United States Patent

[11] 3,575,262

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[54] AERIAL LIFT APPARATUS WITH ELEVATOR
3 Claims, 10 Drawing Figs.

[52] U.S. Cl. 182/2, 182/141
[51] Int. Cl. E04g 1/22
[50] Field of Search 182/2, 141

[56] References Cited
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3,132,718	5/1964	Pierce, Jr.	182/2
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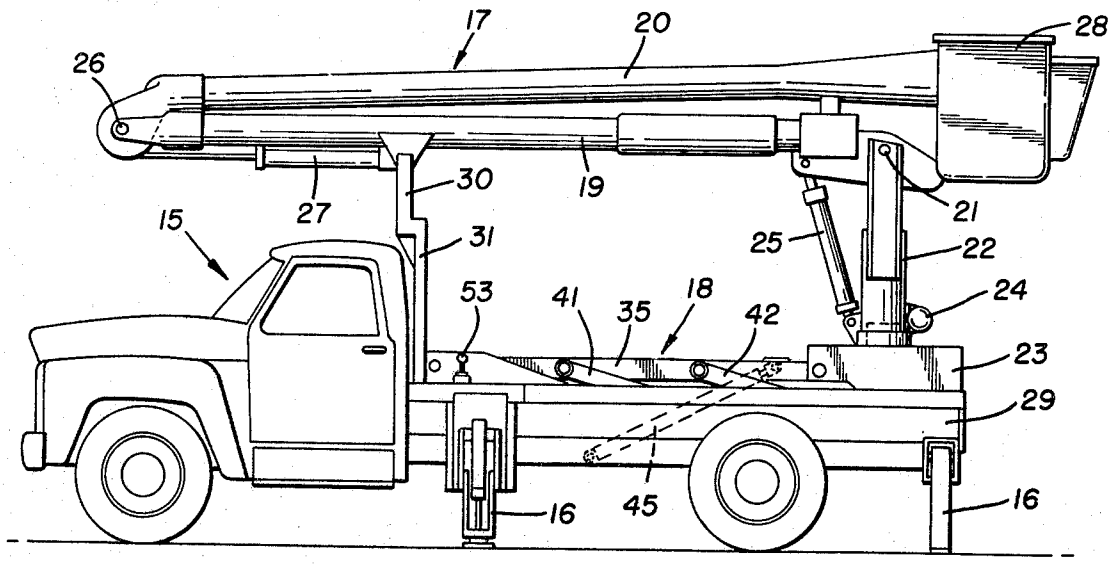
ABSTRACT: An aerial lift apparatus of the type which includes a primary lift boom assembly composed of relatively foldable hinged sections, carried on a vehicle by means of an auxiliary elevator assembly which is supported by parallelogram linkage for vertical swinging movement in a plane extending longitudinally thereof.



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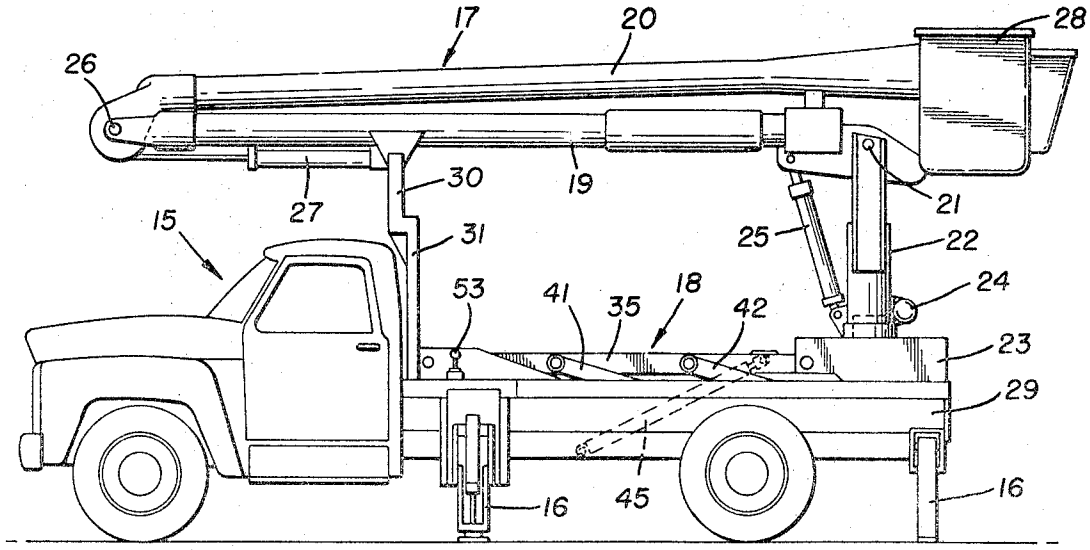

