

[54] **APPARATUS FOR SUPPORTING WORK MEANS ON VERTICALLY DISPOSED SURFACE**

[75] Inventor: **James R. Goff**, Oklahoma City, Okla.
 [73] Assignee: **Robert J. Nelson**, Oklahoma City, Okla.
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 [51] Int. Cl. B24c 3/06, B24c 3/32
 [58] Field of Search 51/8, 9; 118/72, 305, 307, 118/207, 108; 114/222, 224; 212/10

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Primary Examiner—Donald G. Kelly
 Attorney, Agent, or Firm—Morton, Bernard, Brown, Roberts and Sutherland

[57] **ABSTRACT**

A support is disclosed which is adapted to be utilized in conjunction with a vertically disposed surface and position a working device with respect to the vertically disposed surface. The support of the present invention provides for vertical and horizontal movement as well as diagonal of the working device. Advantageously, the support comprises a vertical support frame, a working device, flexible vertical support members adapted to attach the working device to the vertical support frame, and a flexible track in contact with the working device and adapted to provide contact of the working device with the vertically disposed surface.

17 Claims, 4 Drawing Figures

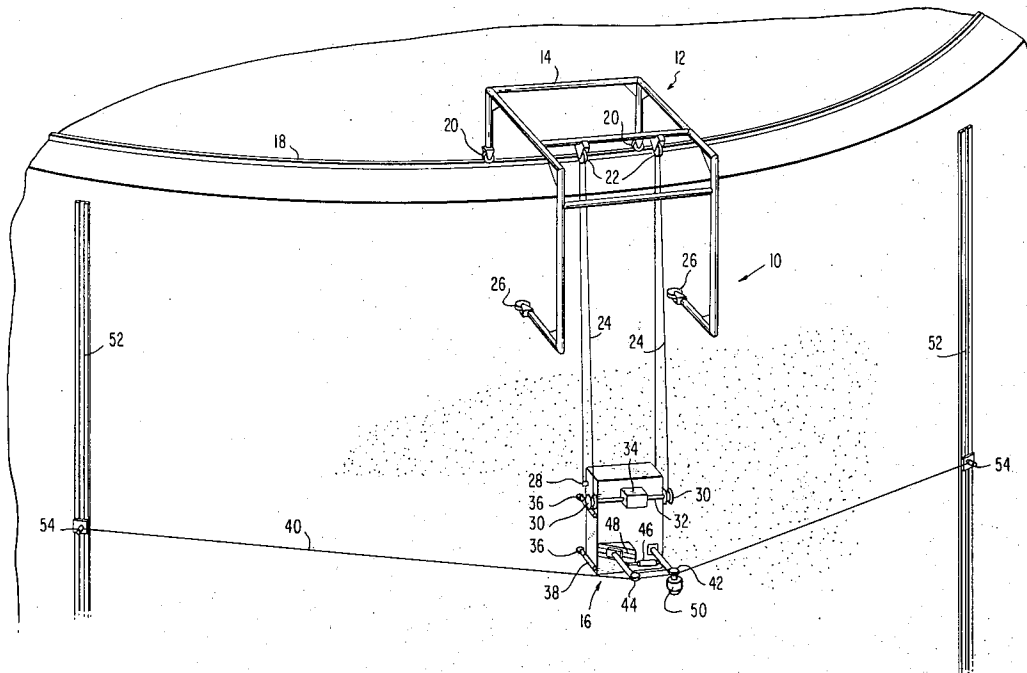


FIG. 1

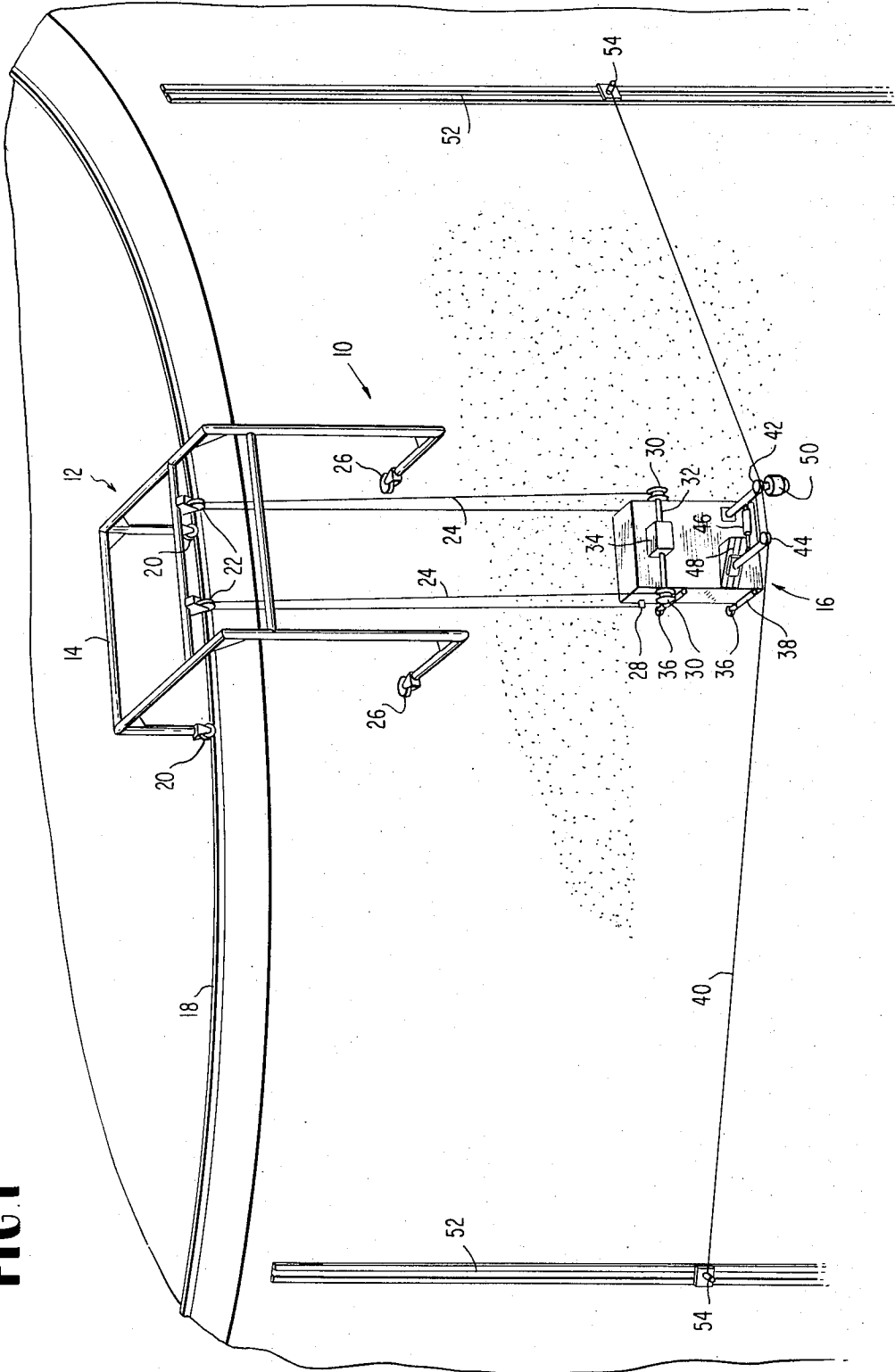


FIG. 2

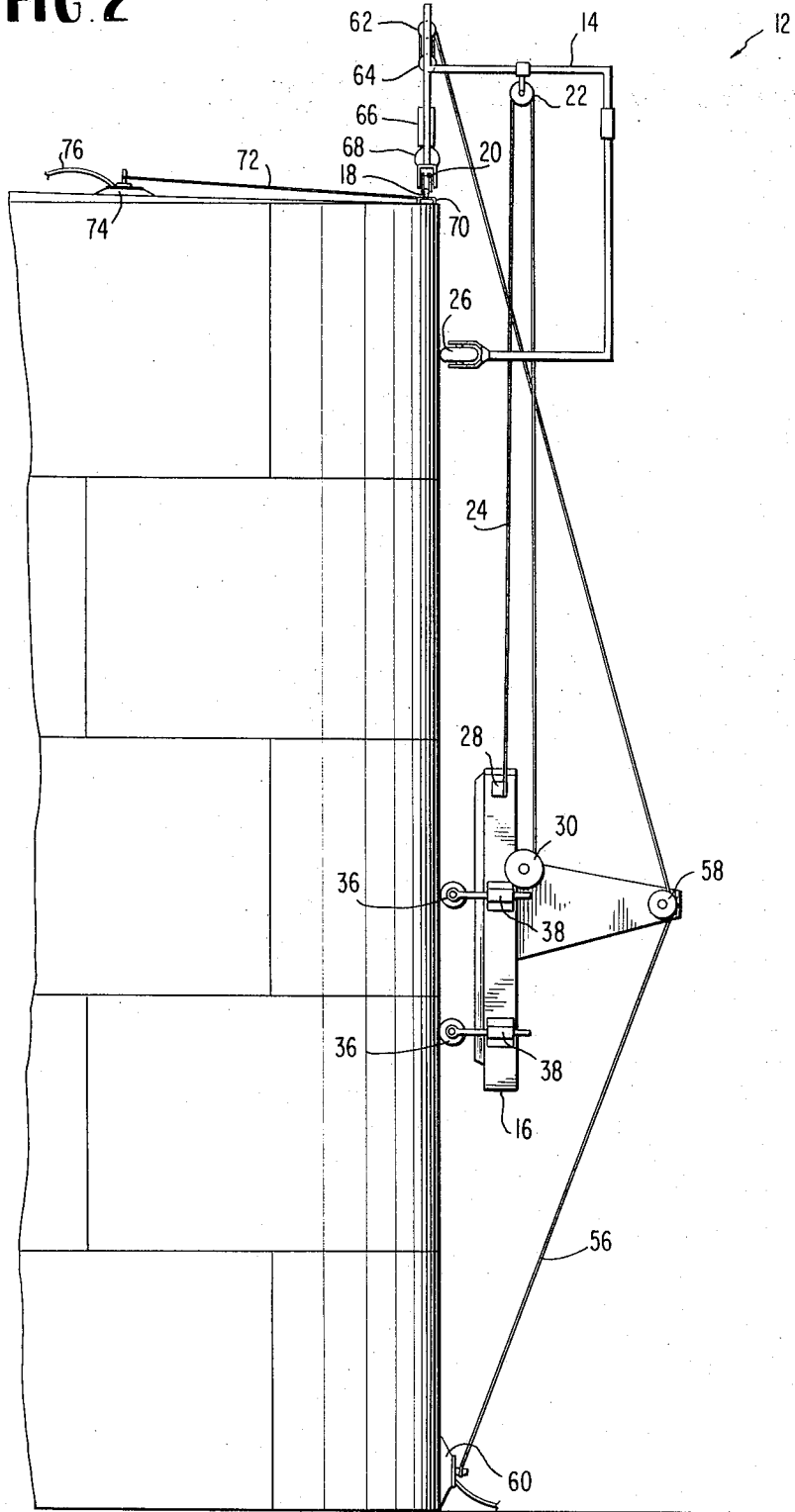


FIG 3

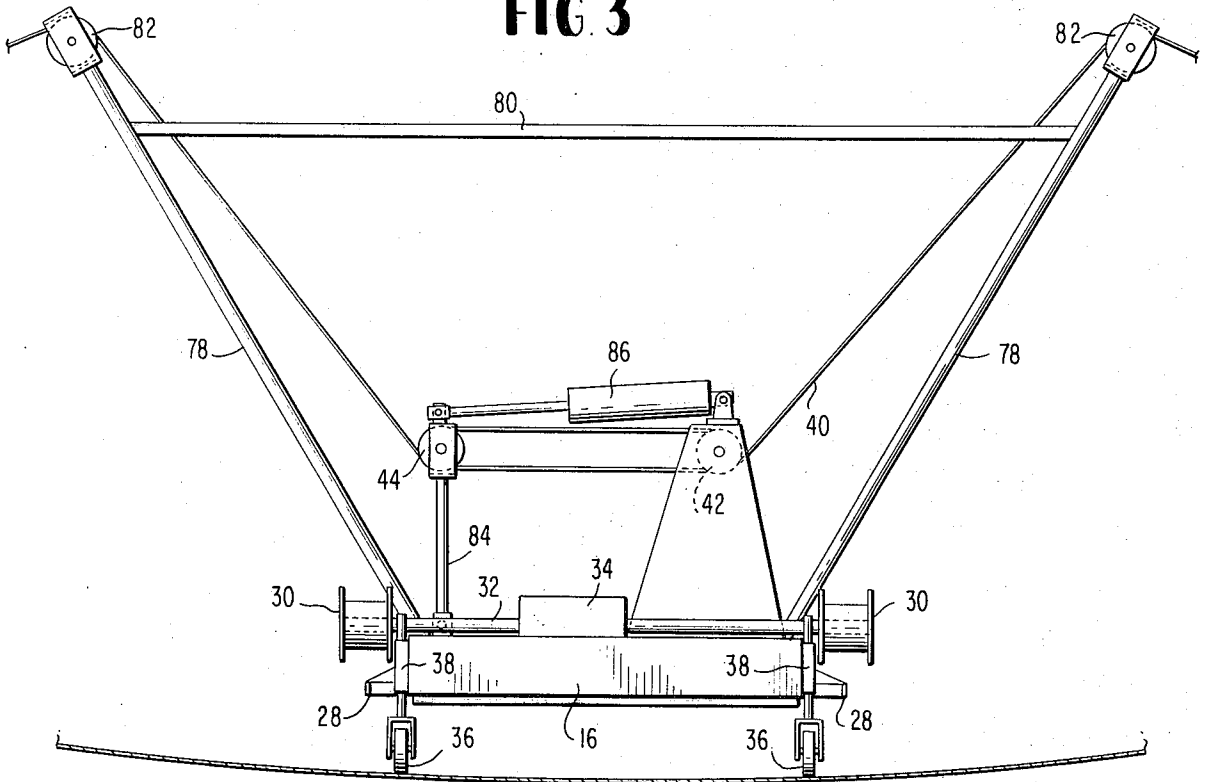
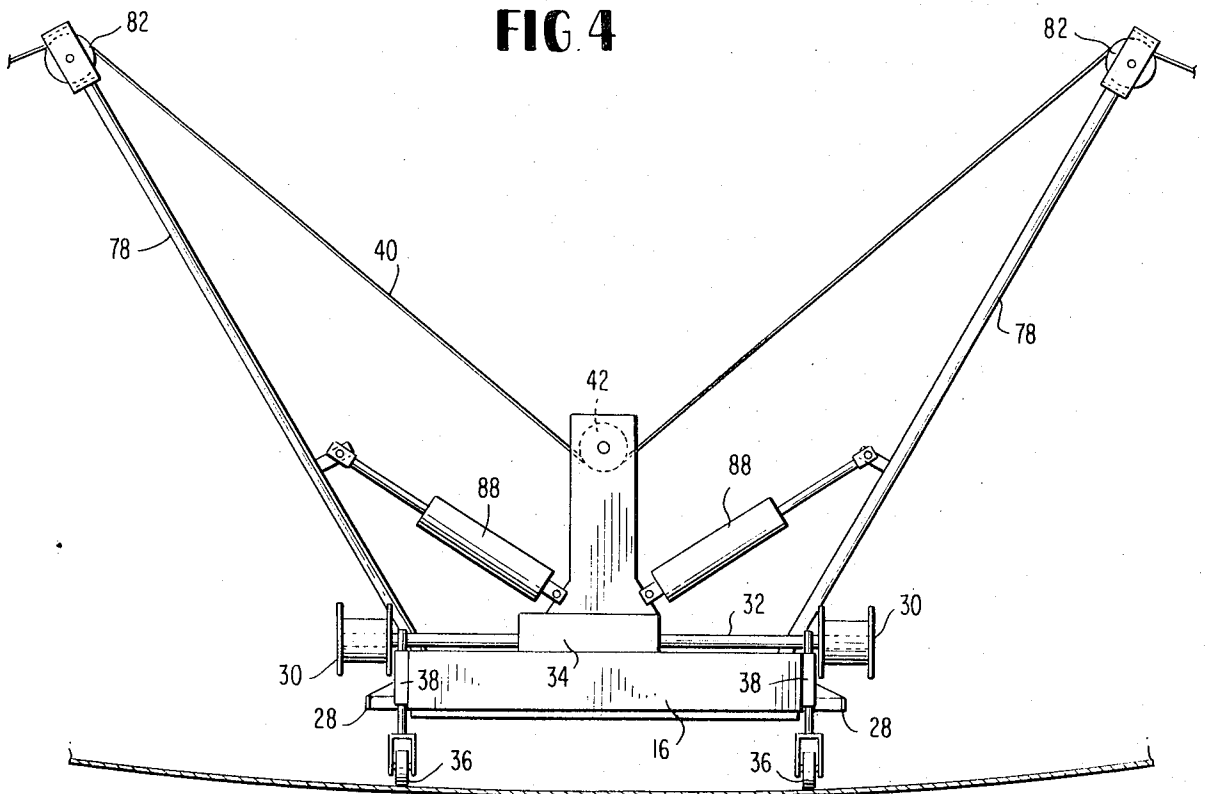


FIG 4



APPARATUS FOR SUPPORTING WORK MEANS ON VERTICALLY DISPOSED SURFACE

The present invention relates to a support means, and in particular to a support means adapted to position a work means in a contact relationship with a vertically disposed surface. The support means in conjunction with the work means enables vertical horizontal and diagonal movement of the work means over the vertically disposed surface. Advantageously, the support means is portable and can easily be attached to and removed from the vertically disposed surface.

