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Harrison

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[54] **MOBILE PLATFORM CARRYING MACHINE**

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[52] **U.S. Cl.** **182/2**

[51] **Int. Cl.** **B66f 11/04**

[58] **Field of Search** 182/2, 141, 148

[56] **References Cited**

UNITED STATES PATENTS

3,467,217	9/1969	Zwight	182/2
3,498,474	3/1970	Pierce	182/2
2,815,250	12/1957	Trump	182/2
3,670,849	6/1972	Milner	182/2
3,590,948	7/1971	Milner	182/2
3,411,606	11/1968	Oldakowski	182/2
3,637,043	1/1972	Zwight et al.	182/2
2,786,580	3/1957	Balogh	182/2

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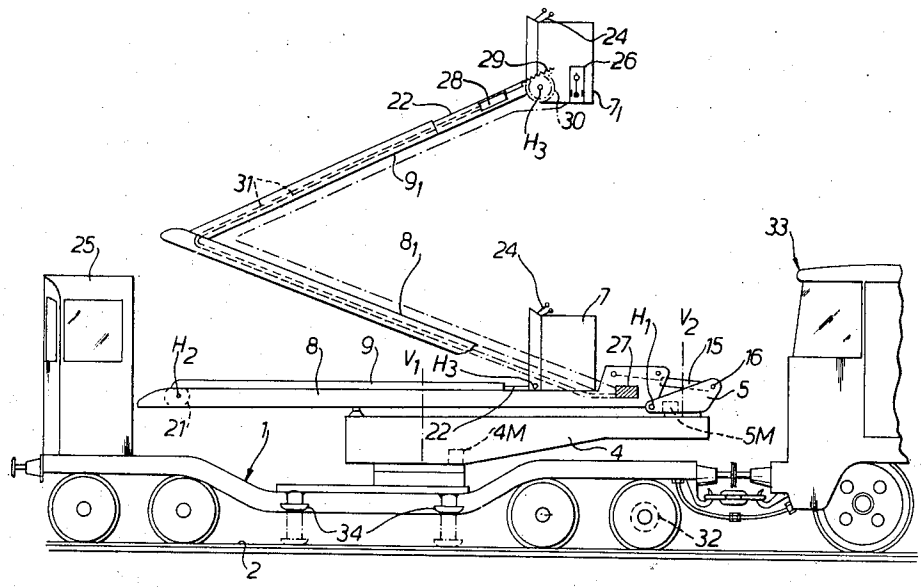
[57] **ABSTRACT**

A platform carrying machine, particularly useful for viaduct inspection, is mounted on a carriage and includes a platform-carrying boom structure mounted on the end of a horizontal support arm which can be swung laterally outwardly from the carriage. The boom structure is arranged to elevate and/or depress the platform relative to the carriage to inspect areas above and below the level of the carriage, the platform having a range of horizontal movement allowing the platform to enter, for example, a viaduct arch beneath the carriage. The entire boom structure can in addition be slewed about a vertical axis at the end of the lateral support arm to further increase the range of positions of the platform.

