portions of the device, operating parts need not be built to extremely small tolerances in dimension while at the same time in no way impairing a continued smoothness in operation.

Also included in among the objects of the invention is to provide an automatic compensating means for wear which may be experienced by the guide mechanism during long continued use thereby to allow the same overall assembly of parts to operate over much longer periods of time.

With these and other objects in view, the invention consists in the construction, arrangement, and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is an end elevational view of the device with vertical mid-portions cut away for convenience in illustration.

FIG. 2 is a side elevational view on the line 2—2 of FIG. 1.

FIG. 3 is a fragmentary end elevational view on the line 3—3 of FIG. 2.

FIG. 4 is a fragmentary cross-sectional view on the line 4—4 of FIG. 2.

FIG. 5 is a fragmentary vertical sectional view on the line 5—5 of FIG. 2.

FIG. 6 is a fragmentary vertical sectional view on the line 6—6 of FIG. 2.

FIG. 7 is a fragmentary vertical sectional view on the line 7—7 of FIG. 2.

FIG. 8 is a fragmentary vertical sectional view on the line 8—8 of FIG. 2.

FIG. 9 is a fragmentary cross-sectional view on the line 9—9 of FIG. 8.

FIG. 10 is a fragmentary vertical sectional view on the line 10—10 of FIG. 8.

FIG. 11 is a fragmentary cross-sectional view on the line 11—11 of FIG. 8.

FIG. 12 is a fragmentary vertical sectional view on the line 12—12 of FIG. 2.

FIG. 13 is a fragmentary cross-sectional view on the line 13—13 of FIG. 12.

FIG. 14 is a fragmentary cross-sectional view on the line 14—14 of FIG. 12.

FIG. 15 is a fragmentary vertical sectional view on the line 15—15 of FIG. 2.

FIG. 16 is a fragmentary vertical sectional view on the line 16—16 of FIG. 15.

FIG. 17 is a fragmentary cross-sectional view on the line 17—17 of FIG. 15.

FIG. 18 is a fragmentary cross-sectional view on the line 18—18 of FIg. 15.

FIG. 19 is a fragmentary vertical sectional view on the line 19—19 of FIG. 15.

FIG. 20 is a fragmentary vertical sectional view on the line 20—20 of FIG. 15.

FIG. 21 is a fragmentary vertical sectional view on the line 21—21 of FIG. 20.

FIG. 22 is a fragmentary cross-sectional view on the line 22—22 of FIG. 20.

FIG. 23 is a fragmentary cross-sectional view on the line 23—23 of FIG. 20.

FIG. 24 is a fragmentary side perspective view of the attachment of the yoke to the platform assembly.

FIG. 25 is a fragmentary vertical sectional view on the line 25—25 of FIG. 24.

FIG. 26 is a fragmentary side elevational view of cams operating with the switch tongues on the line 26—26 of FIG. 7.

In an embodiment of the invention chosen for the purpose of illustration and as shown in general in FIGS. 1 and 2 there is shown a vertical storage device which consists of a frame indicated generally by the reference character 10 made up of some of the vertically disposed members including legs 11, 11' at one end and similar legs 12 at the other end. The legs support bottom girders 13 and 14 above which extend posts 15, 15' at one end and similar posts 16 at the other end. Extending between the posts 15, 15' is a lower track support 17 and a similar lower track support 18 extends between the posts 16.

A vertically extending chain housing 19 at one end accommodates an endless chain made up of links 20 interconnected by means of pivot pins 21. At the lower end of the chain housing 19 is a drive housing 22 containing a motor 23 stepped up to operate a drive mechanism indicated generally by the reference character 24, details of which are not described herein inasmuch as they are adequately disclosed and described in applicant's prior patents numbers.

The chain housing is of such construction that it additionally serves as a main frame extending upwardly from the bottom girder 13 through a point adjacent the top of the device whereby to support the upper end of the endless chain at the point where it crosses over from one side to the other.