Fig 1

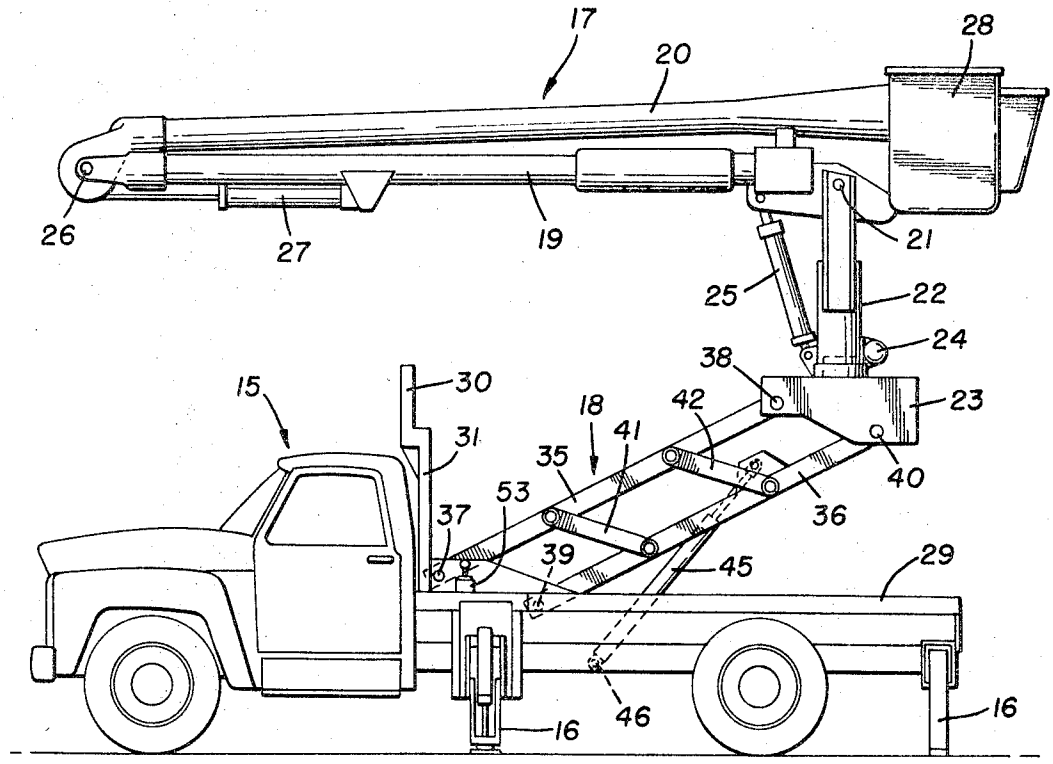

Fig 2

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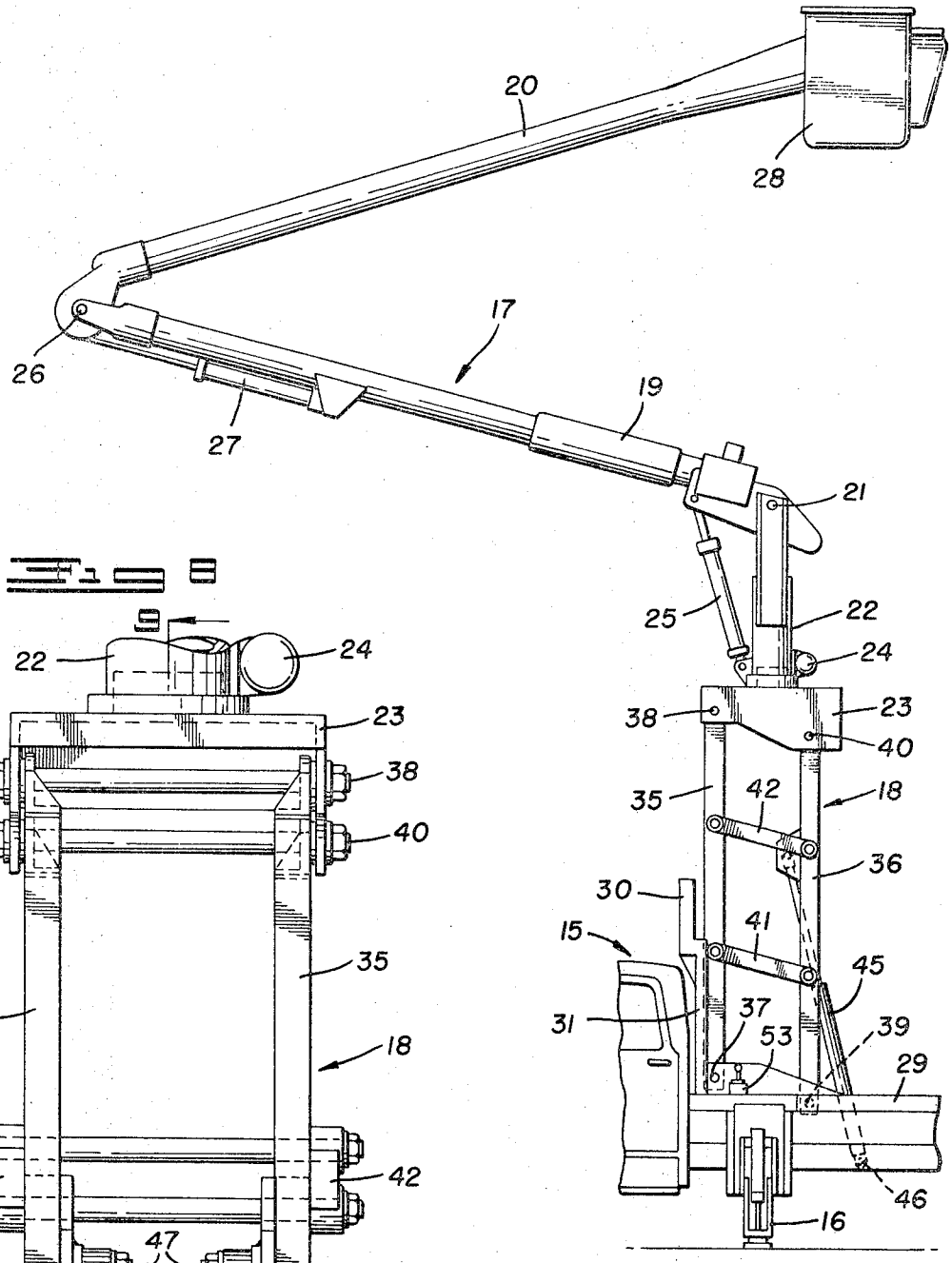