14 Claims, 5 Drawing Figures



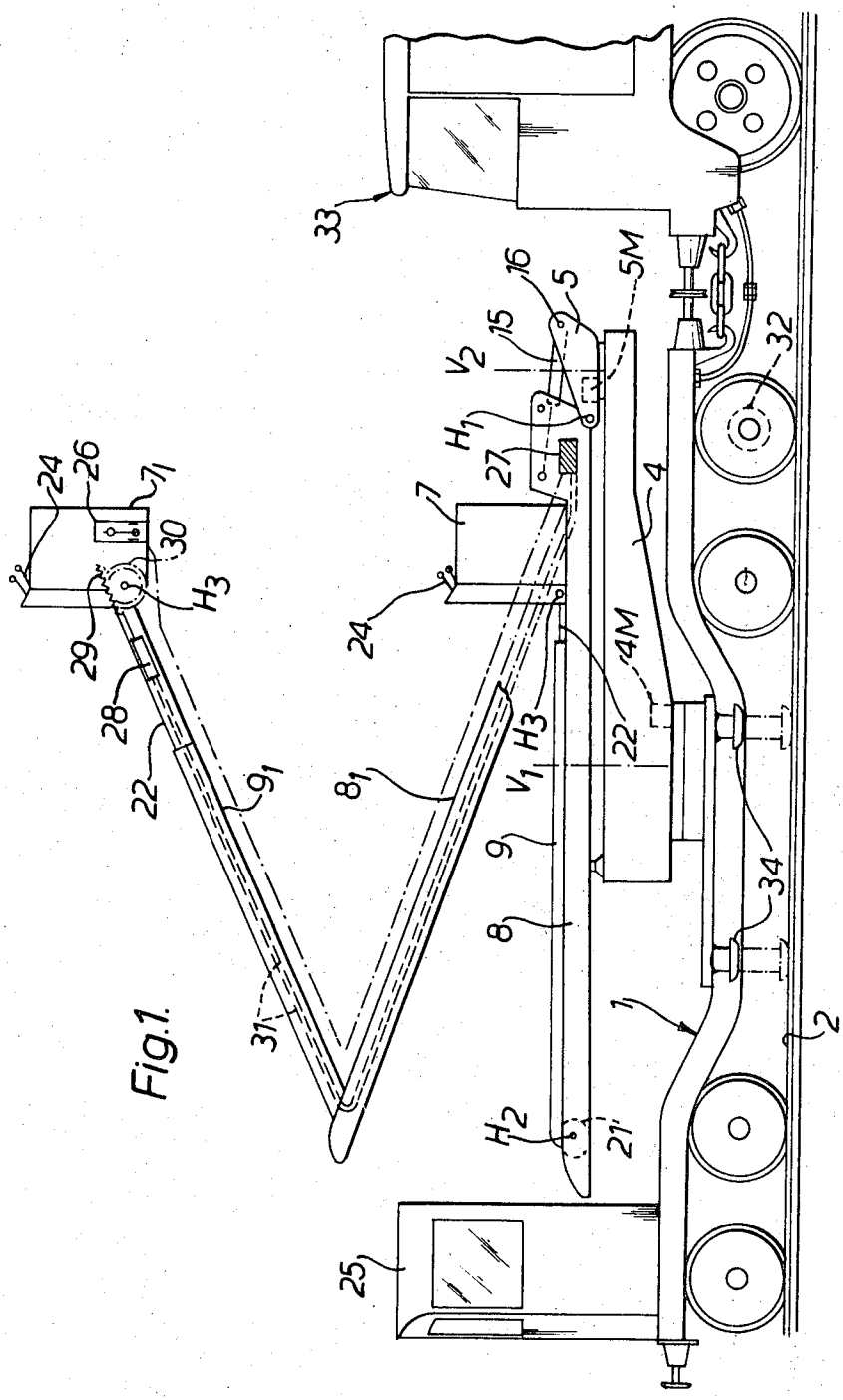

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Fig.1.