A series of platforms 25 is provided with diagonal struts 26 and 27 at each end which are joined together at upper ends and which engage the platform 25 at lower ends. The strut 27 at a location above the junction is anchored to a stub shaft 28 on which is a bushing 29. Arms 30 and 31 extend from the bushing to pivot pins 21 at opposite ends of selected links 20 providing in this way a triangular structure for hanging the platform on the chain. By the structure just described, the individual platforms are supported at opposite ends on the opposite endless chains, one platform equally spaced above and below the next adjacent platforms and extending entirely around both vertical sides of the chain housing in such fashion that the lowermost platform is adapted to be positioned on the ground surface 32 at a loading and unloading station 33. A control 34, automatic in nature, is used for controlling operation of the device and is capable of delivering any selected platform to the loading and unloading station.

## LOWER TRACK ASSEMBLY

A lower track assembly indicated generally by the reference character 40 and shown in some detail in FIG. 3 is located at one lower end of the device as shown in FIGS. 1 and 2. A similar lower track assembly 40' is located at the opposite end. The track assembly consists of a somewhat arcuate plate 41, enlarged at the upper ends 42 and 43 and having a narrow midsection 44 where the opposite sides join together.

On the arcuate plate 41 are two tracks, namely the tracks 45 and 46. Of special consequence is that these tracks overlie each other so that what is the outside track 45 on the right-hand side of the device as viewed in FIG. 3 becomes the inside track on the left-hand side, there being a crossover, one track with relation to the other, at an open intersection 47. On the right-hand side of the device as viewed in FIGS. 1 and 3, the track 46 has an upwardly extending extension 48 while on the left-hand side, as viewed in the same figures, the track 45 has an upwardly extending extension 49.

Extending through the track 45 is a channel 50 and extending through the track 46 is a channel 51, the channels being adapted to receive respective travelers 52 and 53. The travelers in the device chosen for the purpose of illustration, consist of rollers carried by one or another of the arms 54, 55 of the yoke 56.

At the open intersection 47 there is an open space 57 into which both of the channels 50 and 51 communicate. This has the effect of there being produced a first opening 58 and a second opening 59 for the channel 50 and a first opening 60 and second opening 61 for the channel 51. The travelers 52 and 53 must pass through the open space 57 and the respective openings for the particular channel, 50 or 51 as the case may be, as they pass from one side of the device to the other. It is important that the traveler in traversing the open space is not diverted into the wrong channel.

To make certain of proper travel of the travelers there are provided switch tongues 62 and 63 which work together in order to block either the first and second openings 58 and 59 of the channel 50 or the first and second openings 60 and 61 of the channel 51. In FIG. 3 the switch tongues are shown blocking the openings 58 and 59 and leaving clear the openings 60 and 61.

To provide for proper movement of the switch tongues, the switch tongue 62 is shown pivotally supported on the frame by means of a pin 64 and the switch tongue 63 is pivotally mounted on the frame by means of a pin 65. The general location of the pins is shown in FIG. 3 and details of construction are shown in FIG. 7. On the switch tongue 62 is a bracket 66 interconnected with a similar bracket 67 for the switch tongue 63 by means of a toggle arm 68. Interconnected in this fashion when one switch tongue rotates clockwise, the other switch tongue is forced to rotate simultaneously counter-clockwise, and vice versa. Accordingly when the parts are in the position shown in FIG. 3 with the switch tongue 62 closing the first opening 58 and the switch tongue 63 closing the second opening 59, and assuming the travelers to be descending on the right-hand side of FIG. 3 and ascending on the left-hand side, after the traveler 53 has passed through the intersection 47 with the way cleared for it with the switch tongues in the position there shown, when the traveler 52 is forced against the underside of the switch tongue 62 forcing it to rotate counter-clockwise the switch tongue 63 will be forced to rotate clockwise to a position closing the second opening 61 and clearing the second opening 59, while at the same time the switch tongue 62 closes the first opening 60. As a consequence the intersection will be cleared in the path of the channel 50 through which the traveler 52 can pass to the opposite, or left side of the device. Should the device continue operating in the direction just defined the next pair of travelers passing downwardly through the channels 50 and 51 on the right side of the device will be able to pass properly through the intersection because the traveler 53 when forced into contact with the switch tongue 62, then in an upper position closing the opening 60, will force the switch tongue 62 in a counter-clockwise direction downwardly to clear the opening 60 and this action will be transferred to a clockwise rotation of the switch tongue 63 from a position closing the opening 61 to an upper position closing the opening 59 thereby to permit the traveler 53 to travel to the other or left-hand side of the device. After the traveler 53 has passed the intersection with the switch tongues in the solid line positions shown and to which they have just been moved by the action described, the traveler 52 will cause a reverse position of the switch tongue in the same manner as was initially detailed.

