

"VERTICALLY MOVABLE WORKING PLATFORM"

The present invention relates to vertically movable working platforms.

When work is required to be undertaken on the face of a building, for example, it is usual to erect a scaffolding and to include a number of walkways at different working levels extending across the face of the building. Workment and materials may be transported to the appropriate walkways by means of a platform movable up and down a permanently located mast.

The erection and dismantling of such scaffolding is slow and expensive and there therefore exists a need for a manner of transporting men and materials quickly and safely to a required work level above ground level, for example on the face of a building, without the need for scaffolding.

It has been previously proposed to provide work platforms that are supported by and vertically movable on sectional masts. Such a mast, in addition to providing means for supporting and stabilising the workplatform is also provided with a motor which is driving engagement with the said platform. Although such structure would seem to offer economies in erection, their use has been restricted by considerations of safety as well as by the cost of trans-

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porting the structure to the site.

We have now developed a suitable working platform mounted for vertical movement on a mast section and carried on a trailer for transportation to the working  
5 site, the mast section being extendable to the required working height on the site and without removal from the transporting trailer.

Accordingly we provide a mobile vertically movable platform comprising; a chassis supported on at least one  
10 axle carried on associated road wheels; a vertically extending mast section secured to the said chassis having two vertically extending racks secured thereto, a platform carried on the said mast section and including two pinions for engagement with the said racks and two  
15 independent drives for pinions to enable the platform to be moved vertically up and down the said mast section, said platform being capable of being moved and supported by one rack and its associated drive pinion; the drive for each said pinion being an independent energizable  
20 electric motor working through respective reduction gear trains; the said chassis being provided with adjustable stabilisers to enable the mast section to be maintained in a vertical condition in use; wherein each said electric motor includes a centrifugal overspeed  
25 brake which acts to prevent the platform from descending

at a speed greater than a predetermined percentage above the normal speed, and a brake that engages when the power is disconnected from the motor and disengages when power is reconnected to the motor; and the mast  
5 section has a side clear of the platform for attachment to an adjacent structure, the said mast section being constructed to receive additional sections including racks to enable the vertical height thereof to be increased, the said additional sections being capable  
10 of attachment to said adjacent structure.

The chassis may include means for attachment to a motorised towing vehicle, for example, a car, or it may form an integral part of a motorised vehicle.

The platform is surrounded by a safety cage and can  
15 be used to transport the additional mast sections when being moved to or from the working site.

One embodiment of the present invention will now be described with reference to the accompanying drawings in which:-

20 Figure 1 is a diagrammatic representation of a platform of the present invention positioned at the top of an extended mast;

Figure 2 is a diagrammatic representation of a platform of Figure 1 and the top section of the mast;

25 Figure 3 is a circuit diagram illustrating the supply and control circuitry.

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In the drawings a chassis 1 is supported by an axle (not shown) carried on road wheels 2. Telescopic stabiliser arms 3 extend from each of the four corners of the chassis and include vertically adjustable feet 4 5 to enable the chassis to be maintained in a horizontal position during use.

A lower mast section 6 is permanently attached to the chassis by welding. Additional sections of mast, 7, 8, 9, 10 and 11, are in turn bolted together to form 10 a rigid vertical structure having racks 19 and 20 rigidly attached thereto to provide continuous racks extending for the complete height of the mast. Load bearing jacks (not shown) are placed directly under section 6 when in use.

15 A working platform generally indicated at 12 includes a flat working base 13 containing an open sided aperture 25 for clearance around the mast sections on three sides thereof. A safety cage 14, which includes hinged access gates 26 at the ends, surrounds the base 13. The access 20 gates are preferably provided with safety switches (not shown) that are connected to the circuits energising the electric motors (described below) so that if the gates are not properly closed the motors cannot be energised. The platform is supported by a support structure including a 25 pair of horizontal frames 15 and 15a holding vertical

members 27 in sliding contact with three sides of the mast and struts 16 extending from the lower frame 15 to the base 13.

