Jan. 7, 1969 R. A. TEXTOR 3,420,332

ELEVATOR FOR QUICK ASSEMBLAGE AND USE IN LIMITED ACCESS ENCLOSURES

Filed July 14, 1967 Sheet 1 of 2

Fig. 1.

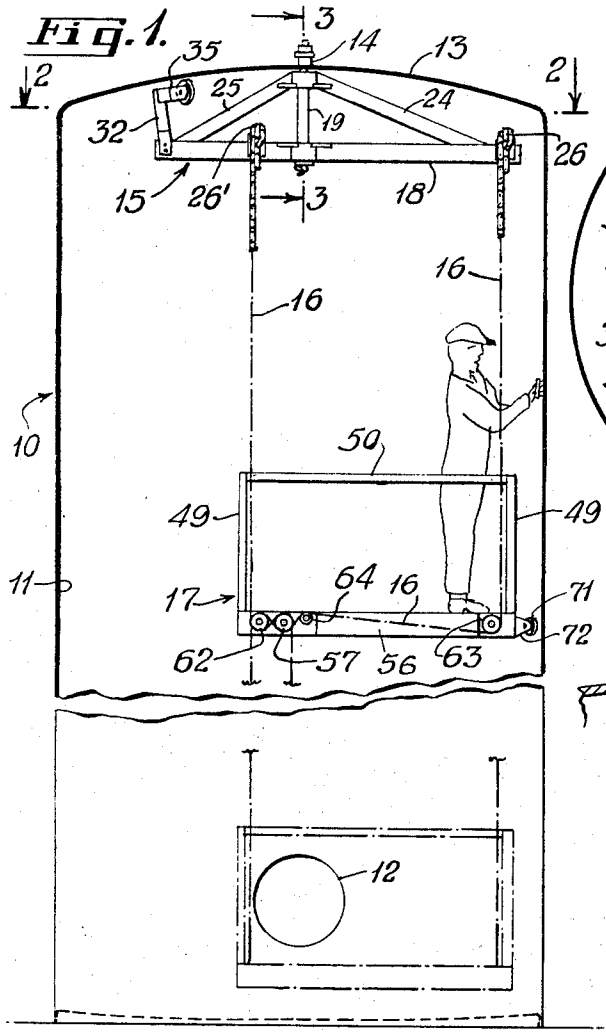


Fig. 2.

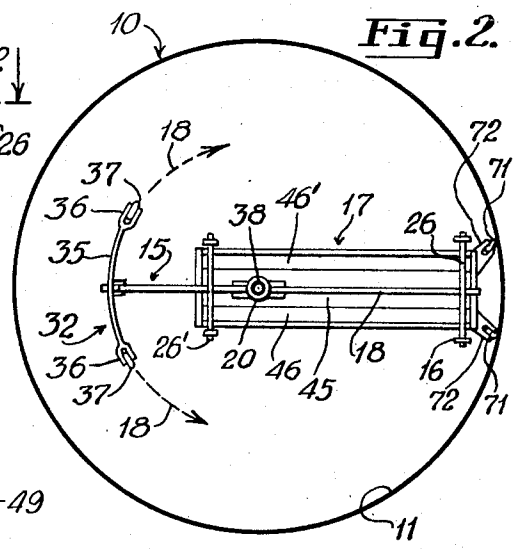


Fig. 3.

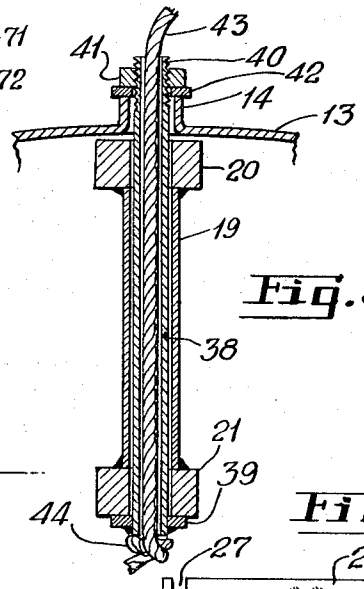


Fig. 5.