Operation of the travelers in a reverse direction namely downwardly on the left side of FIG. 3 and upwardly on the right side of FIG. 3 merely operates the switch tongues in an opposite sequence, the net effect of which will be to clear the channel for the first traveler passing through the intersection and then to clear the opposite channel for the second traveler to pass through the intersection.

Some structural details helpful in understanding the mounting of the switch tongues are disclosed in FIG. 7 wherein there is shown a jacket 69 enclosing a space 70 in which is located what has been previously described as the pin 65, the pin being surrounded by a sleeve 71. The sleeve 71 is carried by a mounting plate 72 in turn anchored to the arcuate plate 41 which gives the sleeve 71 a fixed location above which the switch tongue 63 is adapted to rotate in the FIG. 7 view, supported by bearings 73, 73'. The switch tongue 62 is similarly mounted such that a description of the mounting for the switch tongue 63 will suffice for the mounting of the switch tongue 62.

To improve the smoothness in operation of the switch tongues 62 and 63 cams are provided as shown in FIG. 26, the purpose of which is to gradually start movement of the switch tongues as one or another of the travelers 52, 53 approach so that there will not be an abrupt, rapid change in the switch tongue position. One cam 63' and its operation is disclosed in FIG. 26. The cam is pivotally secured to the switch tongue 63 by means of a pivot pin 64', the cam being additionally held in position by means of a pin 65' in the arcuate plate 41, the pin riding in an elongated slot 66' in the cam 163. A camway 67' at the lower edge of the cam is adapted to be engaged by the traveler 53 as it rolls in the channel 51 of the track 46. The general location of the cam 63' is also shown in FIG. 7. A similar cam (not shown) is mounted in a corresponding fashion for operation with the switch tongue 62, and comparable cams (not shown) cooperate with the switch tongues 127 and 128 at the top of the device.

In operation let it be assumed that the switch tongue 63 occupies the solid line position shown in FIG. 26 as the traveler 53 is approaching. When the traveler reaches engagement with the camway 67' near its left-hand end as viewed in FIG. 26, the traveler will commence shifting the cam upwardly and, since the cam is attached to the switch tongue at the pivot 64', the switch tongue will at the same time be started in its upward movement toward the broken line position of FIG. 26, the switch tongue 63 moving about its pivot pin 65. Simultaneously the other switch tongue 62, by action of the toggle arm 68, will commence its movement away from the solid line position of FIG. 26 to a position closing the opening 58.

Once the switch tongue 63 has assumed the broken line position of FIG. 26 and the traveler 53 has passed the open space 57, the traveler 52 as it descends the channel 50 will engage a camway 68' on the opposite side of the cam. The effect of this engagement will be to gradually and progressively depress the cam 63' simultaneously and gradually move the switch tongue 63 from its broken line position of FIG. 26 to the solid line position. At the same time, by action of the toggle arm 68, the other switch tongue will be gradually moved to its contrary position.

In the case of the reverse movement of the travelers 52 and 53, the cam on the opposite side corresponding to the cam 63' will be acted upon by the travelers moving in opposite directions to cause a comparable gradual movement of the switch tongues from one position to the other.

## FLOATING SUPPORT —LOWER TRACK ASSEMBLY

The lower track assemblies 40,40' are so mounted that the entire assembly is permitted to shift slightly in a vertical direction during operation to accommodate to a degree variations in some of the structural parts and also variations which are the result of war. To accomplish this each of the connections which mount the lower track assembly upon the frame have a design such that it permits a certain amount of movement vertically. Portions of the frame useful for mounting the lower track assembly 40, for example, include the bottom girder 13, the first lower track support 17, and a second lower track support 75, the last-mentioned lower track support being clearly shown in FIG. 3 although omitted from FIG. 1. Diagonal braces 76 and 77 remain free of attachment to the lower track assembly.