Rigidly attached to the supporting structure are 5 electrical motors 17 and 18 each being adapted to drive respective pinions (not shown) that engage with racks 19 and 20 for movement of the platform up and down the mast 5, and to support platform at any given height. The motors include integral disc brakes and are powered from 10 an external 3-phase supply of electricity.

Mounted on the support structure for the platform and extending vertically through the platform is a mast 21 movable about a vertical axis and having a crane arm 22 extending therefrom for use in lifting additional sections of mast when extending or reducing the mast height. 15 The crane may also be fixed with a motor for hauling on the rope to enable the crane to be used to facilitate the hoisting of work materials or tools without the necessity for returning the platform to the ground. Preferably 20 there is also a limit switch connected so that motors 17 and 18 cannot be energised unless the crane arm 22 is in a safe "parking" position.

The motors 17 and 18 are operated by a pendant controller (not shown) so that the controller may be used by a person 25 on the platform or by a person standing at ground level.

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The controller preferably includes emergency stop and lock buttons, a "power on" button and a "raise" and "lower" button both of the dead-man type.

The electrical drive motors 17 and 18 are each three  
5 horse power braked drive motors incorporating independent triple reduction spur-gear trains 28,28a driving the device shaft and pinions 29 and 29a respectively engaging racks 19 and 20.

Each of the spur gear trains 28,28a is connected to one of  
10 the motors 17 or 18 by a pair of centrifugal overspeed brakes. These brakes are adapted to operate when the speed of the pinions 28 and 29 is approximately 10% higher than the normal driving speed that is achieved when the platform is being raised or lowered under electrical  
15 power supplied to the motors 17 and 18. Thus for example if the normal vertical speed is 7.5 metres per minute the over-speed brakes would operate to prevent the platform descending over 8.25 metres per minute. At this maximum rate of descent, the platform can be protected against  
20 damage by buffer springs or bumpers suitably mounted on the chassis (not shown).

Each drive unit is individually capable of raising and lowering the platform 12. However, electrical circuits are connected to operate motors 17 and 18 in parallel under  
25 normal working conditions. The disc brakes are of the

fail-to safe type, i.e. power off brake always on.

In order to prevent the platform from being raised above the top of the mast two safety switches 30 are incorporated. The first safety switch is mechanical and 5 comprises a spring loaded roller 31 directed onto a main mast leg face and which is arranged to shut off power immediately it passes the top of the mast. A secondary switch of the proximity type (not shown) is located immediately below the first switch and again 10 operates to shut off power immediately it passes the top of the mast. Both switches are located above the working level of the platform. Similar switches are also provided to limit the downward movement of the platform on the bottom mast section 6.

15 When constructed of suitable material the mast can extend up to a height of 10 metres totally free standing. Above this height the mast should be tied to the structure at about six metre intervals and may extend up to a total of 100 metres.

20 The platform 12 has a length of 4 metres and is capable of being extended to a total length of 12 metres.

When it is required to move the platform and mast from one site to another then, starting from a position shown in figure 1, the platform is lowered from mast 25 section 11 onto section 10 and extension 11 removed with assistance of the crane arm 22. The platform is then

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lowered to the next section and section 10 removed.

This procedure is repeated until the platform is supported only by the lower section of the mast 6 in which position it may be transported on the trailer to 5 a new site after retraction of the stabilisers 3.

It has been found that in practice all of the operations including road transport, erection, dismantling of the work platform can be accomplished by two workers.

The electrical circuits preferably include reversing 10 contactors and a changeover switch so that the direction of rotation of the motors 17 and 18 when the "raise" and "lower" buttons are depressed will be correct regardless of the phase connections that are made to the source of electrical power.

15 The invention includes safety features in addition to those described above. For example one or more safety pull wires 23 may be stretched along and beneath the platform 13 and attached to switches 24 connected in the energising circuit for the motors 17 and 18. If a pull 20 wire 23 is deflected either intentionally by an operator or by engagement with any obstruction, the operation of any of the switches 24 will de-energise the motors 17 and 18 and bring the platform to a stop.