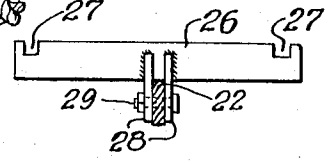
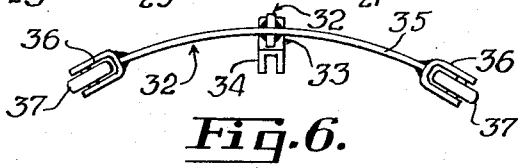


Fig. 4.

Fig. 6.



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Fig. 7.

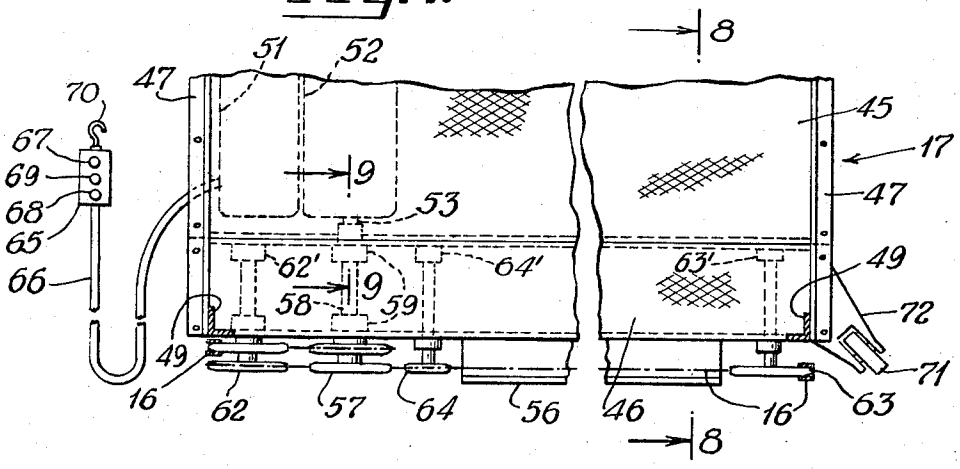


Fig. 8.

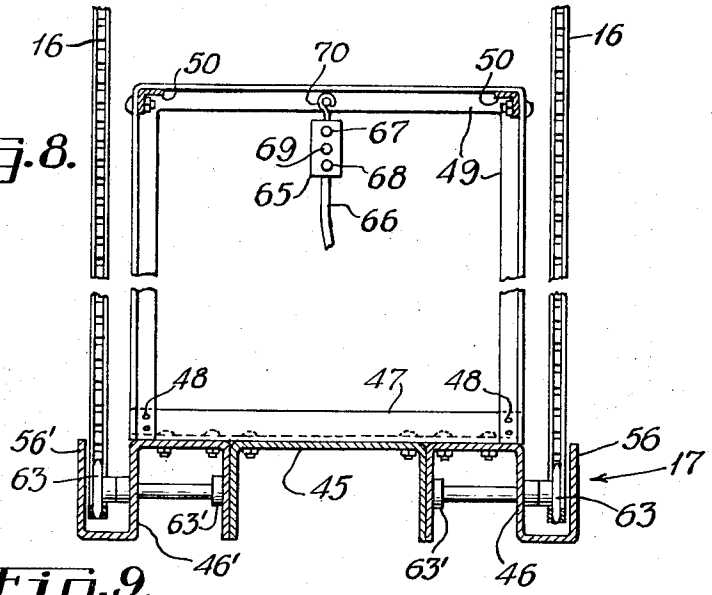
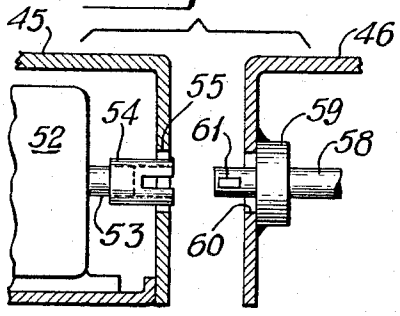


Fig. 9.



