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King et al.

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[54] **PLATFORM LIFT MECHANISM**

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[52] **U.S. Cl.** **182/141**, 182/63, 182/223

[51] **Int. Cl.** **E04g 1/22**

[58] **Field of Search** ..... 182/63, 141, 148, 69; 254/122, 126, 7 R, 9 R, 9 B, 9 C; 248/421; 108/144

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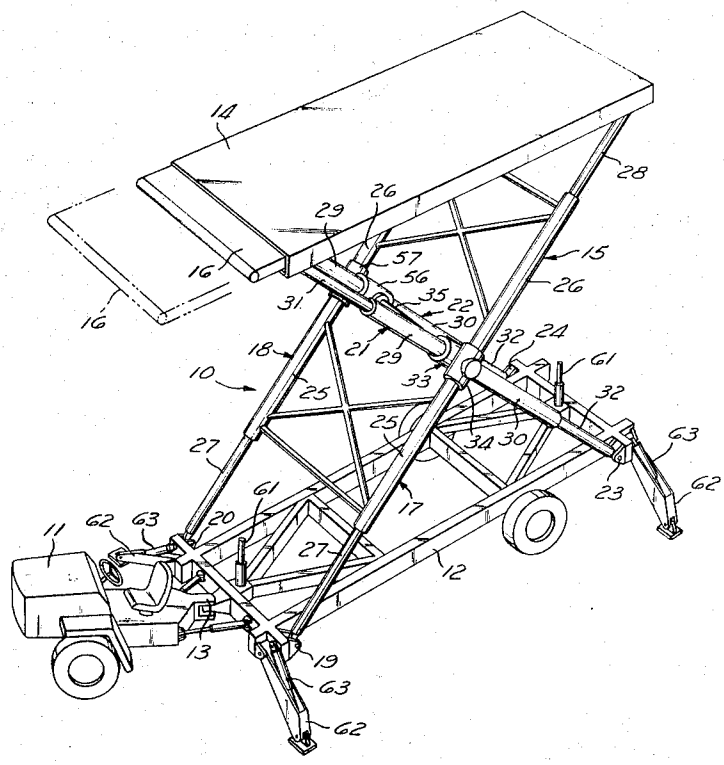
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Primary Examiner—Reinaldo P. Machado
Attorney, Agent, or Firm—McNenny, Farrington, Pearne & Gordon

[57] **ABSTRACT**

A work platform or cargo loader having a mobile base and a vertically translatable platform associated with the base is disclosed. The platform is connected to the base for translation by a linkage which includes a first pair of parallel struts each pivoted at one end to the base and pivoted at the other end to the platform so as to form acute angles with the base and platform. A second pair of parallel struts is provided with each strut pivoted at one end to the base and at the other end to the platform so as to form acute angles with the base and platform. Adjacent, non-parallel struts are pivotally connected to each other, and the pivoted mid-portion of each strut includes oppositely directed, fluid power cylinders each having a ram mounted therein so that the struts are extensible along their axes. Each ram is mechanically interlocked to each other ram to ensure substantially identical values of incremental movement among the rams even if the platform is unequally loaded.