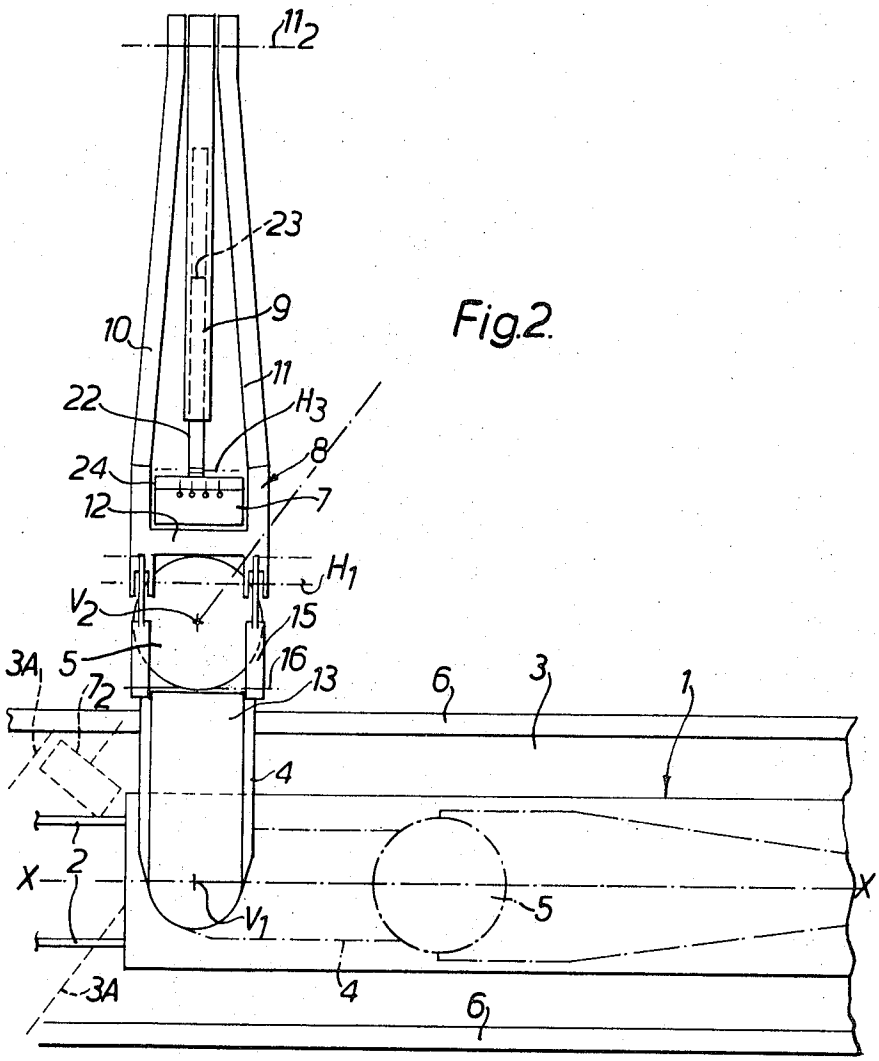

Fig.2.

Fig.3.

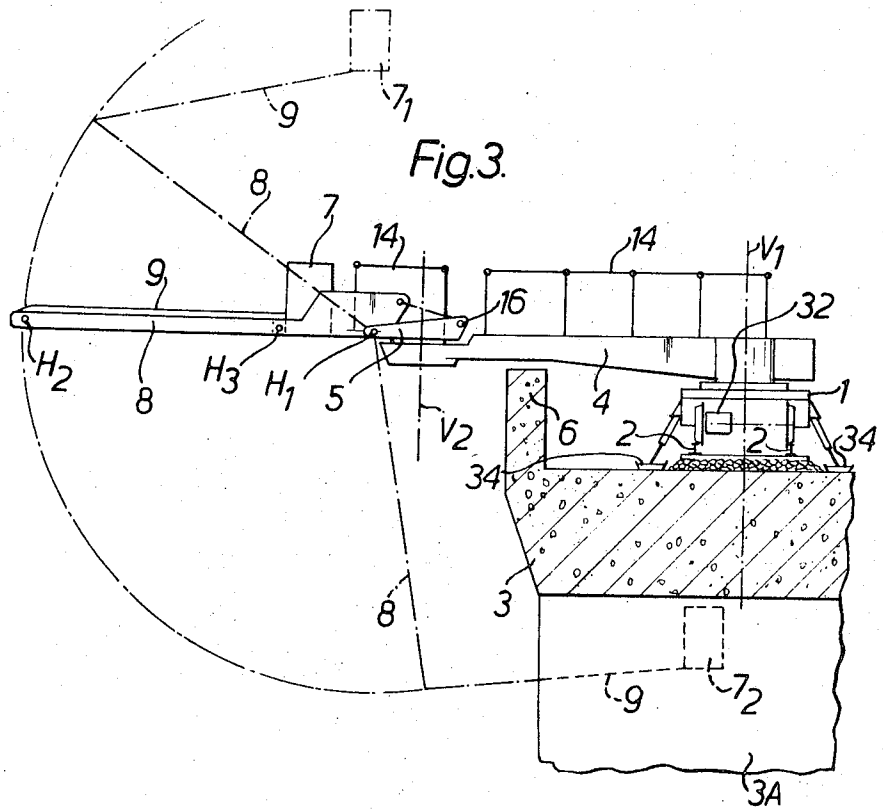
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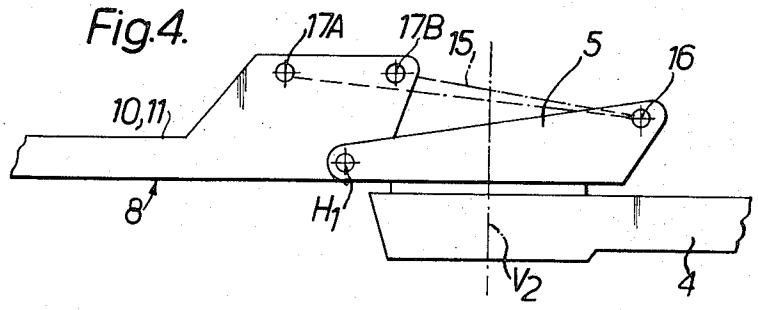
Fig.4.