As shown in FIG. 3 there are a series of floating connections for the arcuate plate 41 of each of the lower track assemblies 40 and 40'. Two such connections at the upper end of the track 46, namely an upper floating lateral or hinged guide connection 78 and a lower floating lateral or hinged guide connection 79. Another (not shown) is located near the lower end of the arcuate plate. The lateral connections 78 and 79 are identical hence details of only one of them as shown in FIG. 5 are sufficient for an explanation of the construction of both. Similar connections 78' and 79' on the opposite side of FIG. 3 assure that the floating action is vertical. Since movement is limited and occurs throughout only a small angle above and below horizontal, any slight lateral shift is negligible. Lugs 80,80' extend downwardly from the lower track support 17 and legs 81,81' pivotally secured to the respective lugs 80,80' by means of a pivot pin 82 are also pivotally secured to the track 46 by means of a pivot pin 83. The connection between the lower track assembly 40 and the lower track support 17 made by the lower floating lateral connection just described allows a degree of shifting of the lower track assembly up and down. Some further floating restraint is provided by an adjustable link 84, in each instance one end of which is pivotally attached to the lower track support 17 by means of a pin 85, and the other end of which is pivotally secured to the extension 48 of the track 46 by means of a pivot pin 86. The same attachments between the upper end of the extension 48 and the second lower track support 75 are given the same reference numbers on FIG. 3 and are built and operated in the same fashion.

The other end of the track 46 on the opposite side of the structure as shown in FIG. 3 is attached to a section 17' of the lower track support by a comparable attachment this being an auxiliary floating lateral connection 88, shown in some detail in FIG. 6. There are lugs 89,89' anchored to the portion 17' of the lower track support from which extend respective legs 90,90', the leg 90' being attached to the lug 89' by a pivot pin 91. Each of the legs 90,90' is attached to the left-hand end of the track 46 by means of a pivot pin 92.

For the other track 45 there are similar upper and lower floating lateral connections 93 and 94 on the left end of the track 45 as viewed in FIG. 3 and a comparable auxiliary floating lateral connection 95 at the right-hand end of the track 45 as viewed in FIG. 3. Structural details of the last referred to lateral connections are the same as those already described in FIGS. 3, 5, and 6.

At the bottom of the lower track assembly 40 there is also a bottom floating connection 97, details of which are shown in FIGS. 8, 9, 10, and 11, the attachment being one between the lower track assembly 40 and, specifically, the bottom girder 13. Extending upwardly from the bottom girder 13 is a lug 98 to which legs 99,99' are pivotally attached by means of a pivot pin 100. A second pivot pin 101 pivotally secures the other end of the legs 99,99' to a bracket 102 mounted on the arcuate plate 41, thereby to permit a limited vertical motion of the arcuate plate 41 with respect to the bottom girder 13.

Additional attachment is provided by an adjustable link 103 pivotally secured at one end by a pin 104 to a bracket 105 on the bottom girder 13. At the other end the adjustable link 103 is secured by means of a pivot pin 106 to the arcuate plate 41, as shown in FIG. 11.

A balanced condition in the arcuate plate 41 is achieved by means of two sets 108 and 109 of compression springs, action of the springs taking effect when the plate condition tends to become unbalanced. These sets of springs are substantially identical except for their opposite action, set 108 consisting of individual coil springs 110 and 111. An angle section 112 on the bottom girder 13 is employed to attach one end of the spring 110 and an angle section 113 on the arcuate plate 41 attaches the other end of the spring 110 to the arcuate plate 41. Similar angle sections 112' and 113' are employed for similarly mounting the compression spring 111. Comparable attachments are employed for the other set 109 of compression springs on the opposite or right-hand side of the device as shown in FIG. 3.

## UPPER TRACK ASSEMBLY — CROSSOVER

Upper track assemblies 120,120' are located at the top of the device as shown in FIG. 2. Additional details of the assembly 120' are shown in FIG. 12. The arcuate plate 41' is enlarged at lower ends 42', 43' and has a narrow mid-section 44'.

The upper track assembly 120' consists of tracks 45' and 46' mounted upon an arcuate plate 41', the track 45' at both of its ends being in substantial vertical alignment with the

comparable ends of the track **45** on the lower track assembly **40** and the opposite ends of the track **46'** being in substantial vertical alignment with corresponding opposite ends of the track **46** of the lower track assembly **40**. Extending through the track **45'** is a channel **50'** and extending through the track **46'** is a channel **51'**.

