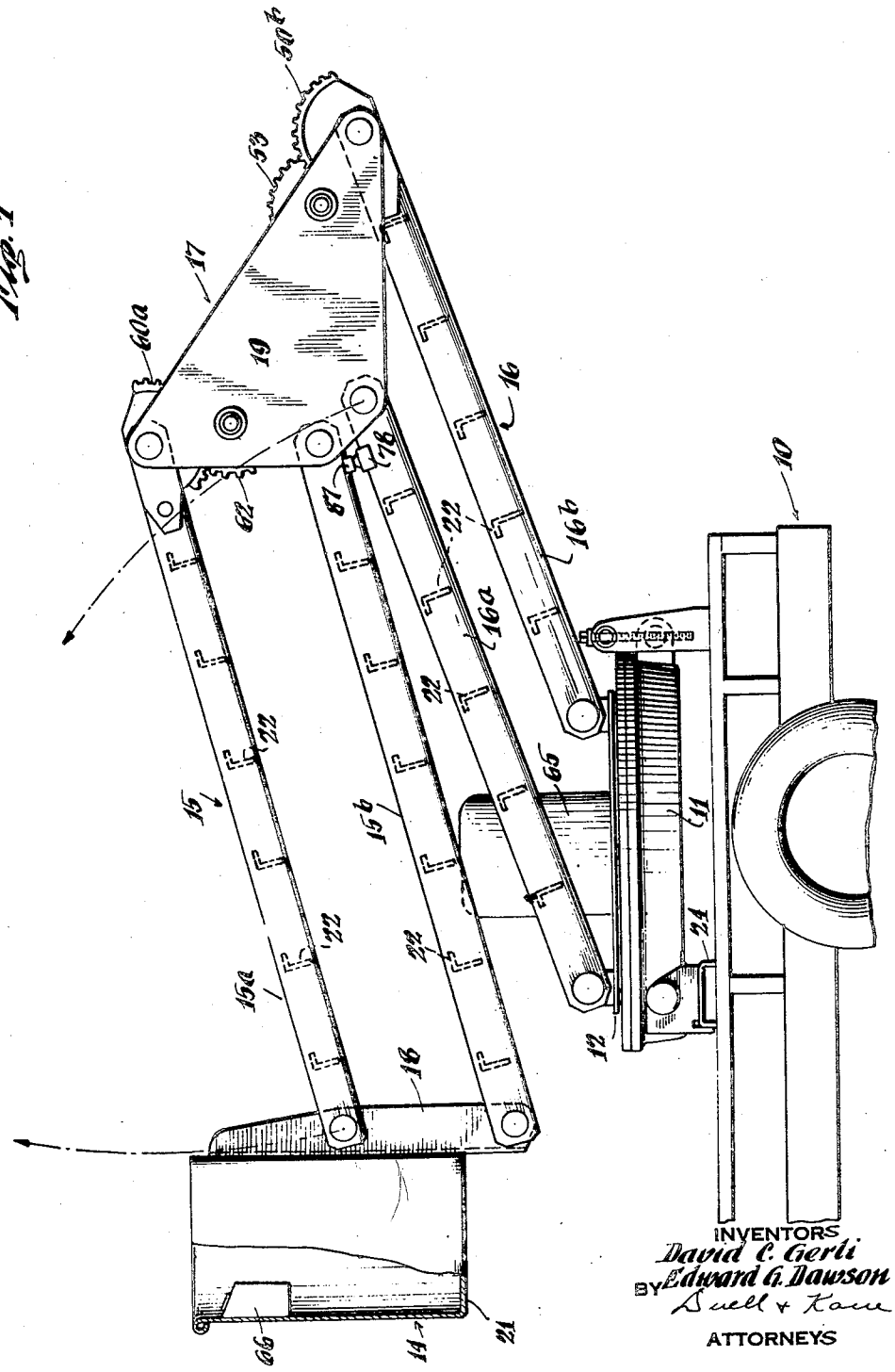
March 14, 1950 D. C. GERLI ET AL 2,500,815