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3,420,332

ELEVATOR FOR QUICK ASSEMBLAGE AND USE IN LIMITED ACCESS ENCLOSURES

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Filed July 14, 1967, Ser. No. 653,453
U.S. Cl. 182—128 17 Claims
Int. Cl. E04g 3/10

ABSTRACT OF THE DISCLOSURE

A quickly assembled and disassembled elevator for dairy silos and other limited access enclosures comprising a plurality of detachably coupled parts providing a lift platform with power unit, guide and drive sprockets for four lift support chains, and protective railing means for said platform, a plurality of other detachably coupled parts providing an elongated suspension unit rotatable on a tubular suspension shaft, having means for mounting at the top of an enclosure, spaced transverse chain anchoring members offset in one direction with respect to said suspension shaft and a counterbalance offset in the opposite direction, having roller engagement with the enclosure top when the suspension unit is raised, with chains attached, to the top of the enclosure, and a movable control station for said power unit permitting raising and lowering of the assembled lift platform selectively from the base of the enclosure and from the lift platform.

Background of the invention

In limited access, vertically extended enclosures such as the milk storage tanks or silos used in the dairy industry, it has heretofore been extremely difficult to properly inspect and maintain the interior of such enclosures. Dairy silos, for example, may be 10 to 12 feet in diameter and 30 to 60 feet high and are normally equipped, in a lower side wall, with an access manhole providing at most a 22 to 24 inch opening. Such silos are generally lined with stainless steel, glass, or other highly resistant material, so that these surfaces can generally be effectively cleaned with proper solutions dispensed by mechanical sprayers which can be raised and lowered within the silo through a central access tube or pipe fitting at the top.

It is possible, even with the most resistant construction materials and careful cleaning techniques, for deposits to accumulate which can harbor bacteria or otherwise contaminate milk stored in such silos, and it is important, from time to time, to make full inspections of the silo interior using ultraviolet light and other inspection aids. Heretofore this has been accomplished by erecting scaffolding within the silo from bits and pieces small enough to be passed through the manhole, a procedure which is extremely costly and time consuming.

The invention

The problems above described are overcome in accordance with the present invention by providing an elevator device comprising a suspension unit and a lift platform, each made up of a plurality of easily assembled and disassembled parts, with these parts as disassembled being readily passed through an access manhole having a maximum dimension of 22 to 24 inches. The elevator, which can be completely assembled and ready to operate within a 15 to 20 minute period, provides freedom of movement vertically and circumferentially as desired by the operator so that all inner surfaces of dairy silos and other vertical cylindrical enclosures can be closely examined and reached for cleaning and repair.

The versatility of the new elevator device is provided by the overall combination of elements and the structural details of the multi-component suspension unit and

the multi-component lift platform thereof. The suspension unit comprises a main frame having a bearing portion which receives a tubular suspension shaft with short and long arms projecting in diametrically opposite directions from said bearing portion; a pair of detachable transverse yoke members secured to said frame, one at the protruding end of said long arm and the other at the inner end of said short arm, and each having notched ends for receiving lift supporting chains, and a counterbrace detachably secured at the end of said short arm and extending transversely of said frame, with end rollers adapted for rolling engagement with the top of an enclosure.

The left platform comprises a plurality of platform sections with one carrying a power unit and two others carrying chain guide and drive sprockets with interfitting means on the power unit and drive sprockets to engage the same as the platform sections are secured in juxtaposed position. The platform sections are joined by brace members, coextensive with the assemblage which also provide means for mounting components of a protective railing structure. Control of the power unit is effected from a control station at the end of a long flexible conductor permitting the control to move with the lift platform or to remain, and be operated from, the base of the enclosure. The platform is preferably divided lengthwise to a center section with the power unit and two similar (mirror image) side sections with the side sectons including side bins for storage of the suspension chains when the elevator is disassembled.

The power unit comprises a conventional electric motor with dual starters to permit operation in both directions, and the motor is coupled directly with a gear reducer, the output shafts of which carry the coupling means which interfit with the drive sprockets. Except for this quick coupling feature and the movable control station the details of the power unit can be found in a variety of commercially available equipment, and provide no part of the present invention.