There is a crossover between the tracks **45'** and **46'** at a location close to the mid-portions providing an open intersection **121**. At the intersection is an open space **122** which communicates with opposite sides of the channel **51** by means of first and second openings **123** and **124**. Similar first and second openings **125** and **126** communicate between the space **102** and opposite sides of the channel **51'**. Switch tongues **127** and **128** operate in unison, the switch tongue **127** being pivotally mounted upon the arcuate plate **41** by means of a pin **129** and the switch tongue **128** being pivotally mounted to the same arcuate plate **41** by means of a pin **130**. Anchored to the switch tongue **127** is a bracket **131** and a comparable bracket **132** is anchored to the switch tongue **128**. Free ends of the brackets are interconnected by means of a toggle arm **133**, so that the switch tongues are interconnected in order that when one moves the other will move simultaneously. Action of the switch tongues **127** and **128** is comparable in all substantial particulars to operation of the switch tongues **62** and **63** in the lower track assemblies **40** and **40'**. Accordingly, a further detailed description of structure and operation is not repeated.

## FLOATING SUPPORT, UPPER TRACK ASSEMBLY

The floating attachment of the upper track assemblies to the frame is slightly different from that shown and described for the lower track assemblies. These upper track assemblies are so built and mounted in such a way so as to allow for a certain amount of free motion but there is provided, in addition, a controlled friction mounting which can be forced into place under certain circumstances thereby adding to the total allowed movement of the upper track assembly with respect to the frame.

The upper arcuate plate **41'** has attached to it a central rectangular plate section **135**, the rectangular plate section being stiffened at the bottom by attachment of a channel **136** and stiffened intermediate the bottom and the top by attachment of a second channel **137** as shown in FIgS. **15** and **20**. At opposite edges of the central rectangular plate section **135** are vertically extending channels **138** and **139** as shown in FIGS. **13, 15,** and **18**.

The chain housing **19** previously described extends upwardly within the area of the arcuate plate **41'** and includes a panel **140** adjacent the central rectangular plate section **135** and a similar panel **140'** the combination of which provides a stiff rectangular section as shown in FIG. **13**. Transverse stiffeners **142, 143** are provided on the panel **140** extending from side to side as shown in FIG. **15**. Rigid side elements **147** and **148** extend upwardly from the chain housing **19** to locations adjacent the transverse channel **137**.

To allow for relative movement of the floating portions at the upper end which are embodied in the arcuate plate **41'** together with the central rectangular plate section **135** and stationary portions of the device embodied in part in the chain housing **19**, as shown in FIG. **12**, a movable connection is provided between the stationary portions and the arcuate plate, details of which are shown in FIG. **13, 14,** and **15**. On the left upper end of the panel **140**, as shown in FIG. **12**, is a bracket **140''** to which is pivotally attached a swivel connection **141**. A spring housed in a cylinder **145** attached to the swivel connection has at the other end a similar connection **146** which is attached the rectangular plate section **135**.

Clearly therefor the rectangular plate section **135** and the attached arcuate plate **41'** is enabled to shift up and down, restrained by the spring action of the cylinders **145** and **150**.

For guiding the vertical movement a peg **155** is welded to a slide plate **156** on the central channel section **141**, and the peg **155** is adapted to slide vertically in a slot **157** in the central rectangular plate section **135** (FIG. **20** and FIG. **22**) and to slide in a corresponding slot **158**.

A vertically extending slot **160** in the central rectangular stiffening plate section **135** allows a bolt **161** to slide up and down under a controlled friction resistance a distance appreciably greater than the sliding of the pegs **150** and **155** by reasons of the fact that the slot **160** is appreciably longer.

A slot **162** in the slide plate **156** prevents any interference between the sliding of the bolt **161** and the rectangular plate section **135**.

A nut **163** welded to the central channel section **141** accommodates the threaded end of the bolt **161** so that it can be tightened or loosened relative to spring washers **164** retained beneath a washer **165** (FIG. **23**), the spring washers bearing against a wear-resistant slide washer **166**. A sleeve **167** surrounding the shank of the bolt **161** provides a snug sliding fit for the shank of the bolt **161** in the slots **160** and **162**.