Fig 3

Fig 8

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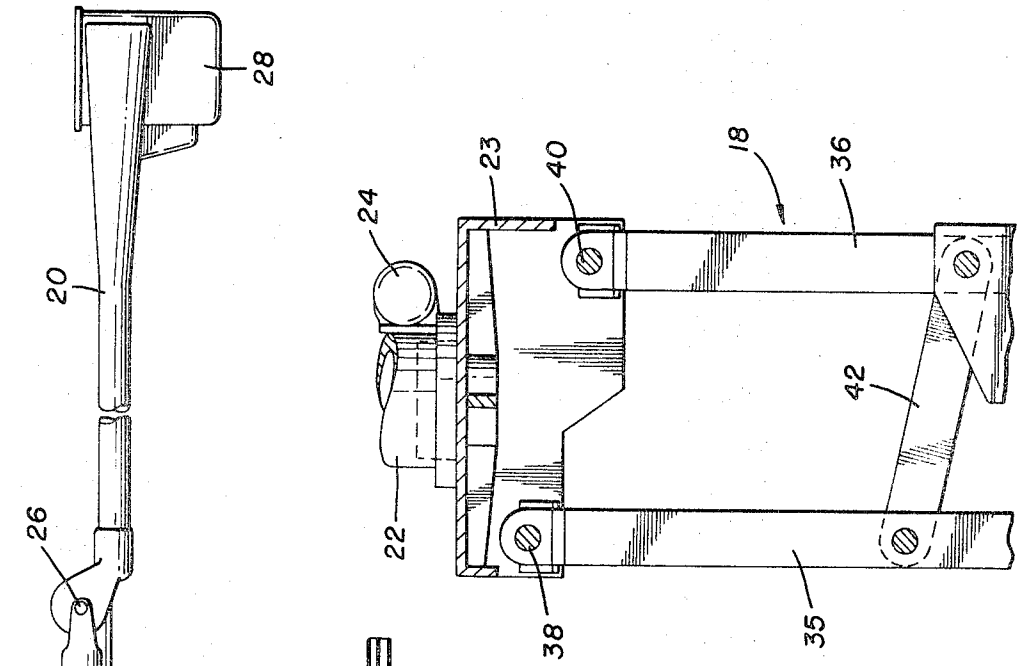