FLYING STAGE

Filed March 10, 1947 4 Sheets-Sheet 1



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Fig. 2

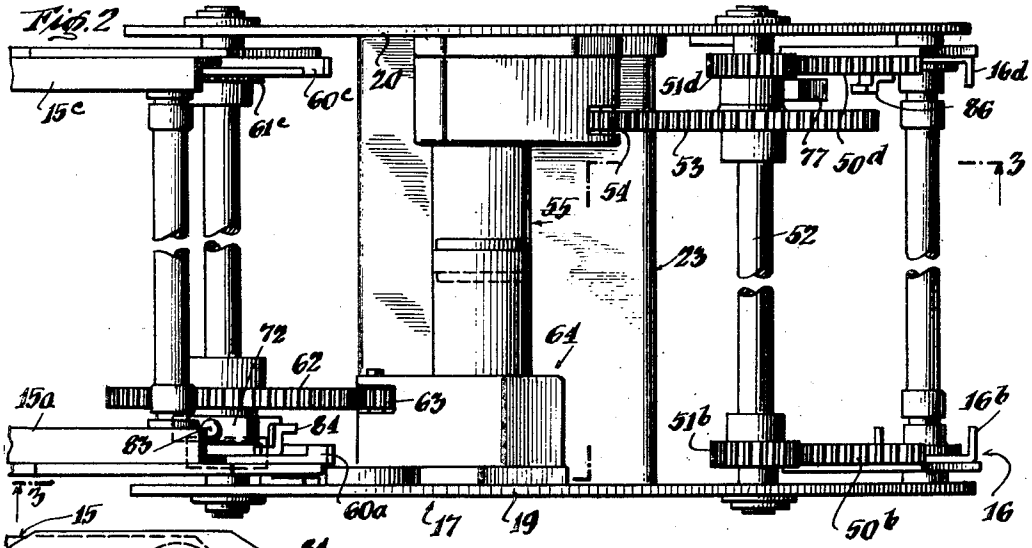
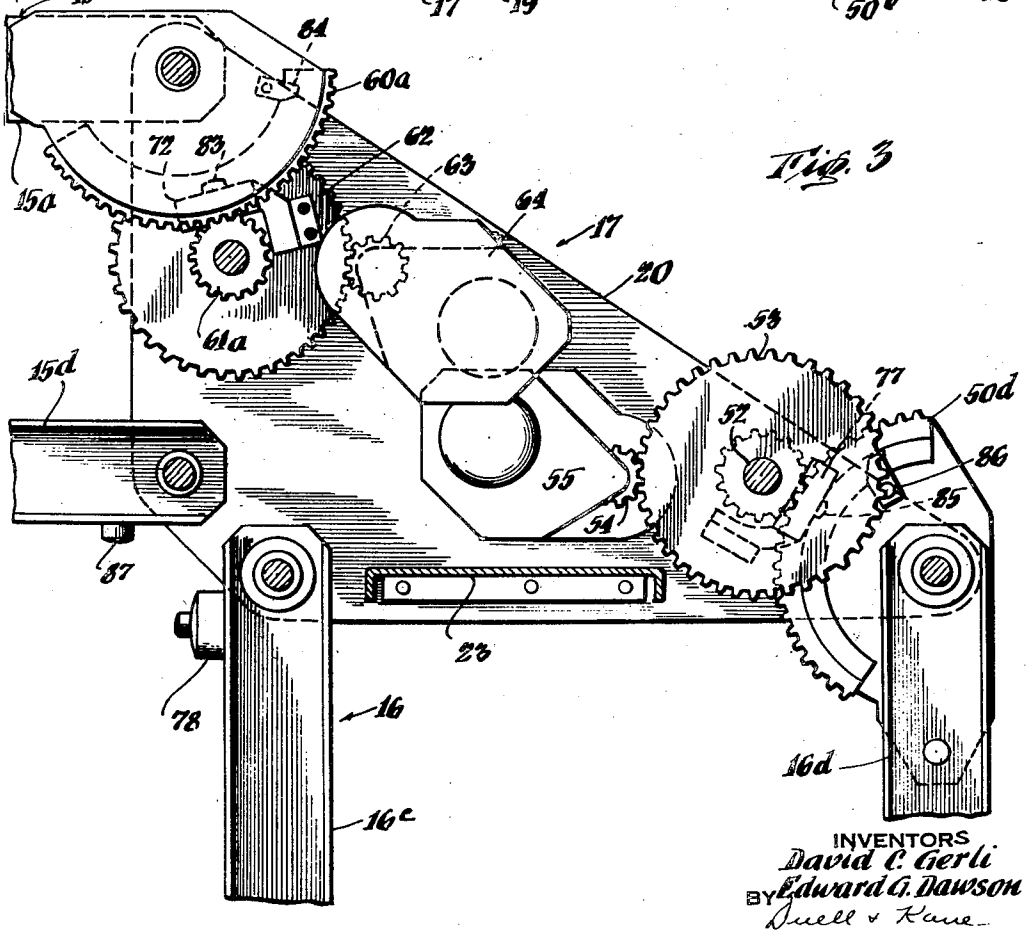