For a more complete understanding of the quickly assemblable elevator and the suspension unit and lift platform thereof, the following description should be considered with reference to the accompanying drawing in which a preferred adaptation of the invention is illustrated with the various parts thereof identified by suitable reference characters in each of the views, and in which:

FIG. 1 is a sectional view through a dairy silo showing the elevator assembled therein.

FIG. 2 is a view looking in the direction of the arrows **2—2** in FIG. 1.

FIG. 3 is a sectional view of the suspension structure substantially on the line **3—3** of FIG. 1.

FIG. 4 is an enlarged side view of the suspension unit as shown in FIG. 1.

FIG. 5 is a side view of a chain hanger substantially on the line **5—5** of FIG. 4.

FIG. 6 is a top view of the counterbrace as viewed in the direction of the arrows **6—6** in FIG. 4.

FIG. 7 is an enlarged partial plan view of the lift platform as seen in FIGS. 1 and 2.

FIG. 8 is a sectional view of the lift platform substantially on the line **8—8** of FIG. 7, and

FIG. 9 is an enlarged exploded view, substantially on the line **9—9** of FIG. 7 illustrating the interengagement of power unit and drive sprockets.

In FIGS. 1 and 2 of the drawing there is shown the outline of a dairy silo **10** having sidewalls **11** with an access manhole **12** at the lower portion thereof, and a top wall **13** with a central tubular extension or pipe fitting **14** (shown in larger detail in FIG. 3). At the top of the silo is a suspension unit **15** connected by chains **16** to a lift platform **17** which moves up and down the chains, and

which together with the suspension unit rotates within the silo as indicated by the arrows **18** in FIG. 2. The components of the suspension unit **15**, which are more fully illustrated in FIGS. 3 to 6, and the components of the lift platform **17** which are more fully illustrated in FIGS. 7 to 9 are all small enough to be passed through the manhole **12** for quick assembly within the silo.

The suspension unit comprises a main frame **18** made up of a vertical shaft **19** terminating in an upper bearing **20** and lower bearing **21**, as clearly shown in FIGS. 3 and 4, from which extend in diametrically opposed positions a long arm **22** and a short arm **23** in alignment with the bearing **21** and angularly disposed members **24** and **25** joining remote ends of said arms with the bearing **20**. These parts are suitably welded together and supplemental stiffening means **26** may join the angular members **24** and **25**.

Detachably secured to the frame **18** are a pair of transverse yoke members **26**, **26'** of similar structure having end notches **27** for receiving the chains **16**, but with the spacing of the notches **27** differing slightly to correspond with the chain sprocket spacing on the platform **17**, as hereinafter described. The yokes **26**, **26'** have perpendicularly disposed and closely spaced flanges **28**, **28'**, the flanges having aligned apertures **29**, **29'** for bolting the yokes to the frame **18** through appropriate apertures **30** and **31** which are located respectively at the free end of the long arm **22** and at the inner end of the short arm **23**. Also secured to the frame **18** at the end of the short arm **23** is a counterbrace **32** comprising an upstanding member **33** having a forked lower end **34** for bolting to the frame **18**, and a transverse arcuate yoke **35** at the upper end thereof having forked ends **36** receiving rollers **37** which bear against the inner surface of the upper wall **13** of an enclosure as seen in FIG. 1.

The frame **18** is carried by a tubular suspension shaft **38** having an outwardly protruding flange **39** at the lower end thereof for engaging the bearing **21** and having a threaded portion **40** protruding substantially beyond the bearing **20** to extend through the tubular extension **14** in the enclosure top **13** as seen in FIG. 3. The threaded portion **40** receives a suitable nut **41** and washer **42** which bears against the upper end of the tubular extension **14** to anchor the suspension unit **15** at the top of the enclosure to permit its free rotation around the suspension shaft **38**. Raising and lowering of the suspension unit **15** with the chains **16** attached thereto is effected by means of a rope or cable **43** passing through the tubular extension **14** and the tubular suspension shaft **38** and knotted or otherwise anchored at the lower end of the suspension shaft as indicated at **44**.

The lift platform **17** is made up of a central channel section **45** and two narrower channel sections **46**, **46'** which are quickly bolted together by transverse angle irons or braces **47**. These braces **47** also support by bolts or other detachable fasteners **48** upstanding U-frames **49** forming end guard rails on the platform which may be joined, if desired, by detachable side rails **50**.