17A
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10,11
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H₁
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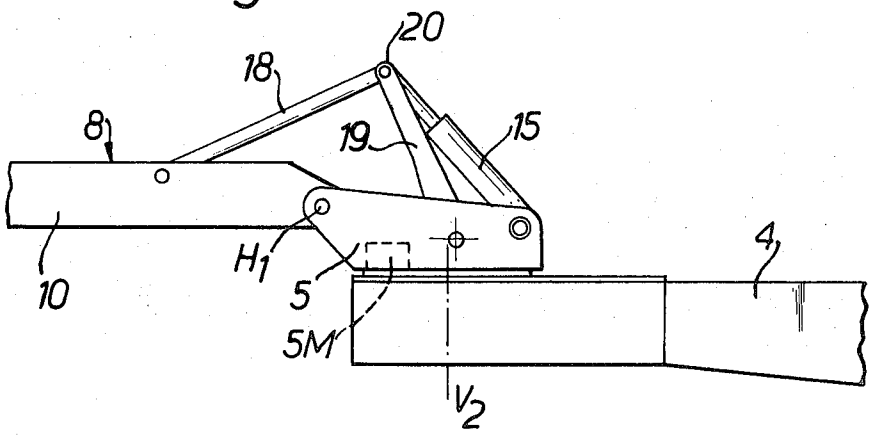
Fig.5.



MOBILE PLATFORM CARRYING MACHINE

BACKGROUND AND BRIEF DESCRIPTION OF THE INVENTION

This invention relates to mobile platform-carrying machines, more particularly machines of the type in which a lead platform carried on a boom structure is mounted on a mobile carriage.

The use of mobile platform-carrying machine is well known for overhead inspection and repair work. An object of this invention is to provide such a machine which is potentially capable of positioning its load platform within a wide range of horizontal and vertical movements.

According to the invention there is provided a platform-carrying machine adapted to be mounted on a carriage, and characterised by the combination of: a support arm capable of projecting laterally outwardly in a direction transverse to the direction of movement of the carriage; a boom structure carried at the projecting end of the said arm and arranged for controlled pivotal movement about at least one horizontal axis and for controlled bodily slewing movement about a vertical axis at said projecting end of the support arm and spaced laterally from the carriage; a load platform carried by the boom structure, and control means for controlling the said pivotal and slewing movements of the boom structure to position the platform as desired within a given range of horizontal and vertical movements.

By mounting the boom structure for slewing movement about a vertical axis at the projecting end of the lateral support arm greater freedom is afforded in the horizontal and vertical movements which can be imparted to the load platform. Thus in a preferred embodiment of the invention the lateral projection of the support arm may be such that the boom structure can be pivoted about the said horizontal axis or axes to positions below the level of the carriage.

The mobile platform-carrying machine according to the invention finds a particularly useful application in the inspection and maintenance of relatively inaccessible structures. For example, the underside of a road or railway viaduct may be inspected from overhead by a platform carried by a machine according to the invention, the machine carriage resting on the viaduct itself. This avoids the need for expensive and time-consuming scaffolding construction.

The ability to swing the boom structure about a vertical axis spaced laterally outwardly of the supporting carriage further facilitates the inspection of inaccessible structures, enabling the load platform to be moved into a recess, tunnel or arch in a direction inclined to the direction of carriage movement, by suitable slewing movement of the boom structure.

Preferably, the boom structure is adapted for pivotal movement about said horizontal axis or axes selectively to permit either raising or lowering of the platform relative to the level of the carriage. This gives the machine a dual-purpose role, enabling it to be used selectively both for overhead inspection and maintenance, in the manner of a conventional elevating platform, or for inspection from overhead as described previously.