To balance action of the rectangular plate section **135** and the attached arcuate plate **41'**, there are provided diagonally acting springs **170, 170'** and **171**, as shown in FIGS. **15** and **16**. A bracket **172** attached to the central rectangular plate section **135** by means of the channel **136** serves as an attachment for the upper ends of the springs **170, 170'** and **171**. More specifically, a shaft **173** for the spring **170** is attached to the bracket **172** by means of a pin **174** in a manner such that a collar **175** bears against the uppermost end of the spring **170**. The shaft **173** extends through an appropriate hole in a flange **177** of a supporting bracket **178**, the lower end of the spring also bearing against the flange **177**. The collar **175** is threadedly adjustable along the shaft **173** to set the tension in the spring **170**. A similar attachment is provided for the springs **170'** and **171**.

As shown in FIG. **16** the supporting bracket **178** is anchored to the stationary panel **140**. Supported in this fashion by springs, the rectangular plate section **135** is yieldably urged to a central position subject to displacement laterally adjacent the bottom or to displacement vertically against tension exerted by one or another of the diagonally mounted sets of springs **170, 171**.

In addition to the guides already described for slidably guiding the upper arcuate plate **41'** there is provided a square peg **180**, shown near the bottom of FIG. **20**, this square peg being welded to the inside face of the channel **136** and also welded to the rectangular plate section **135** where the peg passes through the section, there being additionally provided a diagonal plate **181** for bracing.

The square peg **180** extends through slots **182** and **183**, the slot **182** being in the panel **140** and the slot **183** being substantially coincident with it in a reinforcing strip **184**.

To assist in providing for the floating or slidable retention of the upper track assembly **120'** for example carried by the panel **140**, certain sliding relationships are created between side edges of the panel **140** and side edges of the central rectangular plate section **135**, as well as elsewhere.

As previously made reference to, channels **138** and **139** at side edges of the rectangular plate section **135** extend downwardly as shown in FIGS. **15, 17,** and **18**. A box section **186** attached to the chain housing **19'** carries an angle section **187** against which one of the flanges of the channel **138** is adapted to slide, confined there against by the assistance of another stationary angle section **188**.

At its lower end the channel **138** is attached by an angle bracket **189** to a transverse channel section **190**.

A transverse upper channel section **194**, forming a part of the stationary frame, additionally serves to slidably retain the rectangular plate section **135**.

The transverse channel section **190** previously referred to as being secured to the bottoms of the channels **138, 139**, extends laterally through an opening **195** in the adjacent side of the chain housing **19** wherein it is confined by angle brackets **196** and **197**. The opening **195** is appreciably larger than the cross-sectional shape and size of the channel section **190**

thereby permitting the channel section to shift in the opening by a corresponding amount.

Normally the central rectangular plate section **135** together with the upper track assembly in each instance is so constructed that it can move up and down somewhat freely to a degree determined by the capabilities of the springs **170, 171**. Under such circumstances the peg **150** fastened to the rectangular plate section can move up and down in the slots **151** and **152**. At the same time the rectangular plate section can move relative to the peg **155** which is stationary, a distance limited by the length of the slot **157** in which the peg is located.

Also during this movement the square peg **180** is free to slide up and down within the slots **182** and **183**.

It is also true that the rectangular plate section possessed of a relatively long slot **162** extending around the shank of the bolt **161** is free to move relative to the bolt but throughout an appreciably long distance limited only by the length of the slot **160**. The resistance to such movement is offered by the spring washers **164** which are confined by the head of the bolt **161** to a small space between the head of the bolt and adjacent washer **165** and ultimately the central channel section **141** acting through the washer **198** and the reinforcing plate **156**, as shown in FIG. **23**. The sleeve **199** around the shank of the bolt **161** centers the bolt with respect to the spring washers **164**, the washer **198** and the slide plate **156**.

Providing the freedom of motion described herein both with respect to the upper track assemblies at each end and the lower track assemblies at each end operating misalignments which unavoidably are built into a mechanical moving device of the kind herein disclosed are accommodated by shifting of the track assemblies against spring tension. As wear occurs, however, there is an additional tendency to move one or another of the track assemblies. The device provides for this by making it possible to shift the position of the upper track assemblies automatically up or down as the case may be to a new position of adjustment against the friction resistance offered by the bolt **161** acting against the spring washers **164**. In the new position the same freedom of motion previously described is allowed to continue.