An earth monitoring system can be incorporated to 25 ensure that the platform is electrically connected to the

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earth at all times. This can be accomplished by conventional circuitry, whereby a failure of the earth connection to the platform will cause a main electrical contactor supplying power to the motors 17 and 18 and other 5 circuits on the platform to be disconnected.

Each of the motors 17 and 18 is also provided with an overload disconnect circuit of a conventional type.

Audible alarm and flashing beacon devices may be fitted under the platform and arranged to sound and flash 10 whenever the platform is in motion.

Suitable grounded power take off sockets (not shown) are provided on the platform for connection of hand tools.

An earth leakage circuit breaker may be incorporated in the energizing circuit for the motors 17 and 18 for 15 additional electrical protection.

Figure 3 is a circuit diagram illustrating the electrical supply and control circuitry referred to above. Three phase electrical power is supplied to leads 74 which are connected to a changeover switch 76. The switch 20 76 may be thrown mechanically to either of two positions for reversing the sequence of the phases to change motor direction in response to closure of contacts 78 of the "raise" button or contacts 80 of the "lower" button on the pendent controller, as described above. The switch 25 76 is connected to contacts in an earth leakage circuit



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breaker 82 having an operating coil 84. From the circuit breaker 82 three phase leads are connected to contacts of a main circuit breaker 86, from which contacts leads are connected to the contacts 78 and 80 respectively.

5      Leads 88 from two of the phases are connected to a transformer 90 having 110 volt and 24 volt secondary connections. A lead 92 represents the earth connection to the chassis of the unit as described below. Wires 94 and 96 are at 110 volts above ground, wire 98 is at 24  
10 volts above ground, and a wire 100 is at ground potential.

The wire 96 supplies power to utility outlets 102 on the platform 12 and connects through contacts 104 on the main circuit breaker 86 to a rectifier 106 for supplying current to the parallel connected motor brakes 108.

15 Preferably as shown current is supplied through other contacts 110 on the main circuit breaker 86.

The lead 94 supplies power for operating a "raise" coil 112 which operates the contacts 78 and a "lower" coil 114 which operates the contacts 80. As will be  
20 seen the current reaches these coils through a number of series connected contacts that provide essential safety features in accordance with this invention. Contacts 116 are on a limit switch that is located so that the contacts will be closed only when the crane arm 23 is in its  
25 "parking" position as described above. Contacts 118

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belong to limit switches located so that the contacts will be closed only when the access gates 26 are closed. Contacts 120 are on the "emergency stop and lock" button on the pendent controller. These contacts remain open 5 once the button is depressed, and are not reclosed until the button is mechanically rotated and released in accordance with conventional practice.

A "power on" button 122 is of the type that must be held down to make contact. When it is initially de- 10 pressed, current is supplied to a main contactor coil 124 having locking contacts 126. When the pushbutton 122 is then released, the current is maintained through the contacts 126.

In normal operation, leads 128 and 130 are respec- 15 tively connected through a normally closed top working limit switch 132 and a normally closed bottom working limit switch 134 in the energising circuits of the "raise" coil 112 and "lower" coil 114, respectively. A "raise" button 136 completes the circuit to the coil 112 when the 20 limit switch 132 is in its normal closed position with the platform 12 below its top working limit position. Similarly a "lower" pushbutton 138 completes the circuit for energising the coil 114 for lowering the platform 12 when the limit switch 134 is in its normal closed position 25 with the platform above its lower working limit position.

Additional safety features are provided by an ultimate lower limit switch 140 and an upper top limit switch 142. The switch 140 is normally closed, but opened if the platform has moved beyond the normal opening position of the switch 134, due to a possible failure thereof. similarly the switch 142 is normally closed but opens if the platform is elevated above the position in which the switch 132 normally opens, due to a possible failure thereof. Thus for example, upon operation of the switch 140, the operating coil 124 of the main circuit breaker is de-energised. This opens the contacts 86 leading to the motor leads 78 and 80. On the other hand, if the "power on" button 122 is depressed in the condition with the ultimate lower limit switch 140 open, a circuit is provided to the operating coil 124 as well as to the lead 128, whereby it is possible to raise the platform by depression of the "raise" button 136. The movement of the platform will then automatically reclose the limit switch 140.