FIG. 3

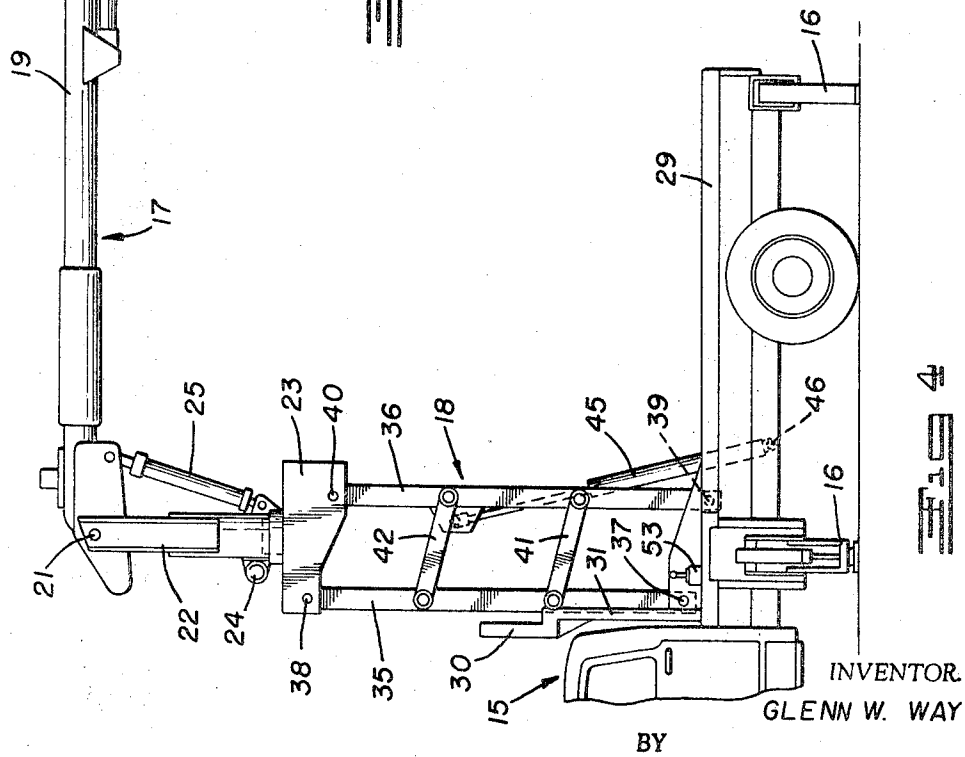

FIG. 4

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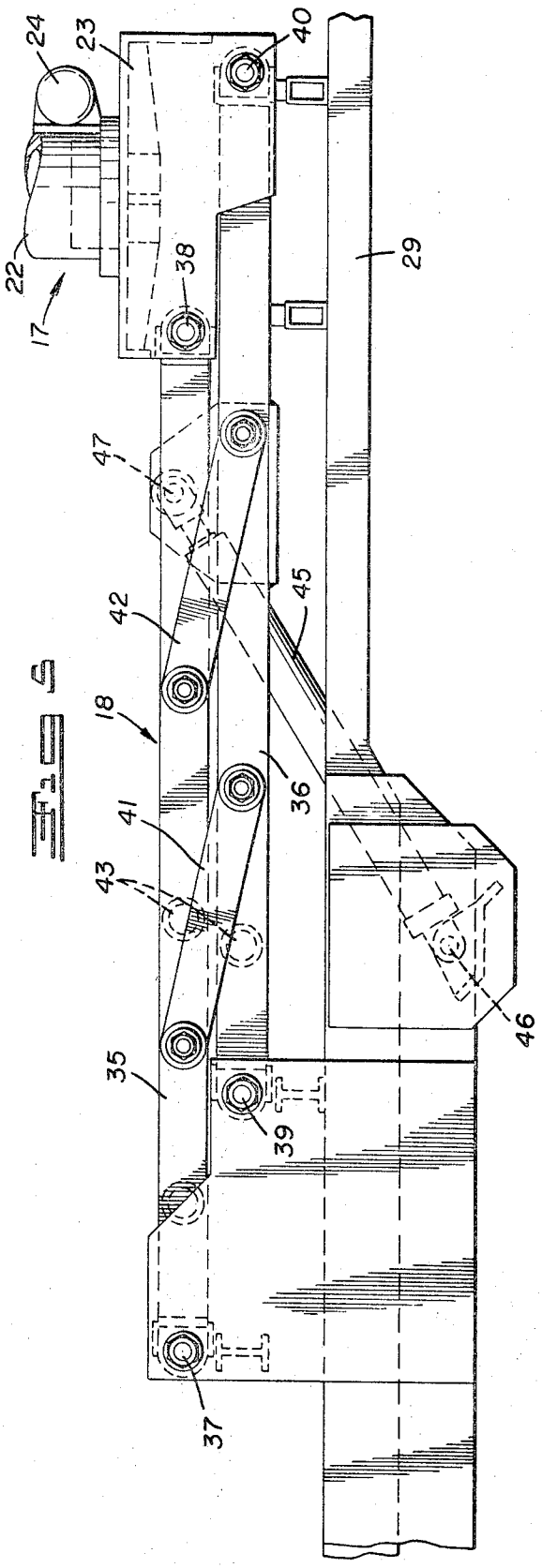