Fig. 3



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Fig. 4

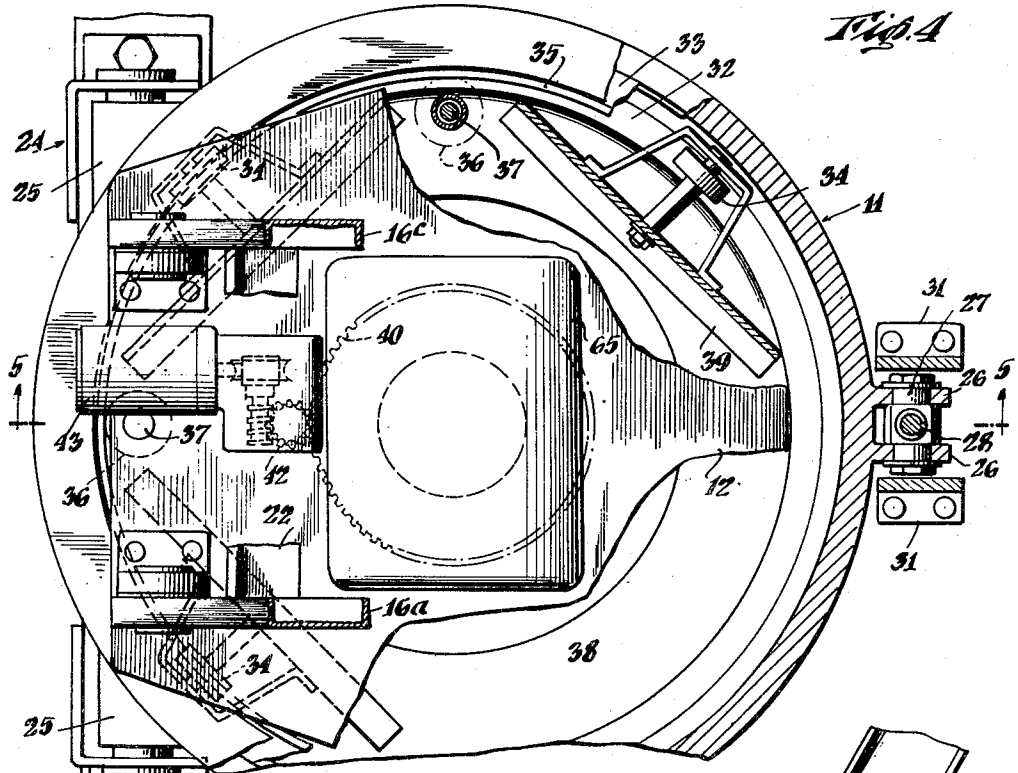
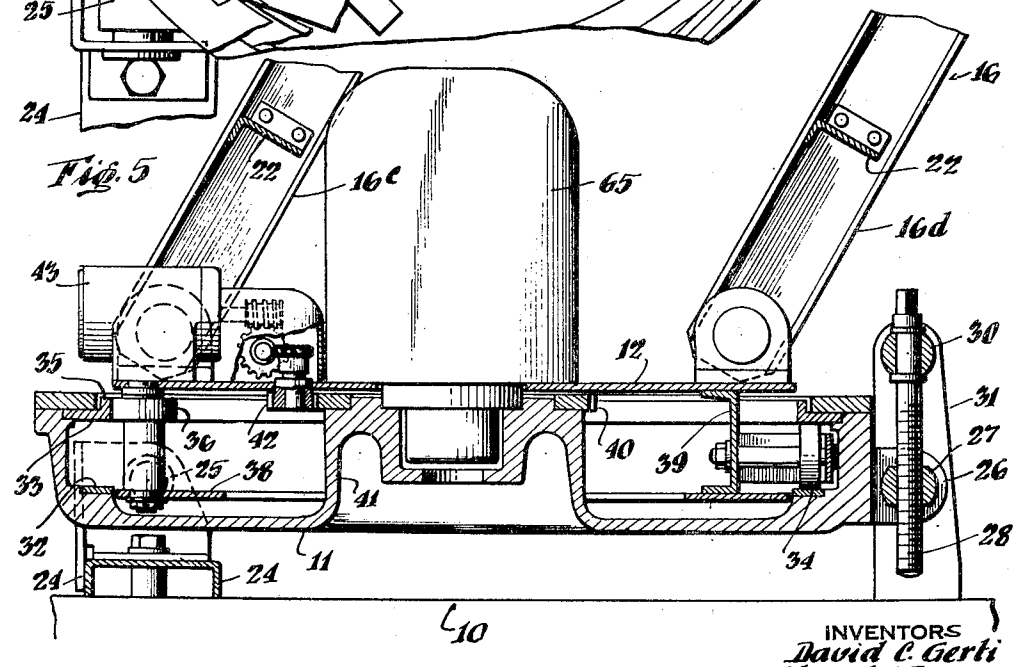