On the other hand, the opening of the ultimate top limit switch 142 does not have a similar effect, in that depression of the "power on" button 122 does not supply power to the operating coil 124 of the main circuit breaker and it is not possible to raise or lower the platform.

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Contacts 144 are located in the switches 24 shown in figure 2. These switches are shown at the two ends of the pull wire 23 however; in the alternative it may be desired to provide rollers at the four corners of the platform, and to wrap the wire 23 around substantially the entire perimeter, in which case the switches 24 are located adjacent the aperture 25 in the platform, thus providing full perimeter protection by means of these two switches.

10      Contacts 146 are operated by the coil 84 in the earth monitoring relay. The coil 84 is energised by the 24 volt lead 98 connection to the transformer 90, with the circuit being completed through a lead 148 that descends from the control panel to the chassis represented at 150, through  
15 the chassis to the ground lead 92 that extends from the chassis back to the transformer 90. Thus if the circuit is broken by failure of the wire 148 to be connected to the ground lead 92 through the chassis, the coil 84 is de-energised opening the contacts 146.

20      Contacts 152 and 154 are overload relay contacts in the respective motors as previously described.

Preferably a safety fence is erected on the platform surrounding the mast. This has been omitted from the drawing for clarity of illustration.

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#### CLAIMS:

1. A mobile vertically movable work platform comprising: a chassis supported on at least one axle and carried on associated road wheels; a vertically  
5 extending mast section secured to the said chassis having two vertically extending racks secured thereto, a platform carried on the said mast section and including two pinions for engagement with the said racks and two independent drives for pinions to enable the platform  
10 to be moved vertically up and down the said mast section, said platform being capable of being moved and supported by one rack and its associated driven pinion; the drive for each said pinion being an independent energisable electric motor working through respective reduction gear  
15 trains; the said chassis being provided with adjustable stabilisers to enable the mast section to be maintained in a vertical condition in use; wherein each said electric motor includes a centrifugal overspeed brake which acts to prevent the platform from descending at a speed  
20 greater than a predetermined percentage above the normal speed, and a brake that engages when the power is disconnected from the motor and disengages when power is reconnected to the motor; and the mast section has a side clear of the platform for attachment to an adjacent structure, the said mast section being constructed to receive  
25 additional sections including racks to enable the vertical



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height thereof to be increased, the said additional sections being capable of attachment to said adjacent structure.

2. A platform according to claim 1 wherein each  
5 said centrifugal overspeed brake operates when the speed of the said pinions exceeds a speed 10% higher than normal driving speed.

3. A platform according to claim 1 or 2 wherein  
the or each drive incorporates a brake that engages  
10 when the power is disconnected from the motor and disengages when the power is connected to the motor.

4. A platform according to any one of claims 1 - 3  
wherein the means for connecting each motor to a power  
source includes a top safety switch to disengage the or  
15 each motor upon the platform reaching a height within a predetermined distance of the top of the mast.

5. A platform according to any one of claims 1 - 4  
wherein the means for connecting each motor to a power  
source includes a safety switch and a pull wire extending  
20 generally parallel to and beneath said platform and operable on said switch when pulled, to de-energise the or each motor.

6. A platform according to claim 4 including a  
control circuit comprising terminals for connection to a  
25 source of electrical power, a circuit breaker having con-



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tacts connected to each of said terminals, a raise coil and a lower coil each having contactors connecting between the circuit breaker contacts and said motors, said motors being connected in parallel, the contactors of said coils 5 being connected for opposite directions of rotation of the motors, and a coil energizing circuit including a normally energized lead and a pair of circuits extending therefrom to the raise and lower coils respectively, said circuit to the raise coil including said normally closed 10 top working safety switch.

7. A platform according to claim 6, in which said circuit to the lower coil includes a normally closed bottom working safety switch operable upon the platform reaching a height within a predetermined distance of the 15 bottom of the mast.

8. A mobile vertically movable working platform substantially as herein described with reference to figures 1 and 2 of the drawings.

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