FIG 5

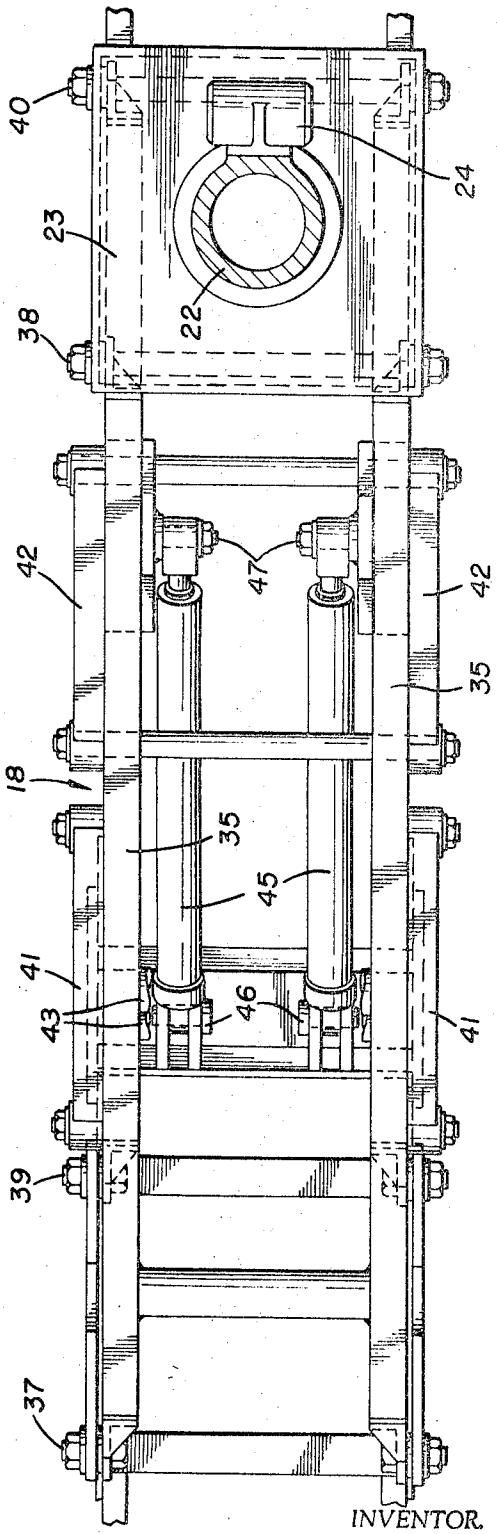

FIG 6

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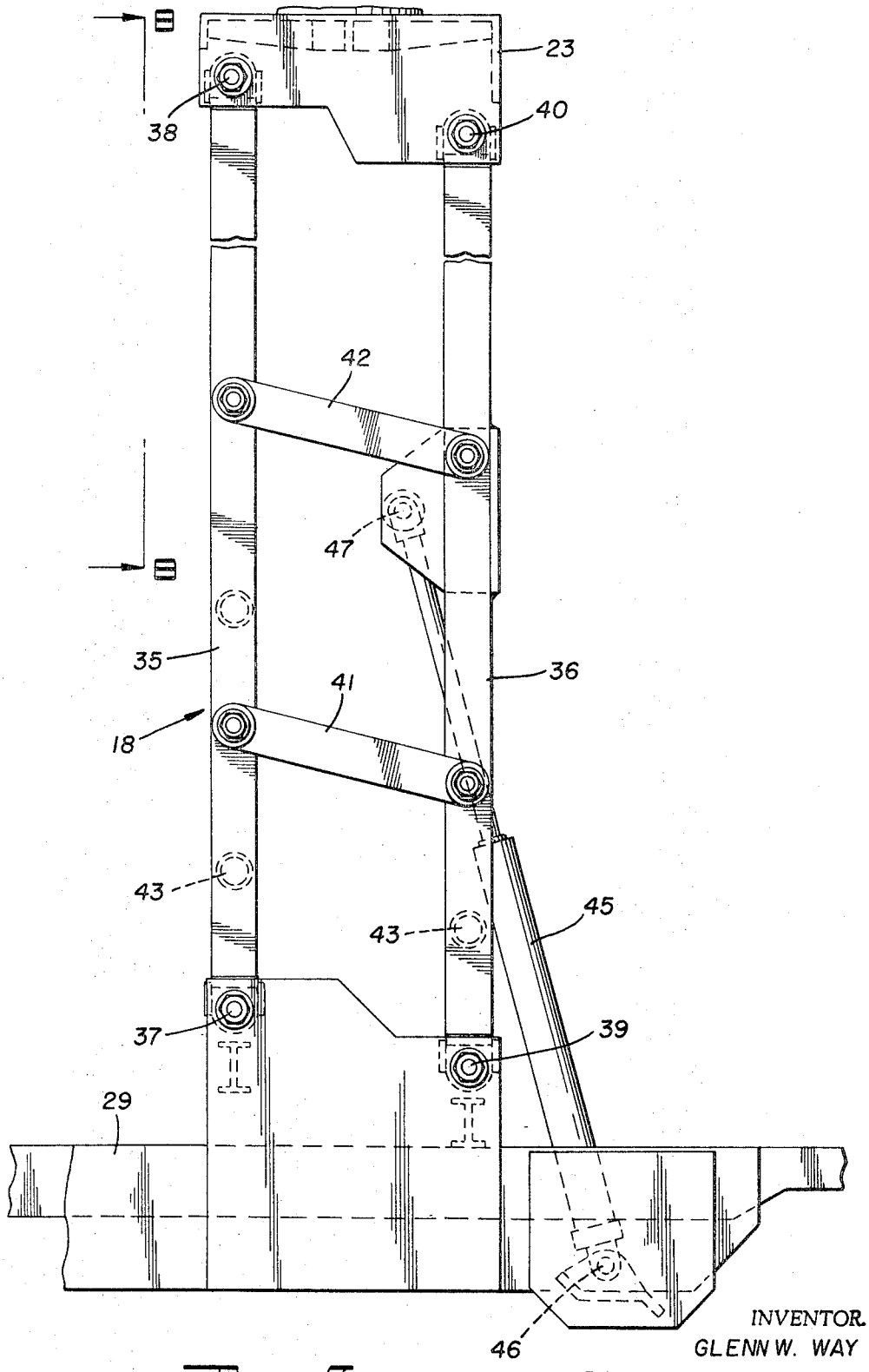