Fig. 5



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Fig. 6

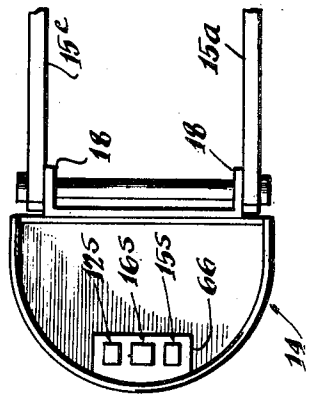
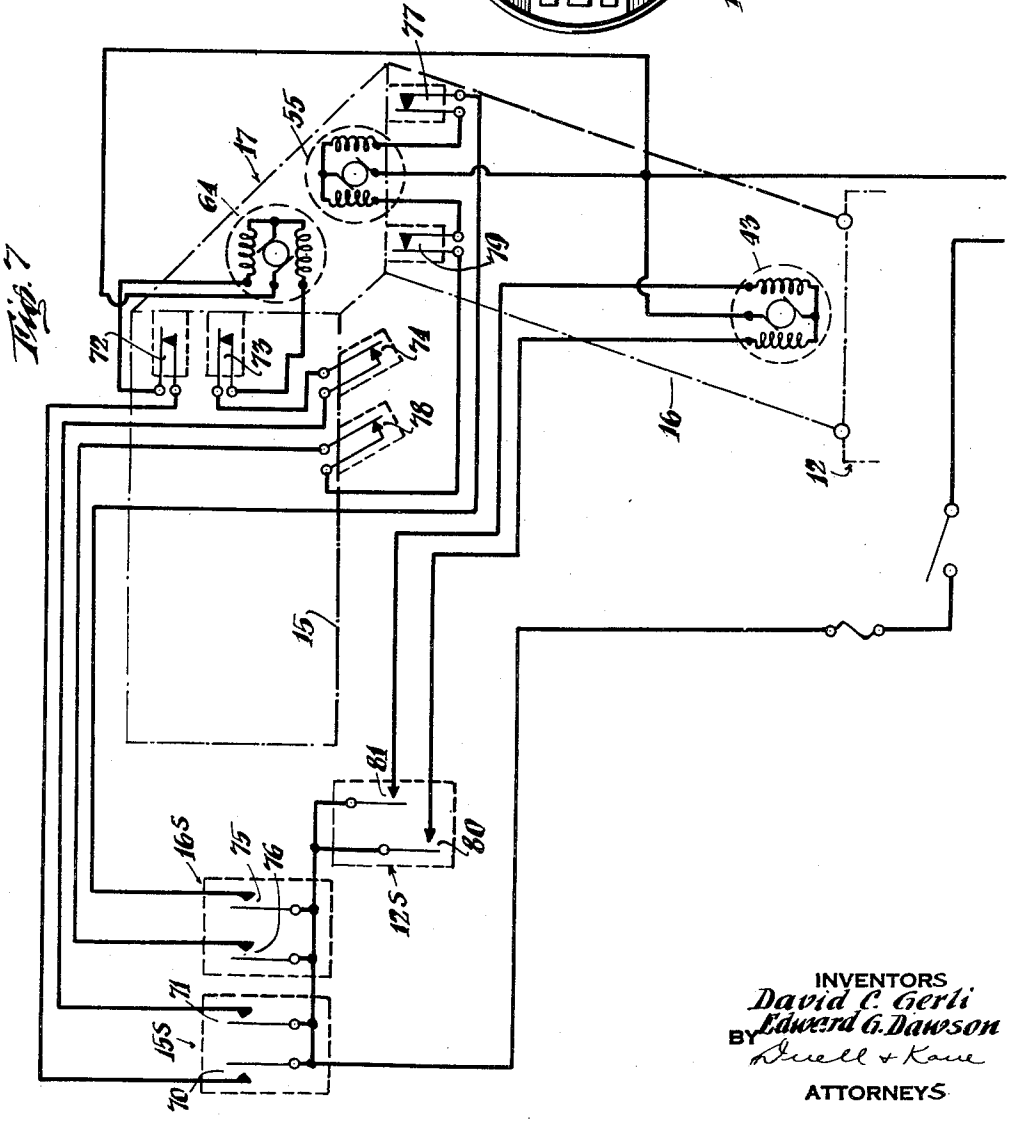


Fig. 7



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UNITED STATES PATENT OFFICE

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FLYING STAGE

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Application March 10, 1947, Serial No. 733,698

10 Claims. (Cl. 304—29)

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This invention relates to an improved structure in which a platform or stage is supported by a compound boom so arranged that the platform may be raised or lowered, or moved forwardly or rearwardly, without deviation from a horizontal plane.