In preferred embodiments of the invention the support arm is movable about a vertical axis on the carriage between an inoperative position in which the said arm and the boom structure carried thereby are generally parallel to the direction of movement of the carriage, and an operative position in which said arm projects laterally outwardly from the carriage.

Preferably the support arm carries a turntable at its projecting end on which the boom structure is supported, and including means for controllably rotating the turntable to control the slewing movement of the boom structure.

The boom structure preferably comprises a first boom pivotally attached at one end to the turntable and at its other end to one end of a second boom, the load platform being carried at the other end of the second boom.

The first boom may comprise twin arms between which the second boom and the load platform can pass, enabling the platform to be lowered or elevated as desired.

The second boom is preferably telescopic, actuator means being provided for controlling the extension of said second boom.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be more specifically described, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic side elevation of a platform-carrying machine according to one embodiment of the invention;

FIG. 2 is a diagrammatic plan view of a machine according to a preferred embodiment of the invention;

FIG. 3 is a diagrammatic end elevation of the machine showing some of its operative positions;

FIG. 4 is a side elevation of part of the machine as shown in FIG. 3, on an enlarged scale, showing one arrangement for pivoting the first boom of the machine, and

FIG. 5 is a corresponding side elevational view of the same part of the machine as that shown in FIG. 4, showing an alternative arrangement for pivoting the first boom of the machine.

DETAILED DESCRIPTION OF THE ILLUSTRATED MACHINE

The drawings illustrate a machine according to the invention adapted for use as a railway viaduct inspection rig. The machine is mounted on a wheeled carriage 1 which runs on rails 2 on the upper surface of a viaduct 3.

A horizontal support arm 4 is mounted on the carriage 1 for swinging movement about a vertical axis V_1 which intersects the longitudinal centreline X–X of the carriage 1 (FIG. 2). The arm 4 can be swung through approximately 90° in either direction from an inoperative position, shown diagrammatically in FIG. 1, in which the arm 4 lies along the longitudinal centreline x—X of the carriage 1 and operative positions, one of which is shown in full lines in FIGS. 2 and 3, in which the arm 4 projects laterally outwardly from the carriage 1 in a direction perpendicular to the longitudinal centreline X—X of the carriage and, therefore, perpendicular to the direction of movement of the carriage.

A turntable 5 is carried at the end of the support arm 4 remote from its vertical pivot axis V_1, the turntable 5 being itself rotatable about a vertical axis V_2 which, in the operative position of the support arm (FIG. 2) is laterally spaced from the carriage 1;

in this embodiment the length of the support arm **4** is such that in its operative position the turntable **5** overhangs the viaduct **3**, the turntable axis V_2 being positioned laterally outwardly of the parapet **6** of the viaduct **3**.

The turntable **5** supports a boom structure for effecting controlled elevation and lowering relative to the carriage **1** of a load platform **7**. The boom structure is a dual-purpose boom structure which is capable of operation selectively either to elevate or to lower the load platform **7**. The boom structure may alternatively comprise a conventional hydraulic platform lowering or platform elevating boom structure as known per se.

This boom structure, as shown in the drawings, comprises a first boom **8** pivotally attached at one end to the turntable **5** for pivotal movement about a horizontal hinge axis H_1 and pivotally connected at its other end to one end of a second boom **9** by way of a second horizontal hinge axis H_2. The second boom **9** carries the platform **7** at its other end, said platform **7** being pivotally connected to the boom **9** for pivotal movement relative thereto about a third horizontal hinge axis H_3.

FIG. **1** shows the booms **8, 9** in their horizontal, collapsed positions, and in addition shows, very diagrammatically, typical elevated positions 8_1, 9_1, and 7_1 of the booms **8, 9** and the platform **7**.

The length of the first boom **8** exceeds the combined length of the second boom **9** and the platform **7** carried thereby, so that the second boom **9** may undergo pivotal movement about the hinge axis H_2 between positions in which the platform **7** is elevated above the level of the carriage **1**, as exemplified by the position 7_1 shown in broken outline in FIGS. **1** and **3**, and positions in which the platform **7** is depressed below the level of the carriage **1**, as exemplified by the position 7_2 shown in broken outline in FIG. **3**.