Within the central channel part **45** adjacent to one end thereof is mounted a motor **51** and reduction gear unit **52** with drive shafts **53** at opposed sides thereof terminating in bayonet groove coupling members **54** aligned with apertures **55** in the legs of the channel member **45** as clearly shown in FIG. 9.

The side channel members **46**, **46'** are in every respect mirror images of each other having through a major portion of their length inverted channel portions **56**, **56'** protruding outwardly therefrom and providing chain storage bins. Each of the side channel members carry a dual drive sprocket **57** mounted on a shaft **58** supported in suitable bearings **59** with the shaft protruding through an aperture **60** in the inner channel wall so that laterally protruding lugs **61** on the shaft **58** can engage the bayonet coupling **54** as the side channel member **46** or **46'** is brought into abutting engagement with the central channel member **45**. Thus it will be apparent that a positive drive of the sprockets **57** is assured when the platform sections have been joined by the braces **47**.

In addition to the drive sprockets **57** each of the side sections **46**, **46'** carry a dual idler sprocket **62** in closely spaced relation to the sprocket **57** and a single idler sprocket **63** at the opposed end of the platform section. A smaller single idler sprocket **64** is arranged adjacent to sprocket **57** and between this and sprocket **63** with the axis of the sprocket **64** being above the axis of the other sprockets as seen in FIG. 1. The idler sprockets are carried on shafts mounted in suitable bearings **62'**, **63'** and **64'** within the channel members **46**, **46'**.

The suspension chains **16** secured to the yoke **26** pass under sprockets **63** over sprocket **64**, under the drive sprockets **57** and over sprocket **62**; while the chains secured to yoke **26'** pass under sprockets **62** and over drive sprockets **57** as indicated in FIG. 1 of the drawing. Thus, as viewed in FIG. 1, a clockwise rotation of the drive sprockets **57** causes upward movement of the lift platform **17** on the chains **16**, and a counterclockwise movement of the drive sprockets **57** causes downward movement of the lift platform. The chains should engage teeth of the sprockets **57** through at least 90° of the circumference thereof; and if desired, conventional guards (not shown in the drawing) can be employed to prevent possible accidental displacement of the chains from the drive sprockets.

As earlier mentioned, the motor **51** has dual starters for reverse operation and is preferably provided with a movable control station **65** at the end of a long flexible conductor **66** and having a control button **67** to initiate lifting movement, a control button **68** to initiate lowering movement and a control button **69** for stopping the motor **51**. The control station **65** can thus be operated by a person remaining at the base of the enclosure or can be carried by the lift platform suitably positioned on the guardrail **49** by a hook **70**.

The chains **16** are quite flexible in one plane permitting free rotation around the idler and drive sprockets but are relatively stiff in a plane perpendicular thereto. There is little tendency for the platform **17** to swing from side to side, but there is a tendency for swinging motion toward and from the enclosure unit **11**, particularly when the platform **17** is suspended a substantial distance below the suspension unit **15**. It is desirable, therefore, to provide stabilizing and enclosure protecting rollers **71**, suitably made of rubber or other resilient material at the corners of the platform which are nearest the wall **11**. These rollers can be mounted in various ways but are suitably mounted, at an angle of about 45° to the platform edge, by means of brackets **72** which may be joined to the assemblage by the same bolts or fasteners used to secure the brace **47** to the platform section **46**, **46'**, as shown in FIG. 7 of the drawing.

For best performance in checking swinging movement of the platform the brackets **72** should be of a size to positively engage the rollers **71** with the wall **11** and cause a slight defection of the chains **16** from the vertical or free hanging position. In this way a small component of force holds the platform against the wall **11**, but a person riding the elevator can easily push against the wall **11** to disengage the rollers **71** from the wall **11** when rotary movement of the lift platform **17** within the enclosure is desired.