It is an object of the invention to provide apparatus embodying a platform capable of carrying an operator and/or other useful load, an articulated parallel-linkage system for supporting said platform, and means for automatically extending or retracting the linkage system to raise, lower or extend the platform to a desired position.

It is another object of the invention to provide apparatus as aforesaid, wherein the motor drive means for the linkage systems may be manually controlled by an operator stationed on the work platform or at ground level, limit control means being provided for automatically stopping the motor drive within safe limits of rotation of the linkages.

It is another object of the invention to provide a mobile unit including an articulated parallelogram linkage mounted on a mechanically rotatable turntable, said linkage carrying a work platform, and the entire unit being mounted on a truck or trailer for mobility.

The invention is capable of many uses in which it is necessary to position a platform at various vertical elevations and lateral or horizontal positions. For example, the unit may be stationed in an orchard, between two rows of trees, and a picker will be able to position his platform at the various elevations and horizontal displacements necessary to get the fruit at the top, bottom and adjacent side of the trees of each row.

Other contemplated uses are in connection with building maintenance or repair, wherein high, long walls are to be painted or inspected. The workman may place his platform at any location, vertically or horizontally, by control means located on the platform, thus making it unnecessary for a ground crew to move or adjust scaffolding or the like.

Within reasonable load limits, the apparatus is useful in cargo or materials handling where the cargo hatch or port—as in aircraft—may be a number of feet above ground level.

In a preferred form, the apparatus comprises a turntable base, a load platform, and a pair of mutually articulated booms each comprising load members arranged as a parallelogram linkage. Suitable platform structure comprises a link end of one boom system, and the turntable base provides a link end of the second boom structure.

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The fourth link of each boom consists of side wall plates or equivalent of a motor and gear housing, to which plates the boom ends are pivotally attached.

A reversing motor is associated with each boom system, and by means of controls at the disposal of the operator on the platform, each boom may be swung so as individually or collectively to bring the platform to the desired point in space. A reversing motor on the turntable base provides controlled rotation over a complete circle of rotation.

The range of angular movement of each boom is such that the structure can be collapsed to a relatively compact structure. Limit switches are provided to prevent over extension of the booms to a position of unstable equilibrium, and to guard against the booms folding against or striking each other.

Other features and advantages will hereinafter be described.

In the accompanying drawings:

Fig. 1 is a side elevation of a preferred form of the invention, retracted to its lowermost position; the vehicle on which the apparatus is mounted is fragmentarily shown;

Fig. 2 is a top plan view of the motor and gear housing;

Fig. 3 is a side elevation taken on lines 3—3 of Fig. 2;

Fig. 4 is a plan view partly in section showing the turntable mounting for the unit;

Fig. 5 is a vertical elevation taken on lines 5—5 of Fig. 4;

Fig. 6 is a plan view of the platform or worker's stage; and

Fig. 7 is a schematic wiring diagram.

Referring to the drawings, 10 represents a truck chassis which carries a housing 11 for a turntable platform 12. A load platform or workman's stage 14 is movable vertically and laterally with respect to the turntable base by the respective booms 15 and 16 which are mutually articulated by pivotal association with a motor and gear housing structure 17.

It will be noted that the respective members of the boom 15 are pivotally connected at one end to the frame members 18 of the load platform, and at the other end with the spaced walls 19, 20 of said housing 17. The boom 16 is pivoted to the turntable 12 and to the said side walls of the housing 17.

The boom 15 comprises preferably two pairs of load members 15a, 15b and 15c, 15d. It will be understood that each pair is arranged as a paral-

lelogram linkage which includes the appropriate platform member 18 and the appropriate side plate of the motor housing. A line through the respective pivot points at the motor housing is parallel to the line through the pivot points at the platform member 18.

Similarly, boom 16 comprises the pairs of members 16*a*, 16*b*, and 16*c*, 16*d*. Each pair of boom members comprises a parallelogram linkage in which a line extending between the pivot points at the motor housing is parallel to the corresponding pivot line of the turntable 12. As clearly appears in Fig. 1, the pivot points of the booms 15 and 16 are in a right angular relationship at the motor housing. Therefore rotation of boom 16 about its turntable pivots will project the load platform 14 forwardly or rearwardly in an arc in which the deck 21 of the load platform 14 will always be parallel to the turntable 12. Such parallel relationship will prevail during the raising or lowering of the boom 15.