The first boom **8** comprises twin arms **10, 11** spaced apart horizontally by a cross arm **12** adjoining the hinge axis H_1 such that the platform **7** may pass between the arms **10, 11**, as illustrated in FIG. **2**, the second boom **9** being pivotally mounted between the outer ends of the twin arms **10, 11** of the first boom **8**.

When the platform **7** is located between the twin arms **10, 11** adjacent the cross arm **12**, as shown in FIG. **2**, it is easily accessible for loading purposes. To facilitate loading, the upper surface of the horizontal support arm **4** and the turntable **5** is furnished with decking **13** and with removable handrails **14** (FIG. **3**). In the illustrated embodiment the platform **7** is a man-carrying inspection platform, but it may take the form of any convenient load carrier.

It will be appreciated that by selective combination of pivotal movements of the two booms **8** and **9** about the axes H_1 and H_2, and bodily slewing movement of the entire boom structure about the turntable axis V_2 it is possible to position the platform **7** within a range of horizontal and vertical movements extending above and below the support arm **4** to either side of the support arm **4**. The platform position 7_2 represents a typical position of the platform **7** for inspection of the underside of the viaduct **3** from overhead. If this position is combined with slewing movement of the boom structure about the vertical turntable axis V_2 then the platform **7** may be manoeuvred into spaces such as viaduct arches the walls **3A** of which are inclined to the direction of the viaduct **3** itself, as indicated by the broken lines in FIG. **2**.

In each position of the platform **7** the booms **8** and **9** are indicated by chain lines in FIGS. **2** and **3**.

The movement of the support arm **4** between its operative and inoperative positions and the slewing movement of the turntable **5** about the vertical axis V_2 are controllable independently by respective hydraulic motors **4M, 5M**, indicated diagrammatically by broken lines, or by any convenient type of actuator. Similarly, the pivotal movement of the booms **8** and **9** about the horizontal axes H_1 and H_2 are independently controllable by respective actuators. The actuators can be hydraulic rams or may for example comprise hydraulic torque actuators or mechanical worm/wheel drives.

The actuators for controlling the first boom **8** comprise a pair of hydraulic double-acting rams **15** (FIG. **2**) pivotally attached to the turntable **5** at a common pivot axis **16** (FIGS. **3** and **4**). The rams **15** have pivotal connections to the first boom arms **10** and **11** which are spaced from the horizontal pivot axis H_1. Means are provided for changing the pivotal connections of the rams **15** to the boom arms **10, 11** according as the first boom **8** is to be raised or lowered: for raising the boom **8** the rams **15** are fully extended and connected to the boom **8** at a pivot axis **17A**. Retraction of the rams **15** then raises the boom **8**. For lowering the boom **8** the rams **15** are fully retracted and connected to the boom **8** at a pivot axis **17B**; extension of the rams **15** then lowers the boom **8**. The horizontal spacing of the pivot axes **17A** and **17B** from the axis **16** is respectively greater and less than the horizontal spacing of the hinge axis H_1 from the axis **16** when the boom **8** is horizontal, as shown in FIG. **4**. Changeover of the pivot axes **17A** and **17B** is effected when the boom **8** is supported on the carriage **1** in the collapsed horizontal position shown in FIG. **1**, with the support arm **4** in its inoperative position, aligned with the centreline X—X of the carriage **1**.

As an alternative to providing means for changing over the pivotal connections of the rams **15** to the boom arms **10** and **11**, the rams **15** may act upon the boom arms **10** and **11** by way of suitable linkages, as shown in FIG. **5**, which dispenses with the need for such changeover. Each linkage consists of two links **18, 19** pivotally interconnected at a pivot pin **20** and pivotally connected at their respective ends remote from the pivot pin **20** to the respective first boom arm (**10** in FIG. **5**) and to the turntable **5**. The rams **15** are pivotally connected to the respective pivot pins **20** of the two linkages, the latter being such that the axis of the pivot pin **20** is above the horizontal pivot axis H_1 of the first boom arms **10, 11** throughout the operating range of raised and lowered angular positions of the first boom **8**.

The actuator for controlling pivotal movement of the second boom **9** relative to the first boom **8** is shown diagrammatically by broken lines **21** and comprises a rotary torque generating actuator, either electrical or hydraulic, or a mechanical worm wheel drive, located at the end of the first boom **8** and acting directly on the second boom **9**. Alternatively, a ram having two alternative positions of attachment to one of the booms may be used for this purpose, the ram being interposed between the two booms **8, 9**, in an arrangement similar to that of the rams **15** between the boom **8** and the turntable **5**.