Fig 7

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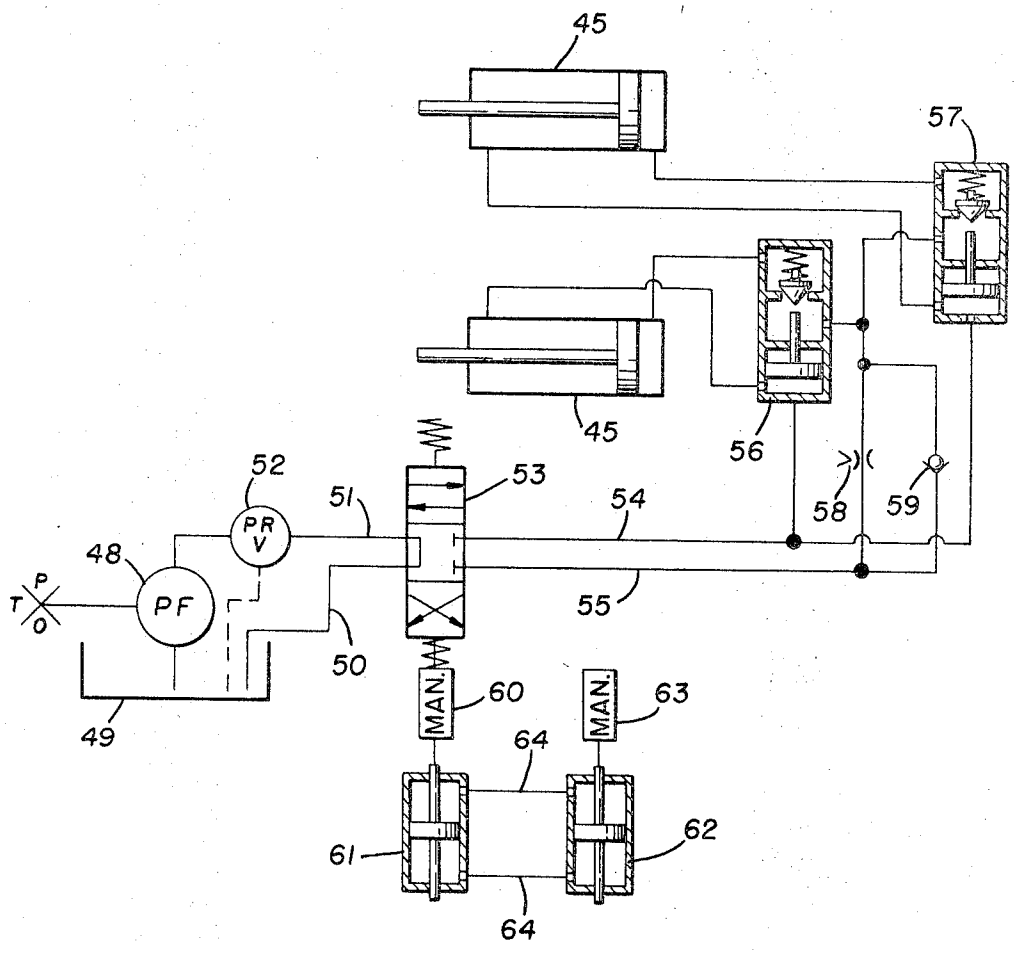

Fig 10

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AERIAL LIFT APPARATUS WITH ELEVATOR

The usual aerial lift apparatus provided in the prior art consists of a boom assembly consisting of several boom sections hinged together for movement from a folded position in association with the vehicle bed to an unfolded and extended position. The assembly may be mounted on the bed by means of a turntable or mast which permits horizontal swinging of the assembly in addition to the necessary vertical swinging permitted by the hinge arrangement. To increase the reach in a vertical direction of the boom assembly, an auxiliary elevator assembly is provided, according to this invention, for supporting the boom assembly which is the primary lift apparatus. This auxiliary elevator is pivoted to the vehicle by parallelogram linkage for swinging movement in a vertical plane extending longitudinally of the vehicle from a substantially horizontal folded-down inoperative position along the bed of the vehicle to a vertical upright operative or load-supporting position. The primary lift apparatus, consisting of the boom assembly, has its inner boom section hinged to the uppermost elevator section for swinging movement in a vertical plane. Thus, the work height possible with the apparatus of this invention is greatly increased.

In the prior art, for example, in U.S. Pat. No. 3,132,718, it has been proposed to provide an elevator for carrying a boom assembly which was supported by parallelogram linkage for swinging raising and lowering movement in a plane transversely of the vehicle. Obviously, swinging the supporting elevator transversely to one side or the other of the vehicle would result in a very unstable vehicle which would tend to tip toward the load side when the boom assembly was swung to one side or the other. Therefore, according to this patent, very complicated apparatus was required to obtain some degree of stability as the elevator was swung transversely vertically and this apparatus consisted of separate sets of relatively extensible, parallelogram linkage articulated with each other and independently controlled by separate rams in the raising and lowering operation. In the load-supporting position of the elevator, those separate sets of linkage were not completely extended but were angularly disposed so that any load would tend to fold them which would detract from stability of the elevator.

According to my invention, the elevator structure does not detract to any harmful extent from the stability of the vehicle and is formed of a simple set of parallelogram linkage composed of links arranged parallel to the longitudinal axis of the vehicle and hinged for movement in a vertical plane about axes extending transversely of the centerline of the vehicle at right angles thereto. Thus, there will be no tendency to tilt the vehicle to either side and any imbalance will be in the direction of the centerline or axis of the vehicle and the length of the vehicle will be sufficient so that this will be no problem. Also, when completely raised, the platform of the elevator will be supported by links of the parallelogram linkage which are upright and normal to the horizontal plane of the bed of the vehicle and serve as upright load-supporting posts. Thus, during actual use in handling the load, the elevator platform will be completely stable and rigid.