8 Claims, 2 Drawing Figures



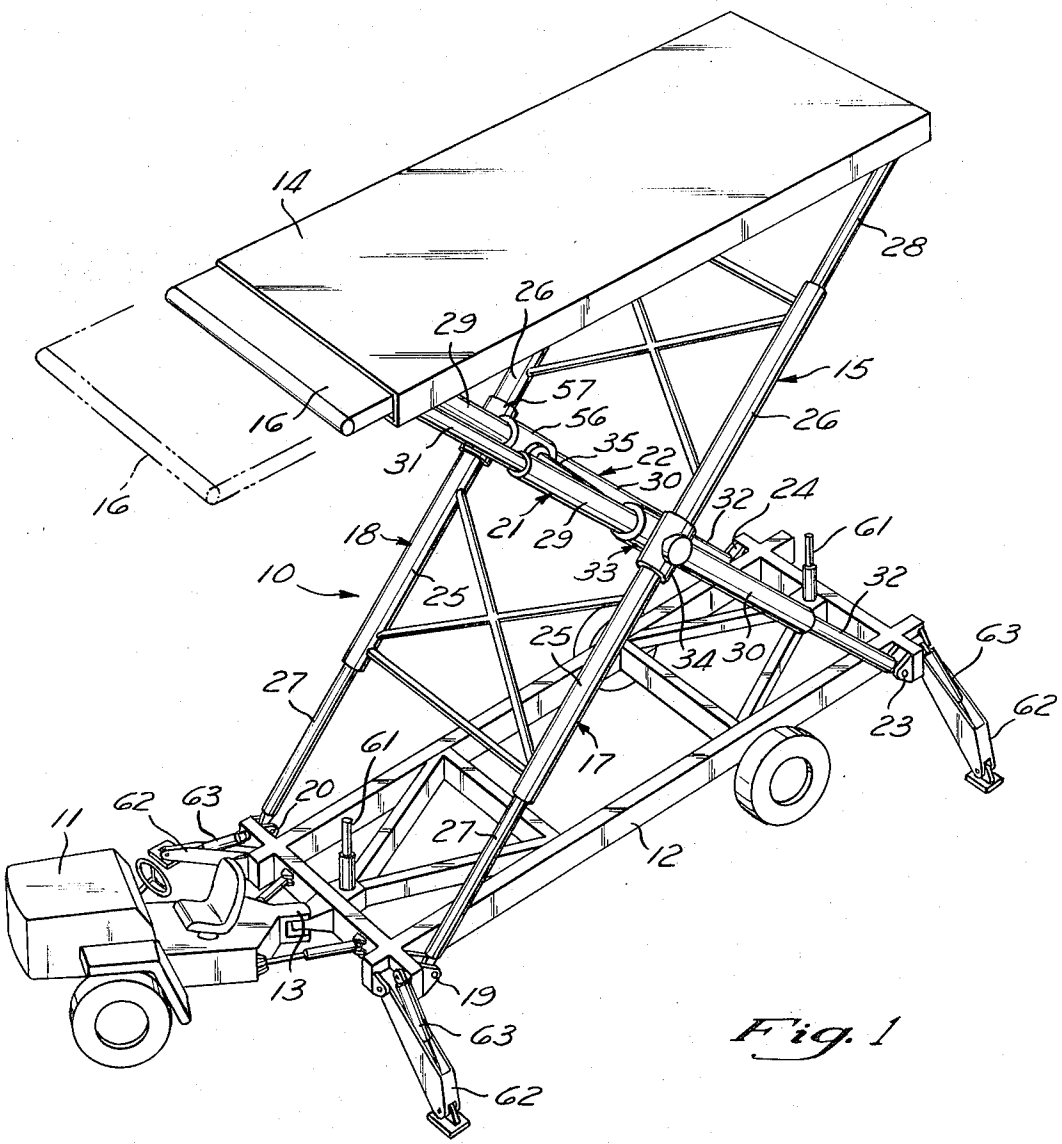

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Fig. 1

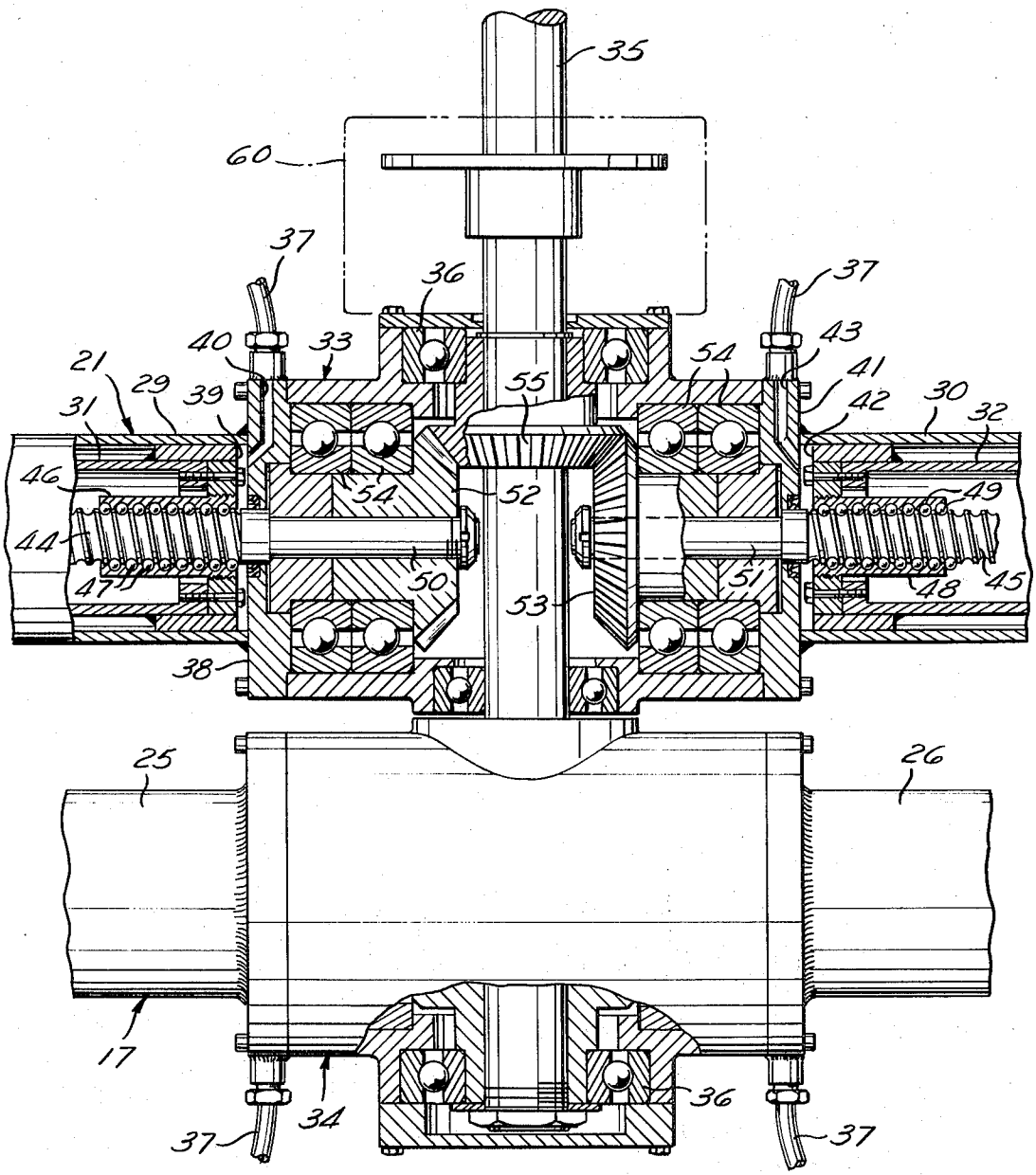

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Fig. 2

PLATFORM LIFT MECHANISM

BACKGROUND OF THE INVENTION

This invention relates to platform lift devices and, more particularly, to lift devices which are particularly suitable for raising workmen and equipment to elevated positions which will enable them to perform maintenance work on aircraft. Typical arrangements for performing such operations include a mobile, wheeled chassis having a bed or platform mounted thereon for vertical translation. Powdered scissor linkages are provided between the chassis and the platform to raise the platform to an elevated position. The scissor linkage generally includes two pairs of elongated, cooperating scissor beams, with the beams of each pair pivotally connected to one another at their central portion and with one beam of each pair pivotally connected at one end to either the platform or the chassis. The other end of each beam is provided with a sliding connection, such as a roller, which rides along a track in the platform or chassis.