Each of the booms **8, 9** is of hollow box-section. The second boom **9**, which is of square box section, houses

a relatively slidable extension **22** which can be retracted fully within the boom **9** or extended by a telescopic action to vary the effective length of the boom **9** as desired. An hydraulic actuator **23** (broken lines) is housed within the hollow boom **9** for controlling the extension and retraction of the boom extension **22.** Other actuator means may, of course, be employed for this purpose.

All the various actuators referred to above can be controlled from the platform **7** by means of suitable manual valves and/or switches **24** on the platform. These controls are duplicated in a control cab **25** mounted on the carriage **1.**

A platform stabilising system, of any suitable type, is provided for maintaining the platform **7** horizontal independently of the position taken by its supporting boom **9.** One form of such a stabilising system is shown very diagrammatically in FIG. **1** in the elevated positions 8_1 and 9_1 of the two booms. The stabilising system consists of a pendulum sensing unit **26** carried by the platform **7** and adapted to provide electrical signals which pass through leads (indicated by a chain-dotted line in FIG. **1**) within the booms **8, 9** and via an amplifier (not shown) to a solenoid valve **27.** The valve regulates the distribution of hydraulic fluid to a rotary hydraulic motor **28** located within the boom extension **22.** The motor **28** drives a worm **29** which meshes with a worm wheel **30** rigidly attached to the platform **7** and coaxial with the pivot axis H_3 of the latter. This servo-system is arranged so that the rotation imparted to the worm **29** is always such as to maintain the base of the platform **7** horizontal, and the pendulum unit **26** in a neutral position.

Since the platform levelling servo-system is controlled by a pendulum unit it is insensitive to any inclination to the horizontal of the rails **2** on which the carriage **1** rests. The hydraulic connections to the motor **28** are by way of flexible — for example, coiled — hoses **31** (shown by broken lines) which pass through the hollow booms **8, 9** and which permit the full range of extension of the boom **9.** In the event of an hydraulic pressure failure the motor **28** is effectively locked so that the platform **7** is then held rigidly relative to the boom **9.**

It may be found useful for some purposes, for example, for the inspection of retaining walls in railway cuttings, to provide an auxiliary platform, similar to the platform **7,** at the end of the first boom **8,** using any convenient platform stabilising system, for example that described previously.

The entire carriage **1** is movable along the surface of the viaduct **3,** in this example along the rails **2.** The carriage **1** is conveniently self-propelling, having a drive motor **32,** shown diagrammatically in broken outline, connected to at least one of the carriage wheels. The motor or motors **32,** which may, for example, be electric or hydraulic, may be controlled from the platform **7** and from the control cab **25.**

For railway viaduct inspection the carriage **1** is conveniently coupled to a service locomotive, part only of which is shown diagrammatically at **33** in FIG. **1,** which provides the main motive power to the carriage **1,** enabling it to be moved to and from the inspection site at normal rail traffic speeds. The locomotive **33** may also house an hydraulic pump and electric generator for supplying hydraulic and electrical power to the carriage **1.**

When the machine is used for overhead inspection work, exemplified by the platform position 7_1 in FIGS. **1** and **3,** the carriage **1** is stabilised by the extension of feet **34** into engagement with the ground on each side of the carriage **1.** The control system is preferably such that the boom **8** cannot be elevated until the feed **34** are extended.

In a typical embodiment of the invention the maximum obtainable elevation of the platform **7** above the level of the hinge axis H_1 is **20** metres while the maximum descent of the platform **7** below the level of the hinge axis H_1 is **14** metres. To enable the platform **7** to pass between the boom arms **10** and **11** provision may if necessary be made for reducing the length of the platform **7** during transition from ascending to descending movement or vice-versa.