Cross ties 22 rigidly connect the respective pairs of boom-forming elements. Preferably, said cross ties are spaced so as to form rungs or steps by which one may climb the respective booms. Any suitable cross plates 23 extend between the wall plates 19 and 20. Preferably said plates are sufficiently wide to provide a service platform.

Referring now to Fig. 4, the turntable housing 11 is preferably mounted on the truck in such fashion that it may be leveled in one direction at least. Accordingly, a frame 24 carried on the truck body has vertical posts for pivotally receiving trunnions 25 at opposite sides of the housing 11. Centered with respect to said trunnions, said housing has spaced brackets 26, 26 which rotatably receive a support shaft 27 threaded to receive an adjustment screw 28. Said screw 28 is rotatably confined within a shaft 30 rotatably carried by the spaced brackets 31 secured to the truck 10.

Rotation of the screw 28 in one or the other direction will raise or lower the turntable base about its trunnions 25.

The turntable housing 11 is provided with upper and lower concentric tracks 32, 33, which confine the rollers 34 of the turntable 12. The track 33 has a rim or flange 35 along which roll the centering rollers 36 which are supported on a vertical shaft 37 mounted in the turntable 12 and a circular plate 38 carried by the angle members 39 which support the shafts of the rollers 34.

A ring gear 40, fixed to a central structure 41 of the housing 11 engages with a pinion 42 driven by motor 43 mounted on the turntable 12. Motor 43 is reversible, and hence the turntable may be rotated to the right or left. Preferably, the motor transmission includes a double worm drive so that the turntable cannot rotate when the motor is idle.

Segmental gears are provided on each of the booms for cooperation with motor driven gears within the motor housing. Referring to Figs. 2 and 3, gear segments 50*b* and 50*d* are affixed respectively to the boom members 16*b* and 16*d*. Said gear sectors are respectively in mesh with the pinions 51*b* and 51*d* which are fixed on shaft 52 for rotation by means of the gear 53 and pinion 54. Said pinion is driven, preferably through a double worm as aforesaid, from the motor 55. Similarly the boom members 15*a* and 15*c* have gear segments 60*a* and 60*c* secured thereto, said gears being driven by pinions 61*a* and 61*c* which are rotated by the gear 62 and the

pinion 63 driven by motor 64, through a double worm transmission.

The motors 55 and 64 are wound with reversing field coils. The motors may all derive power from a self-powered generator 65 of any conventional type, carried by the turntable 12.

Fig. 7 shows schematically the control system for the boom and turntable motors. It is preferred that a control panel containing the necessary manually operated motor control switches be located both at the control platform and the truck. However, the figure shows only a single set of switches for the sake of simplicity of representation. The second set of manually controllable switches will be in parallel with those illustrated, as well known to those skilled in the art.

Preparatory to a detailed description of the control circuit, it may be observed that each of the motors 43, 55, and 64 has reversing field coils, each field coil being controlled by a normally open switch. It is desirable to limit the extent of rotation of the respective booms 15 and 16 and hence the motor control circuits may include normally closed limit switches which will open the motor circuits at such extremes. Additional limit switches open either of the boom motor circuits to prevent the booms from coming into contact with each other.

On control panel 66, Fig. 6, switch group 15S controls motor 64 which operates to raise or lower boom 15; switch group 16S controls motor 55 which operates to move boom 16 forwardly or rearwardly as viewed in Fig. 1; and switch group 12D controls motor 43 by which the turntable is rotated.

Switch group 15S includes the normally open switches 70 and 71 which are respectively in circuit with the forward and reverse field coils of motor 64. As appears in Fig. 7, the circuit of switch 70 includes a normally closed limit switch 72 and the circuit of switch 71 includes normally closed series connected limit switches 73 and 74.

Switch group 16S includes the normally open switches 75 and 76 respectively in series with the two field coils of the motor 55. Arbitrarily, it may be said that closure of switch 75 will rotate the motor to move boom 16 forwardly, and rearward rotation will follow closure of switch 76. A normally closed limit switch 77 is in series with switch 75, and the normally closed limit switches 78 and 79 are in series with the switch 76.

Switch group 12S includes normally open switches 80 and 81, respectively in series with the field coils of motor 43 to produce clockwise or counterclockwise rotation of turntable 12. No limit switches are in the motor 43 circuit, as it is obviously necessary that the turntable be rotatable through a full circle in either direction.