In the accompanying drawings, there is shown a preferred embodiment of this invention and in these drawings:

FIG. 1 is a side elevational view of a vehicle-mounted aerial lift apparatus embodying this invention with the primary lift assembly in folded-retracted configuration and the auxiliary lift or elevator assembly in its folded-down, horizontal inoperative position longitudinally of the vehicle bed.

FIG. 2 is a side elevational view of the apparatus of FIG. 1 with the auxiliary elevator partially raised toward load-supporting position.

FIG. 3 is a fragmentary side elevational view of the apparatus of FIG. 1 with the auxiliary elevator fully raised to a vertical upright load-supporting position and the primary lift assembly partially extended.

FIG. 4 is a fragmentary side elevational view of the apparatus of FIG. 1 with the auxiliary elevator in its fully raised upright load-supporting position and the primary lift assembly fully extended in a horizontal position.

FIG. 5 is an enlarged scale, side elevational view of the auxiliary elevator in its folded-down, horizontal inoperative position.

FIG. 6 is a top plan view of the auxiliary elevator as shown in FIG. 5.

FIG. 7 is an enlarged scale, side elevational view of the auxiliary elevator fully raised to a vertical load-supporting position.

FIG. 8 is a fragmentary side elevational view taken along line 8–8 of FIG. 7.

FIG. 9 is a fragmentary sectional view of the auxiliary elevator taken along line 9–9 of FIG. 8.

FIG. 10 is a schematic diagram of the fluid control system and actuating mechanism for the auxiliary elevator.

With reference to the drawings, there is indicated in FIGS. 1 to 4 of the drawings a suitable truck 15 which is provided for carrying the aerial lift apparatus and this truck may be provided with the usual outrider jacks 16 for stability. The aerial lift apparatus, as previously indicated, includes the primary lift apparatus or boom assembly 17 and the auxiliary lift assembly or elevator 18, the latter being provided according to the present invention in combination with the former.

The boom assembly 17 may be any of the presently manufactured assemblies consisting of two or more boom sections articulated together. In the example shown, there are two sections shown, a lower or inner section 19 and an upper or outer section 20. The lower section 19 is shown hinged for vertical swinging movement at 21 to the upper end of a short mast section 22 which is mounted by the usual turntable on a flat support plate 23 which is carried by the elevator 18 in a manner to be explained. The turntable is of the usual type and may be controlled in the usual way by a hydraulic drive motor 24. The boom section 19 may be swung about the pivot 21 by the usual hydraulic ram 25 pivotally connected between it and the mast section 22. The inner end of the outer boom section 20 is shown pivoted to the outer end of the section 19 at 26 for relative vertical swinging to fold and unfold it relative to the lower section, this action being controlled in the usual manner by a ram and cable arrangement 27. The outer end of the section 20 may carry a bucket 28 in the usual manner in which the workman can be located. When the boom sections 19 and 20 are folded together in horizontal position above the bed 29 of the truck, as shown in FIG. 1, the outer end of the section 19 may rest in a saddle 30 provided on the upper end of an upstanding support 31 extending upwardly from the horizontal truck bed.

The platform 23, as previously indicated, carries the primary lift or boom assembly 17. This platform is carried by the elevator assembly 18 of this invention which is in the form of parallelogram linkage hinged to the truck bed 29 for vertical swinging movement in a plane extending longitudinally of the vehicle between a lowered or folded-down position, where it is collapsed along the truck bed 29, as shown in FIGS. 1, 5 and 6, to a raised upright position, where it is also expanded, as shown in FIGS. 3, 4, 7, 8, and 9.

The parallelogram linkage of the elevator 18 is made as one set of four links, all of which are pivoted at their lower ends to the vehicle bed 29. The set comprises a pair of forward support beams or posts 35 and a pair of rearward support beams or posts 36 which may be in the form of square tubular members, the members of each pair being rigidly connected together as a unit by the cross braces 43. The members of each pair are disposed in vertical planes on opposite sides of the longitudinal centerline of the vehicle in parallel relationship thereto. The forward posts 35 are pivoted at their inner or forward ends to the bed 29 at a horizontal transverse forward pivot axis 37 and at their outer or rearward ends to the forward edge of the platform 23 at a horizontal transverse rearward pivot axis 38. Similarly, the rearward posts 36 are pivoted to the bed at a pivot axis 39, rearward of and parallel to the axis 37, and to the rearward edge of the platform 23 at

the pivot axis **40** which is rearward of and parallel to the pivot axis **38**. The pairs of posts **35** and **36** are further connected together by the two pairs of inner and outer parallel links **41** and **42** and it will be understood that the entire structure will function as a set of parallelogram linkage with the pairs of posts swinging simultaneously and to the same extent. It will be noted that the platform comprises a flat upper plate and depending flange portions to which the supporting posts are pivoted.