Such scissor mechanisms possess at least three inherent disadvantages when employed as lifting mechanisms. One such disadvantage is the fact that the effective supported base area defined by the scissor ends decreases as the platform is raised, resulting in progressively less stability at higher elevations. A second disadvantage is the fact that the beams which comprise such a scissor linkage are subjected to bending loads (since one end of a beam is in rolling contact with either the platform or chassis) and must, therefore, be relatively stiff to support loads. Stability of a platform is particularly important in applications involving the performance of aircraft maintenance, since those work platforms must be capable of being raised to an elevation of about 30 feet and rolled forward about 8 feet relative to the chassis to engage the aircraft. Any structural or geometric instability may cause damage to not only the work platform assembly, but also to the aircraft. A third disadvantage of scissor-lift mechanisms is that the scissor linkages must be relatively long to accomplish high lift operations if done in one stage. Such long linkages necessitate a correspondingly large and cumbersome storage bed or chassis. Scissor-lift mechanisms having more than one stage (i.e., lazy tong-type scissor mechanisms) have shorter linkages but they are more unstable in elevated positions.

SUMMARY OF THE INVENTION

This invention overcomes these and other disadvantages of prior art elevating mechanisms by providing a novel elevating mechanism in which the elevating linkages are subjected to substantially pure compressive forces under normal loading conditions and in which the ends of the linkage members are pivotally connected to the bed and to the platform in order to minimize instability as the platform is raised.

These objectives are accomplished by providing a base and a vertically translatable platform associated with the base. The platform is connected to the base for vertical translation by a linkage which includes a first pair of parallel struts each pivoted at one end to the base and pivoted at the other end to the platform so as to form acute angles with the base and platform. A second pair of parallel struts is provided with each strut provided at one end to the base and at the other end to the platform so as to form acute angles with the base and platform. Adjacent, non-parallel struts are pivotally connected to each other and the pivoted midportion of each strut includes oppositely directed, axially aligned fluid power cylinders each having a ram or piston mounted therein so that the struts are extensible along their axes and are subjected to pure compressive forces rather than bending forces. To ensure the stability of the platform under unequal loading conditions, each ram is mechanically interlocked to each other ram to ensure substantially identical values of incremental movement among the rams even if the platform is unequally loaded.

According to the specific embodiment shown herein, the mechanical interlock comprises a screw member in each piston which is rotated upon axial extension of the piston. Rotation of each screw member is synchronized with rotation of each other screw member by gear means which ensure that incremental movement of each cylinder will correspond to incremental movement of each other cylinder. For purposes of safety, a brake member may be provided to lock the mechanical elements in preselected, elevated positions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a lift mechanism according to the principles of the invention.

FIG. 2 is a fragmentary view, partly in section, showing mechanical interlocks between axially aligned pistons.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, in greater detail, FIG. 1 shows a platform lift mechanism **10** which incorporates the principles of the invention and which is particularly adapted for elevating workmen and equipment to portions of aircraft which require maintenance. The mechanism **10** includes a tractor **11** which is pivotally connected to a wheeled chassis **12** by a hitch **13.** A work platform **14** is mounted on the chassis **12** and may be vertically translated relative thereto by a linkage assembly **15.** Suitable guard rails (not shown) may be provided on the platform **14,** and, to protect the aircraft contact surface from damage. a projecting spring-loaded apron **15** is telescoped in the platform **14.** To facilitate positioning of the platform **14** adjacent the aircraft door, the platform **14** is mounted on a framework (not shown) connected to the linkage **15** and is relatively movable thereto by power means (not shown) to the position illustrated in phantom outline in FIG. **1.** This facilitates positioning without moving the entire assembly into contact with the aircraft.