Limit switches 72 and 73 are arranged to open the motor circuit at the desired limits of swing of the boom 15. Such limits may be, for example, 50 to 60 degrees above and below the horizontal. A convenient way of operating said switches is from the respective gear segments 60*a* and 60*c* which are affixed to the upper boom members 15*a* and 15*c* respectively. Accordingly, limit switch 72, which controls the maximum upward movement of boom 15 may be mounted by a suitable bracket on the side plate 19, with the push button 83 or other operator of said switch disposed in the path of a cam or lug 84 on gear segment 60*a*.

Limit switch 73 may be mounted on the side plate 20 and its operating means (not shown)

disposed in the path of travel of a similar cam or lug on gear segment 60c, said lug being disposed at from 100 to 120 degrees of rotation away from the lug 84, according to the overall swing of boom 15 which is to be permitted.

Similarly, there is mounted on side plate 20 the limit switch 77 which establishes the extreme of forward movement of boom 16, and the actuator 85 of said switch is in the path of travel of the lug or cam 86 positioned on gear segment 50d. The limit switch 79, which controls the extreme rearward movement of boom 16 may be secured to side plate 19 for cooperation with a lug or cam suitably positioned on gear sector 50b.

Therefore, even though the workman on the platform may be unskilled, or unable to judge the safe maximum extension of the respective booms, the motor circuits will automatically open before the booms have been overextended. The limit switch in the reversing circuit will of course be closed, and after the limit switch of a boom has operated to halt further motor operation in one direction the opposite field coil of the motor is in a circuit which may be completed by the operation of the appropriate manual switch on the control panel.

The limit switches 74 and 78 guard against a condition wherein the booms may fold against each other. Considering boom 16 to be in its extreme reclined position as indicated in Fig. 1, it is seen that the downswing limit switch on boom 15 would not have been actuated, because the boom is not at its maximum declination. Therefore, should the operator carelessly hold the down switch 71 closed long enough, boom 15 would strike against boom 16. Or, if boom 15 were in a certain angular relationship, boom 16 may be carelessly lowered to cause the two booms to strike. Therefore, there are provided the two limit switches 74 and 78, the first of which is in the "down" circuit of motor 64 (controlling boom 15) and the other being in the "back" circuit of motor 55, which operates boom 16.

Preferably, said limit switches are mounted on the respective upper members 16a and 16c of boom 16, and the respective lower members 15b and 15d of boom 15 may carry the cooperating strikers 87. Said switches and strikers are arranged so that before the two booms can come together, the "down" circuit of boom 15 and the "back" circuit of boom 16 will be open and motor operation halted.

The duplicate controls at the truck cab are useful for collapsing the structure for storage after the workman has left the platform.

The booms and other parts above the turntable base are preferably of light metal such as aluminum or magnesium alloys, whereas the turntable housing 11 and its associated parts may be of cast iron or welded steel structures so as to concentrate weight at the base.

It will be understood that we do not consider ourselves limited to the exact arrangement of motor drive and control system illustrated and described in the specification. For example, there are well known mechanical equivalents for the gear drives by which the boom motors effect rotation of the booms; and the use of a double worm transmission is typical of but one transmission which is inherently non-reversing and hence self-braking. We wish, therefore, that the detailed description and reference to a certain presently preferred embodiment be understood in an instructive, rather than a limiting, sense, many changes being possible within the scope of the claims hereto appended.

We claim:

1. A flying stage, comprising a base, a platform structure, and means for positioning said platform structure at desired vertical and lateral positions relative to said base while maintaining a parallel relationship therewith, said means including a pair of parallelogram linkages respectively pivotally secured at one of their ends to said platform structure and to said base, a motor housing including a rigid wall structure, the respective other ends of said linkages being pivotally secured to said rigid wall structure, whereby the latter comprises the fourth link of each parallelogram; a motor individual to each said parallelogram linkage mounted in said motor housing; power transmission means for rotating said linkages relative to said motor housing upon operation of said motors, means disposed at said platform for controlling the operation of each said motor; and means actuated by movement of each said parallelogram linkage to halt motor operation at a desired extreme of movement of said linkages regardless of the operative condition of said platform controls.