To improve the sliding retention of the rectangular plate section **135** by means of the peg **155** there is provided an additional slide washer **200** details of which are readily observable in FIGS. **21** and **22**, the slide washer having in it the slot **158**, extending in a vertical direction although relatively short from end to end.

From the foregoing disclosure, it can be readily understood that the improved particulars of construction featuring the positive guided crossover for the travelers as they shift from one side of the device to the other, coupled with the slidably guided floating mount for the plate upon which the track assemblies are carried, makes certain, by this limited freedom of action and movement, a dependable working but rugged device which can be kept in operation with a correspondingly less amount of service resulting from wearing of parts.

The device, moreover, is provided with an abundance of flexibility which assists in smoothly delivering any one platform to the loading and unloading station whenever it may be needed.

While the invention has herein been shown and described in what is conceived to be a practical and effective embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

What is claimed is:

**1.** In a vertical storage device comprising a vertical frame, endless chain means in vertically mounted position on the frame, a plurality of storage platforms mounted on and moved by said chain, and a drive on said frame for said chain adapted to drive said platforms between a lowermost position and an uppermost position, the combination of a guide mechanism operable between said frame and said platforms and operative at an end of said endless chain means for steadying the motion of said platforms, said guide mechanism comprising a yoke anchored in fixed relation to each platform, said yoke having a pair of arms of substantially equal length, a traveler on each arm, and a track assembly unit on each end of the frame comprising a pair of tracks and a support therefor, one track of each pair being adapted to receive one of said travelers and the other track being adapted to receive the other of said travelers, said tracks being arcuate in shape and equal in radius of curvature and being at the same horizontal level, the tracks being laterally offset from each other at respective free ends of said tracks a distance substantially equal to the horizontal distance between the respective travelers on each of said yokes, whereby said tracks cross each other adjacent a point between opposite ends forming an intersection, and switch means at said intersection comprising interconnected tongues movably mounted in the intersection and movable between one position establishing a clear way through said intersection for one of said tracks and another position establishing a clear way through said intersection for the other of said tracks, whereby said travelers change respective inside and outside positions after passing through said intersection.

**2.** In a vertical storage device comprising a vertical frame, endless chain means in vertically mounted position on the frame, a plurality of storage platforms mounted on and moved by said chain, and a drive on said frame for said chain adapted to drive said platforms between a lowermost position and an uppermost position, the combination of a guide mechanism operable between said frame and said platforms and operative at an end of said endless chain means for steadying the motion of said platforms, said guide mechanism comprising a yoke secured to each platform, said yoke having a pair of arms, a traveler on each arm, and a forward and reverse acting track assembly on the frame comprising a pair of tracks, one track of each pair being adapted to receive one of said travelers and the other track being adapted to receive the other of said travelers, said tracks being arcuate in shape and laterally offset from each other at respective free ends of said tracks a distance substantially equal to the distance between the respective travelers on each of said yokes, whereby said tracks cross each other adjacent a point between opposite ends forming an intersection having two openings for each track, and switch means at said intersection having one position establishing a clear way in both directions through said intersection for one of said tracks and another position establishing a clear way in both directions through said intersection for the other of said tracks, whereby said travelers change respective inside and outside positions after passing through said intersection, means forming an opening for each track at each side of said intersection, said openings together forming a junction on each side wherein the separate tracks have communication with each other, oppositely facing switch tongues operably mounted at the respective junctions, each switch tongue being movable between a position blocking passage to one of the tracks to the respective junction and a position blocking the other of the tracks to such respective junction, said switch tongues being interconnected so that both switch tongues act in unison to block one track and open the other track for movement of said travelers in either direction.

**3.** A storage device, as in claim **2**, wherein there is a pivotal mounting on said track assembly for each of said switch tongues at a location intermediate adjacent respective opposite sections of the two tracks, an arm anchored to each switch tongue and a toggle interconnecting said arms whereby when one switch arm is moved in one direction, the other switch arm is moved in the opposite direction.

**4.** A storage device, as in claim **2**, wherein said switch tongues have unrestrained positions in one or another of said tracks, one of said switch tongues being subject to movement from one position to another by action of the traveler when moved into engagement therewith.