The procedure in assembling the elevator mechanism within the silo **10** can be briefly described as follows:

The center section **45** and the side sections **46**, **46'** with the chains **16** stored in the bins **56**, **56'** are individually passed through the manhole **12** and secured together by means of the angle iron braces **47**. The suspension unit **15**, either assembled or wholly or partially disassembled, is then passed through the manhole **12** and placed on the lift platform. The extent to which the suspension unit can be preassembled externally of the silo will of course de-

pend upon the size of the manhole. Generally it is possible to attach the yoke **26** and the counterbrace **32** before passing the assemblage through the manhole, leaving only attachment of the yoke **26'** to be completed within the enclosure.

A rope or cable **43** is then lowered from the top of the enclosure and secured to the tubular suspension shaft **38**, as previously described. The chains **16** are then hooked in the appropriate notches **27** of the yokes **26, 26'** and the suspension unit with the chains attached is raised to the top of the enclosure and anchored in the manner previously described. When this operation is completed the end railings **49** and the side railings **50**, if desired, are secured to the lift platform and the elevator is ready for operation.

Assembling the elevator in the manner above described, or disassembling the mechanism by the reverse sequence of steps can readily be accomplished within a period of 15 to 20 minutes. Workmen using the elevator can then quickly reach any inner surface of the enclosure by raising or lowering the lift platform **17** or by manually rotating the suspension unit together with the chains and lift platform within the enclosure. The desired proximity of the workmen to the enclosure walls may vary depending upon the nature of the inspection, cleaning, or other servicing to be accomplished. To this end there are preferably a plurality of apertures **30** and **31** permitting the yokes **26, 26'** to be appropriately positioned longitudinally of the frame **18**. This selective positioning of the yokes **26, 26'** can also serve to accommodate the elevator mechanism for use in silos or enclosures of differing diameter. Thus for example, a particular size frame **18** might be suitable for use in silos having a diameter as small as 10 feet or as large as 12 feet. This varying in the positioning of the load is effectively compensated for by the counterbrace **32** and its rolling engagement with the inner surface of the top wall **13** of the enclosure.

The foregoing description emphasizes the manner in which the suspension unit and lift platform complement each other in providing a versatile, yet quickly assembled and disassembled unit for gaining free access to interior surfaces in vertically extended confined spaces. Particular mention has been made of dairy silos since there is a special need for more effective means for inspecting, cleaning, and maintaining such silos.

It is to be understood, however, that the suspension unit and the lift platform are each considered to have novel structural features, and to have independent utility. By way of illustration, the lift platform can be used in connection with any fixed or movable suspending means which provides appropriate spacing of the lift support chains. Thus the lift platform could be effectively used in connection with any interior or exterior vertical surface, with the novel structure and easy assemblage greatly facilitating the moving of the platform from place to place, and the storage of the platform when not in use.

Similarly, the suspension unit can be used to support any lift device which must maintain a load in a position laterally offset with respect to an available point of suspension. The important basic structure of the suspension unit is the load supporting arm **22** protruding from the mounting shaft or bearing **19** in a direction diametrically opposed to the counterbrace carried by the arm **23**. A lift device could readily be suspended from a single yoke member **26**, or directly from the protruding end of the arm **22**. By way of illustration, a simple block and tackle, with the upper pulley hooked in one of the apertures **30** and the lower pulley attached to a chair sling, would permit a workman to reach all vertical surfaces of a silo or similar structure.

Various changes and modifications in the suspension unit, lift platform, and complete elevator apparatus as herein disclosed may occur to those skilled in the art and to the extent that such changes and modifications are embraced by the appended claims it is to be understood that they constitute part of the present invention.

I claim:

1. A quickly assembled and disassembled elevator for dairy silos and other limited access enclosures comprising a plurality of detachably coupled parts providing a lift platform with power unit, and guide and drive sprockets for lift support chains, a plurality of other detachably coupled parts providing an elongated suspension unit rotatable on a tubular suspension shaft having means for mounting at the top of an enclosure, spaced transverse chain anchoring members offset in one direction with respect to said suspension shaft and a counterbrace offset in the opposite direction having roller engagement with an enclosure top when the suspension unit is raised, with chains attached, to the top of the enclosure, and control means for actuating said power unit to selectively raise and lower the lift platform on said chains.