2. A flying stage comprising a base, a platform structure, and means for positioning said platform structure at desired vertical and lateral positions relative to said base while maintaining a parallel relationship therewith, said means including a pair of parallelogram linkages respectively pivotally secured at one of their ends to said platform structure and to said base, a motor housing including a rigid wall structure, the respective other ends of said linkages being pivotally secured to said rigid wall structure, whereby the latter comprises the fourth link of each parallelogram; a motor individual to each said parallelogram linkage mounted in said motor housing; means mechanically connecting each said motor and its said associated parallelogram linkage for rotating said linkage relative to said motor housing; means disposed at said platform for controlling the operation of each said motor; and limit control means responsive to the rotation of said parallelogram linkages for stopping said motors at predetermined extremes of movement of said linkages independently of the operative status of said platform control means.

3. A flying stage, including a rotatable base, a motor drivingly connected with said base for rotation thereof in a horizontal plane, a platform structure, and means for positioning said platform structure at desired vertical and lateral positions relative to said base while maintaining a parallel relationship therewith, said means including a pair of parallelogram linkages respectively pivotally secured at one of their ends to said platform structure and to said base, a motor housing including a rigid wall structure, the respective other ends of said linkages being pivotally secured to said rigid wall structure, whereby the latter comprises the fourth link of each parallelogram; a reversible motor individual to each said parallelogram linkage, said motors being drivingly connected to said linkages to rotate the same in forward or reverse direction, a normally open switch in the respective forward and reverse circuits of each said motor, said switches being disposed at the platform structure for operation by the occupant thereof; normally closed limit switch means in the respective forward and reverse motor circuits, and limit switch operator means operatively associated with each said par-

allelogram linkage to actuate the limit switches to open circuit position upon a predetermined extent of rotation of said linkages.

4. A flying stage according to claim 1, wherein said base has pivotal mounting means and means for rotating the same in a vertical plane.

5. A flying stage according to claim 1, wherein said base has pivotal mounting means and means for positioning said base at a desired extent of vertical rotation about said pivotal mounting means.

6. A flying stage comprising a base, a platform, and means for positioning said platform at desired vertical and lateral positions relative to said base while remaining parallel thereto, said means including a boom structure having parallel members pivotally secured at one end to said platform, a second boom having parallel members pivotally secured at one end to said base, and a rigid link structure serving as a pivotal connection for the respective other ends of the members of each said boom, at least one member of each said boom having gear means affixed thereto; a motor individual to each boom for rotating said booms by driving engagement with said gear means; and switch means in circuit with each said motor for controlling the operation thereof.

7. Apparatus of the class described, comprising a base, a platform, and means for positioning said platform at desired vertical and lateral positions relative to said base, said means including a pair of parallelogram linkages, the parallel members of one said linkage being pivotally connected at one end to said platform and the parallel members of the other of said linkages being pivotally connected at one end to said base; a rigid structure serving as a connecting link between said parallelogram linkages and having a rigid wall structure to which the respective other ends of said linkage elements are pivotally attached; gear means secured to at least one member of each said linkage; a motor for each said linkage and in driving relationship with the gear means thereof to rotate said linkages relative to each other; electric circuit means for controlling the operation of each said motor, said circuits respectively including manually operable switch means; and normally closed switch means in said circuits for opening said circuits to halt motor operation when one of said linkages attains a predetermined minimum angular relationship with respect to the other, regardless of the operative status of said manually operable switch means.

8. Apparatus according to claim 7, wherein said normally closed switch means is disposed on a member of one of said linkages and the adjacent member of the other linkage has switch actuator means for cooperation therewith.

9. Apparatus of the class described, comprising a base, a turntable supported in said base for rotation in a horizontal plane, a platform, and means for positioning said platform at desired vertical and lateral positions relative to said base while remaining in parallel relationship therewith, said means including a pair of parallelogram linkages, the parallel members of one of said linkages being pivotally connected above one another at one end to said platform and the parallel members of the other of said linkages being pivotally connected at horizontally spaced points on said turntable; a structure serving as a connecting link between said parallelogram linkages and having rigid elements to which the respective other ends of said linkages are pivotally attached at points spaced from each other; and a mechanical drive extending between elements of different linkages to positively rock the members of the linkage connected to the platform and move the latter vertically and laterally as the linkage attached to the turntable is rocked with respect to the same.

10. Apparatus of the class described, including a base, a platform, and means for positioning said platform at desired vertical and lateral positions relative to said base, comprising a boom pivotally supported at one end on said base for rotation in a vertical plane, a boom pivotally connected at one end to said platform; a rigid link structure to which the other ends of said booms are pivotally connected; motors individual to each said boom supported on said rigid link structure and drivingly connected to the respective booms for rotation thereof relative to said link structure; an electric circuit for energizing each said motor; and switch means in said circuit and disposed at the said platform for controlling the operation of said motors.

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