I claim:

1. A platform-carrying machine, comprising a movable carriage; a support arm mounted on said carriage and having a position in which it projects laterally outwardly in a direction transverse to the direction of movement of said carriage; a boom structure comprising a first boom carried at the projecting end of said support arm and a second boom carried by said first boom; means pivotally connecting said first boom to said support arm for pivotal movement about a horizontal axis; means defining a vertical swivel axis for said boom structure at the projecting end of said support arm; a load platform carried by said second boom, said first boom comprising twin arms between which said second boom and said load platform are located when both said booms are horizontal, said second boom being pivotable relative to said first boom to enable said platform to be lowered and elevated selectively relative to said carriage; actuator means for effecting pivotal movement of said first boom about said horizontal axis and bodily slewing movement of said boom structure about said vertical axis; and control means controlling said actuator means and, therefore, the position of said platform to position the latter as desired within a given range of horizontal and vertical positions relative to said carriage.

2. A machine as defined in claim **1,** wherein said range of platform positions includes positions of said platform below the level of said carriage.

3. A machine as defined in claim **1,** wherein said boom structure is adapted for pivotal movement about said horizontal axis to permit raising and lowering of said platform selectively relative to the level of the carriage.

4. A machine as defined in claim **1,** including means mounting said support arm for swivelling movement about a vertical axis on the carriage between an inoperative position in which said arm and said boom structure carried thereby are generally parallel to the direction of movement of said carriage, and at least one operative position in which said arm projects laterally outwardly from said carriage.

5. A machine as defined in claim **1,** wherein said control means include manual controls for the pivotal and slewing movements the boom structure, situated on the load platform itself.

6. A machine as defined in claim **1,** including a turntable carried at said projecting end of said support arm and supporting said first boom, said actuator means including means for controllably rotating said turntable to control the slewing movement of said boom struc-

ture, said vertical swivel axis being defined by the turntable axis.

7. A machine as defined in claim 6, wherein said first boom is pivotally attached at one end to said turntable and at its other end to one end of said second boom, said load platform being carried at the other end of said second boom.

8. A machine as defined in claim 1, wherein said actuator means include hydraulic actuators for effecting controlled pivotal movement of the first boom relative to said support arm about a first horizontal axis and controlled pivotal movement of said second boom relative to said first boom about a second horizontal axis.

9. A machine as defined in claim 1, including a turntable carried at said projecting end of said support arm and defining said vertical swivel axis, said first boom being pivotally attached to said turntable for pivotal movement about a horizontal axis, said actuator means including two links pivotally interconnected at a pivot joint and pivotally connected to said turntable and said first boom respectively, and at least one double-acting actuator pivotally attached at one end to said turntable and at its other end to said pivot joint between said links; said actuator being effective through said links to move said first boom relative to said turntable in the full range of permitted movement of said first boom about said horizontal axis.

10. A machine as defined in claim 1, wherein said second boom is telescopic, and including actuator means for controlling the extension of said second boom.

11. A machine as defined in claim 1, and including a platform stabilising system effective to maintain the orientation of said platform substantially constant throughout the permitted range of positions of the platform.

12. A machine as defined in claim 11, wherein said platform stabilising system comprises an hydraulic servo-system including a sensing unit on said platform sensitive to movement of said platform from an upright orientation, and an actuator mounted on the boom structure and connected to said platform; said actuator being responsive to said sensing unit to adjust the orientation of the platform relative to said boom structure to maintain said platform upright in all positions of the latter.

13. A machine as defined in claim 1, wherein said carriage has at least one traction motor for self-propulsion of the carriage.

14. A platform-carrying machine, comprising a movable carriage; a support arm mounted on said carriage and having a position in which it projects laterally outwardly in a direction transverse to the direction of movement of said carriage; a turntable carried at said projecting end of said support arm and defining a vertical swivel axis at said projecting end; a boom structure pivotable about said vertical swivel axis and including at least one boom, said boom being pivotally attached to said turntable for pivotal movement about a horizontal axis so that said boom structure is pivotable about at least one horizontal axis; a load platform carried by said boom structure; actuator means for effecting pivotal movement of said boom structure about said horizontal axis and bodily slewing movement of said boom structure about said vertical swivel axis, said actuator means including at least one double-acting actuator pivotally attached at one end to said turntable and at its other end to a selected one of two points of pivotal attachment on said boom, said actuator being effective to elevate said boom when connected to one of said attachment points and being effective to depress said boom when connected to the other of said attachment points; and control means controlling said actuator means and, therefore, the position of said platform to position the latter as desired within a given range of horizontal and vertical positions relative to said carriage.

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