**5.** A storage device, as in claim **2**, including cam means in said tracks in operable engagement with respective switch tongues, said cam means having cam tracks responsive to engage-

ment by said travelers in advance of arrival of the travelers at the respective switch tongue location, whereby the switch tongues are shifted gradually from one position to another.

6. In a vertical storage device comprising a vertical frame, endless chain means in vertically mounted position on the frame, a plurality of storage platforms mounted on and moved by said chain, and a drive on said frame for said chain adapted to drive said platforms between a lowermost position and an uppermost position, the combination of a guide mechanism operable between said frame and said platforms and operative at an end of said endless chain means for steadying the motion of said platforms, said guide mechanism comprising a yoke anchored in fixed relation to each platform, said yoke having a pair of arms of substantially equal length, a traveler on each arm, and a track assembly unit on each end of the frame comprising a pair of tracks and a support therefor, one track of each pair being adapted to receive one of said travelers and the other track being adapted to receive the other of said travelers, said tracks being arcuate in shape and equal in radius of curvature and being at the same horizontal level, the tracks being laterally offset from each other at respective free ends of said tracks a distance substantially equal to the horizontal distance between the respective travelers on each of said yokes, whereby said tracks cross each other adjacent a point between opposite ends forming an intersection, and switch means at said intersection having one position establishing a clear way through said intersection for one of said tracks and another position establishing a clear way through said intersection for the other of said tracks, whereby said travelers change respective inside and outside positions after passing through said intersection, at least one of said track assembly units having a freely vertically slideable mounting on said frame and being secured against horizontal movement relative to the frame, said track assembly unit when engaged by travelers of each yoke being productive of a stability condition in said yoke and the platform acting therewith when the travelers are passing through said respective track assembly unit.

7. A vertical storage device as in claim 6 wherein the track assembly unit which has a vertically slideable mounting includes yieldable means acting upwardly between the frame and the track assembly unit in amount greater than the weight of the track assembly unit and that of a yoke and platform acting therewith when in engagement with the respective track assembly unit.

8. A vertical storage device, as in claim 7 wherein said vertically slideable mounting comprises vertically sliding retainers between the frame and the track assembly and longitudinally yieldable pivotally acting ties in oblique counterbalanced relationship between the frame and the track assembly.

9. A vertical storage device, as in claim 7 wherein said yieldable means comprises sets of springs acting diagonally between opposite sides of one of said track assembly units and the frame and longitudinally yieldable resilient means acting between the frame and the other of said track assembly units.

10. A vertical storage device as in claim 9 wherein said longitudinally yieldable resilient means comprize two complementary cylinder and piston members, one of each of said members being attached to the frame and the other of each said member being attached to the track assembly unit.

11. In a vertical storage device comprising a vertical frame, endless chain means in vertically mounted position on the frame, a plurality of storage platforms mounted on and moved by said chain, and a drive on said frame for said chain adapted to drive said platforms between a lowermost position and uppermost position, the combination of a guide mechanism operable between said frame and said platforms and operative at an end of said endless chain means for steadying the motion of said platforms, said guide mechanism comprising a yoke anchored in fixed relation to each platform, said yoke having a pair of arms of substantially equal length, a traveler on each arm, and a track assembly unit on each end of the frame comprising a pair of tracks and a support therefor, one track of each pair being adapted to receive one of said travelers and the other track being adapted to receive the other of said travelers, said tracks being arcuate in shape and equal in radius of curvature and being at the same horizontal level, the tracks being laterally offset from each other at respective free ends of said tracks a distance substantially equal to the horizontal distance between the respective travelers on each of said yokes, whereby said tracks cross each other adjacent a point between opposite ends forming an intersection, and switch means at said intersection having one position establishing a clear way through said intersection for one of said tracks and another position establishing a clear way through said intersection for the other of said tracks, whereby said travelers change respective inside and outside positions after passing through said intersection, both said track assembly units having a freely vertically slideable mounting on said frame and being secured against both horizontal and tiltable movement relative to the frame, said track assembly units when engaged by said travelers of each yoke being productive of a stability condition in said yoke and the platform acting therewith when the travelers are passing through said respective track assembly unit.

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