The linkage assembly **15** includes a first pair of parallel struts **17** and **18** which are respectively pivoted to the chassis **12** by pivot connections **19** and **20.** The other ends of the struts **17** and **18** are pivotally connected to the supporting framework of the platform **14.** A second pair of parallel struts **21** and **22** is provided and each strut is respectively pivoted at one end to the chassis **12** by pivot connections **23** and **24.** The other end of each strut **21** and **22** is pivotally connected to the supporting framework of the work platform **14.** Each strut **17** and **18** comprises a pair of axially aligned and oppositely directed cylinders **25** and **26** which are respectively provided with pistons **27** and **28.** Similarly, each strut **21** and **22** is respectively provided with axially aligned and oppositely directed cylinders **29** and

30, which are respectively provided with cooperating pistons 31 and 32.

Referring now to FIG. 2, it may be seen that the cylinders 29 and 30 of the strut 21 are welded to a gear housing 33 and the cylinders 25 and 26 of the strut 17 are welded to a gear housing 34. The gear housings 33 and 34 are pivotally mounted on a cross shaft 35 by bearings 36. Each piston may be extended relative to each cylinder by fluid pressure admitted through tubing 37. For purposes of simplicity, the operation of the pistons and cylinders which comprise the strut 21 will be described in detail. It should be understood, however, that each other strut is provided with similar mechanisms. Fluid pressure is admitted to a pressure chamber defined by an end wall 38 of the housing 33, the interior of the cylinder 29, and the interior of the piston 31 (which is sealed at its other end by a cap, not shown), by way of a passageway 40 drilled through the end wall 38. The effective force exerted on the piston 31 is, therefore, the pressure times the cross sectional area of the outside diameter of the piston 31. Similarly, fluid pressure is admitted to a pressure chamber defined by an end wall 41 of the housing 33, the interior of the cylinder 30, and the interior of the piston 32 (which is closed at its other end by a cap, not shown), by way of a passageway 43 drilled through the end wall 41. The effective force exerted on the piston 32 is, therefore, the pressure times the cross sectional area of the outside diameter of the piston 31. As fluid is admitted to these pressure chambers, the pistons 31 and 32 are extended. Extension of the pistons 31 and 32 causes opposite rotation of ball screw shafts 44 and 45, which are respectively associated with the pistons 31 and 32. The ball screw shaft 44 is threaded through a sleeve 46 which retains a plurality of balls 47 for threaded rolling contact with the shaft 44. The sleeve 46 is threaded into and retained by a piston head 39. Therefore, it may be seen that extension of the piston 31 rotates the shaft 44 in increments which are directly related to the degree of piston extension.

The shaft 45 is threaded through a sleeve 48 which retains a plurality of balls 49 for threaded rolling contact with the shaft 45. The sleeve 48 is threaded into and retained by a piston head 42. It may be seen, therefore, that extension of the piston 32 causes rotation of the shaft 45 in increments which are directly related to the degree of piston extension. Each shaft 44 and 45 has a projecting end portion 50 and 51, respectively, which extends through the end walls 38 and 41, and on which are mounted miter gears 52 and 53. The miter gears are mounted for rotation relative to the housing by bearings 54 and, as was previously indicated, the gears 52 and 53 are oppositely rotated by the shafts 44 and 45. Cooperating with the miter gears 52 and 53 is a miter gear 55 which is fixed to the cross shaft 35 and which carries the inner race of the bearing 36.

As may be seen in FIG. 1, the other end of the cross shaft 35 is associated with bearing housings 56 and 57, which respectively correspond to the housings 33 and 34, and which include identical ball screw and miter gear arrangements.

The cylinders are manifolded together by means (not shown) as fluid pressure is applied. Therefore, it may be seen that when fluid pressure is admitted to all of the pressure chambers, each piston is extended in equal increments, since each piston is mechanically interlocked to each other piston to ensure substantially identical values of incremental movement among the pistons even if the platform is unevenly loaded, since unequal loads are transmitted through and compensated by the mechanical interlock. As a safety feature, a disk brake 60 (shown schematically in FIG. 2) may be provided on the cross shaft 35 to positively lock the cross shaft, and therefore the pistons, in a preselected, elevated position. The brake will hold the pistons against retraction if fluid pressure in the cylinders should fail.