2. An elevator as defined in claim **1**, wherein additional detachably coupled parts provide a guard railing for said lift platform.

3. An elevator as defined in claim **1**, wherein additional detachably coupled parts provide bearing rollers at one end of the lift platform adapted to bear against the enclosure wall when the lift platform is suspended by said chains.

4. An elevator as defined in claim **1**, wherein additional detachably coupled parts provide bearing rollers at one end of the lift platform adapted to bear against the enclosure wall when the lift platform is suspended by said chains, said rollers being oriented to rotate in the raising and lowering of said lift platform, and the rollers being readily disengageable from the enclosure wall to permit rotation of the suspension unit and lift platform within the enclosure.

5. An elevator as defined in claim **1**, wherein the control means is a movable control station on an elongated flexible conductor permitting the same to be selectively operated from the base of the enclosure and carried by said lift platform.

6. An elevator as defined in claim **1**, wherein means is provided for varying the position of said chain anchoring members longitudinally of said suspension unit.

7. An elevator as defined in claim **1**, wherein the detachably coupled parts of said lift platform include a central channeled member housing said power unit with drive shafts exposed at opposed sides of said channeled member, and two similar, mirror image, side channeled members adapted for support in juxtaposition with said central channel member by transverse connecting braces, said side channel members carrying said guide and drive sprockets, and interfitting means on the shafts of said drive sprockets and drive shafts of said power unit permitting automatic engagement therebetween as the channeled members are moved to juxtaposition.

8. A suspension unit for rotatable mounting at the top of an enclosure, said suspension unit comprising a main frame having a vertical tubular bearing with horizontal long and short arms projecting in diametrically opposed directions from said bearing, a suspension shaft extending through said bearing and having means at the upper end thereof for positioning the same within an enclosure, load supporting means at the free end portion of said long arm, and a counterbrace at the free end portion of said short arm carrying spaced rollers for engagement with the inner surface of the enclosure top.

9. A suspension unit as defined in claim **8** wherein said load supporting means comprises a yoke disposed perpendicularly to said long arm having load positioning means equally spaced from said arm.

10. A suspension unit as defined in claim **8** wherein said load supporting means comprises a yoke disposed perpendicularly to said long arm having load positioning means equally spaced from said arm, and a second yoke

parallel to said first named yoke secured to said frame in close proximity to said bearing.

11. A suspension unit as defined in claim **10**, wherein said suspension shaft, yoke members and counterbrace are separate parts readily attachable and detachable with respect to said main frame.

12. A suspension unit as defined in claim **11**, wherein the detachable mounting of said yoke members includes means for varying the position of said yoke members longitudinally of said frame.

13. A suspension unit as defined in claim **8** wherein said suspension shaft is of tubular structure facilitating the raising and lowering of said suspension unit by strand means passing through said tubular shaft.

14. A lift platform adapted for quick assembly and disassembly comprising a central channeled member carrying a power unit with drive shafts exposed at opposed sides thereof, a pair of similar, mirror images, side channeled members carrying guide and drive sprockets for lift support chains, detachable transverse brace members for securing said side channeled members in juxtaposition to said central channeled member, and interfitting means on the shafts of said drive sprockets and the drive shafts of said power unit permitting automatic engagement therebetween as the channeled members are moved to juxtaposition.

15. A lift platform as defined in claim **14**, wherein said transverse brace members also detachably support a guard rail for said lift platform.

16. A lift platform as defined in claim **14**, wherein said side channeled members include, at the sides thereof remote from said central member, inverted channel portions forming storage bins for said lift support chains.

17. A lift platform as defined in claim **14**, wherein each of said side channeled members have a double guide sprocket at one end thereof, a double drive sprocket closely spaced therefrom, a single guide sprocket at the other end thereof, all with axes in a common plane, and a smaller single idler sprocket between said single guide sprocket and drive sprocket, having its axis upwardly spaced from said common plane, one chain passing under the single drive sprocket, over the idler sprocket, under the drive sprocket and over the double guide sprocket, and another chain passing under the double guide sprocket and over the drive sprocket.

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U.S. Cl. X.R.

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