The elevator **18** is raised and lowered by means of a pair of simultaneously controlled double-acting hydraulic rams **45**. The rams are disposed at opposite sides of the elevator and each has an inner end pivoted to the truck chassis at a horizontal transverse pivot axis **46** and an outer end pivoted to one of the beams **36** at a horizontal transverse pivot axis **47** adjacent the support plate **23**. By controlling the fluid to these rams, the elevator may be raised from a rearward folded-down collapsed inoperative position along the truck bed **29** (FIG. **1**) to a forward upright expanded operative or load-supporting position (FIG. **4**) perpendicular to the bed of the truck.

The hydraulic control circuit for the rams **45** may be of the type shown schematically in FIG. **10**, which is connected to a suitable pressurized, hydraulic fluid source such as a fixed-displacement hydraulic pump **48**. The pump **48** is mechanically coupled to a prime mover (not shown) such as the vehicle engine through a power takeoff connection. A hydraulic fluid reservoir **49** connects with the pump **48** and a return conduit **50** of the hydraulic circuit while a pressure conduit **51** of the circuit connects with a pump outlet port through a pressure relief valve **52**. A four-way, spring-centered control valve **53** connects the pressure and return conduits **51** and **50** in the centered position while blocking the ports connected with respective distribution conduits **54** and **55** leading to the rod and head ends, respectively, of the hydraulic rams **45**. Interposed in the distribution conduits **54** and **55** to each hydraulic ram **45** as a safety factor are respective fluid-locking valves **56** and **57**. Each fluid-locking valve **56** and **57** is placed in close proximity to the head end of the respective ram to minimize conduit length therebetween and, while permitting free fluid flow into the head end of the associated ram, only permits outflow from the head end when fluid under pressure is being supplied to the rod end. A restrictor valve **58** and a check valve **59** are connected in the conduit **55** to permit free fluid flow to the head end while restricting fluid flow from the head end thus limiting the rate of lowering of the elevator assembly **18** to a relatively low value. The control valve **53** is mounted on the truck bed **29** with the other boom controls (not shown) and is provided with both a manual and a servoactuator, **60,61**. A servocontrol **62** provided with a manual actuator **63** is mounted on the bucket **28** and interconnects with the servoactuator **61** by suitable fluid conduits **64**. Thus, the elevator assembly **18** may be controlled from either the ground or the bucket in effecting either raising or lowering.

Assuming the elevator **18** is in the position shown in FIG. **1**, the rams **45** will be actuated to raise the elevator platform **23**. As it raises, as indicated in FIG. **2**, it will move vertically upwardly but will always be in a horizontal plane. The linkage will expand so that by the time the platform **23** reaches its highest position, as shown in FIG. **4**, the linkage will be completely expanded and have the four beams or posts at the four corners of the platform **23** upright and normal to the vehicle bed **29** so as to adequately support the platform in a level horizontal position at a level much higher than the truck bed **29** and with complete stability. At this time, the boom assembly may be unfolded and swung around as desired and as indicated in FIGS. **3** and **4**. The elevator **18** can be readily lowered to its folded-down collapsed position along the truck bed by properly controlling the rams **45**. Even during movement of the platform **23** between horizontal lowered position and horizontal raised position and vice versa, any imbalance occurring during the swinging movement of the parallelogram linkage will be adequately resisted by the length of the vehicle since the swinging movement of the links is in vertical planes at opposite sides of the vehicle axis, parallel thereto, and normal to the horizontal plane of the bed of the vehicle. The boom assembly **17** will ordinarily be retracted and folded before the elevator is lowered. Also, it will be understood that the boom assembly may be folded and unfolded without actuating the elevator.

It will be apparent that this invention provides a simple, rugged and stable elevator structure when raised to greatly increase the possible work level of the lift apparatus. When not in use, the elevator will be folded down or stowed without substantially increasing the usual stowed height of the apparatus.

I claim:

1. An aerial lift apparatus mounted on a vehicle comprising a boom assembly composed of articulated boom sections and including an inner boom section, an elevator mounted on the vehicle and movable between a lowered position and a raised position, and means for pivotally supporting said inner boom section on said elevator; said elevator comprising a platform to which said inner boom section is pivoted, a set of parallelogram linkage pivoted to said vehicle and to said platform and comprising a plurality of links pivoted to the vehicle and to the platform about pivot axes extending transversely of the vehicle for swinging movement in vertical planes parallel to the longitudinal axis of the vehicle so that vertical swinging of the links will move the platform vertically in the direction of the longitudinal axis of the vehicle but will maintain said platform horizontal, said linkage including a pair of forward links and a pair of rearward links with said pairs pivoted to said vehicle in longitudinally spaced relationship, with the links of each forward and rearward pair of links equally spaced on opposite sides of the longitudinal axis of said vehicle in planes parallel thereto, and actuating means connected between the vehicle and said links for swinging each of them in planes parallel to said longitudinal axis between a lowered, horizontal position and a raised, vertically upright position and stabilizing said links in said upright position, said actuating means including a pair of hydraulic rams with each of the rams being equally spaced on opposite sides of the vehicle axis and connected, respectively, to the rearward links, and means for simultaneously actuating both of said rams.

2. Apparatus according to claim **1** in which the forward and rearward parallelogram links at each side are connected together by additional pivoted links.

3. Apparatus according to claim **2** in which the two links of each of the forward and rearward pairs are rigidly connected together by crossbracing.