In order to establish a pre-elevation position in which the struts are not in a dead center condition, vertically extending hydraulic booster cylinders 61 are provided on the chassis 12 to engage the underside of the work platform 14. The cylinders 61 initially raise the platform about 4 inches from the chassis to establish a strut angle of, for example, about 7 degrees to the horizontal prior to further elevation of the work platform.

During lifting and lowering operations, ground-engaging pads 62 are lowered by cylinders 63 so that the wheels of the vehicle are not subjected to heavy static loads.

It should be appreciated that the invention herein disclosed is not limited to the use of fluid power to extend the pistons. Means may be provided to rotate the cross shaft 35 and mechanically induce piston extension and retraction. In such instances, the mechanical interlock itself would comprise the sole power means and would also perform its mechanical interlocking function.

It should also be appreciated that the invention is not limited to the use of an open work platform. The platform may be enclosed so that the assembly may be employed as a cargo loader.

The scope of the invention is, therefore, not limited to the slavish imitation of all of the structural and operative details mentioned above. These have been given merely by way of an example of a presently preferred embodiment of the invention.

What is claimed is:

1. A lift mechanism comprising a base, a support platform above said base, a pair of crossed struts angularly related to each other and pivotally connected at one end to the base and pivotally connected at their other ends to the support platform, each of said struts having components which are linearly movable relative to each other to raise and lower the platform, power means to move said components, said power means including means to mechanically interlock the components of each strut to each other, to mechanically interlock those components to the components of the other strut, and to mechanically ensure substantially identical values of incremental movement among all of said components.

2. A lift mechanism according to claim 1, wherein said means to mechanically interlock the strut components includes first rotatable means connecting the components of one of said struts, and second rotatable means connecting the components of the other strut, shaft means connecting said first and second rotatable means so that said first and second rotatable means are rotatable in equal angular increments as said components move relative to each other.

3. A lift mechanism comprising a base, a support platform above said base, a pair of crossed struts angularly related to each other and pivotally connected at one end to the base and pivotally connected at their other ends to the support platform, each of said struts

having components which are linearly movable relative to each other to raise and lower the platform, each strut having gear means to move said components, means to interlock the components of each strut to the components of each other strut to ensure substantially identical values of incremental movement between or among all of said components.

4. A lift mechanism according to claim **3,** wherein each of said struts includes a central section pivotally connected to the central section of the other strut included in said pair and wherein said pivotally connected strut ends are components linearly movable with respect to said central sections.

5. A lift mechanism according to claim **4,** wherein two pairs of crossed struts are provided.

6. A lift mechanism comprising a base, a support platform above said base, a pair of crossed struts angularly related to each other and pivotally connected at one end to the base and pivotally connected at their other ends to the support platform, each of said struts comprising a centrally located housing and a pair of oppoitely directed cylinders axially extending in opposite directions from said housing, a piston in each cylinder defining a pressure chamber with said cylinder, means to admit fluid pressure to each pressure chamber to move said piston relative to said cylinders, means to mechanically interlock the pistons of each strut to each other, to mechanically interlock those pistons to the pistons of the other strut, and to mechanically ensure substantially identical values of incremental movement among all of said pistons.

7. A lift mechanism according to claim **6,** wherein said means to mechanically interlock said pistons comprises a screw shaft threadedly associated with each piston and being rotatable upon movement of said piston, each shaft extending into said housing and having a miter gear fixed thereto, a cross shaft extending through each housing and having a miter gear in each housing cooperating with the miter gears associated with the end of each screw shaft.

8. A platform lift mechanism according to claim **7,** wherein a brake means is provided on said cross shaft to positively lock said pistons in a predetermined position relative to said cylinders.

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