The present invention provides an advantageous means for supporting a work means, for instance, a spray head, a blast head, other surface treating tool means, tool support means or a scaffolding means, in a desired relationship to a vertically disposed surface. By the novel apparatus it is possible to position the work means in continuous relation with the vertically disposed surface or at a desired distance from the vertically disposed surface. The support means can be employed in conjunction with flat surfaces as well as surfaces of variable or changing contour, e.g., vertical curvature as well as horizontal curvature and convex as well as concave curvature. Since the support means of the present invention enables movement of the work means in a horizontal and vertical direction over the vertically disposed surface, it is highly beneficial where, for instance, a large vertical surface needs to be treated. Minimal labor and time are required to set up this apparatus, and hence, economic benefits can be achieved in employing the present invention. Further, the apparatus of the present invention is adapted to be vertically supported at the upper edge or top surface of the vertically disposed surface. Thus, the support means can be utilized over water, oil, rough land terrain and the like without concern. As is seen, the apparatus of the present invention is particularly useful in supporting surface treating tool means or scaffolding required for the treatment of vertically disposed surfaces such as the side walls of a ship's hull, large conservation tanks for water, gas, petroleum or other fluids or solids, walls, exteriors of buildings and the like.

Heretofore, the positioning of a work means with respect to large vertical surfaces and at a desired distance therefrom has been accomplished by the use of a frame means which is supported by the terrain surrounding the vertically disposed surface. Such devices are obviously cumbersome, require extensive manpower in constructing and in operating, normally permits easy movement of the work means solely in the vertical direction, and its use is restricted by the surrounding terrain. Further, complicated positioning means are required on such a frame means to locate the work means at the desired location with respect to the vertically disposed surface, particularly if the surface is contoured. Another apparatus for supporting a work means employs vertically depending flexible support members affixed to the upper portion of the vertically disposed surface. While such an apparatus may allow vertical movement of the work means, it is not satisfactory in many circumstances in that horizontal movement is difficult, no means are provided to position the work means at a desired location with respect to the vertical surface, and satisfactory control over the work means may be impossible due to the fact that the work means may be affected by adverse environmental factors, for example, wind.

The apparatus of the present invention is comprised of a vertical support frame, a work means, flexible vertical support members depending from the support frame and affixed to the work means, and a flexible track means contacting the work means and adapted to provide contact of the work means with the vertically disposed surface. In more detail, the work means is preferably provided with a positioning means adapted to contact the surface to locate the work means with respect to the surface. The positioning means can be casters, slides or the like to facilitate the movement of the work means over the surface. Additionally, the work means can be provided with a tensioning means which is adapted to contact the track means in a manner such as to force the work means into contact with the surface. Beneficially, the work means is self-propelled; however, it is also possible to propel the apparatus by other means.

The supporting means of the present invention is generally easily adaptable to numerous uses and is thus broadly practical and salable. The novel apparatus is economical to manufacture and simply constructed yet sturdy and durable under extended use and operates with relative freedom from wear. It is also possible to adapt the support means and work means for remote control. Such remote control adaptation need not be accompanied by extensive sensing means for positioning the work means.

For a fuller understanding of the invention, reference should be made to the following detailed description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of a support means of the present invention with a schematic representation of a work means and with a horizontal track means;

FIG. 2 is a side elevational view of a support means of the present invention having a vertically positioned track means;

FIG. 3 is a top view of a schematic representation of a work means provided with one type of tensioning means adaptable for engaging a horizontal track means; and

FIG. 4 is a top view of a schematic representation of a work means provided with another type of tensioning means adaptable for engaging a horizontal track means.

With reference to FIG. 1, the apparatus of the present invention is generally referred to as 10. A vertical support means 12 is illustrated as comprising rigid frame members 14 which are adapted to support themselves and work means 16 when positioned above or at the upper edge of the vertically disposed surface. The frame means 12 is depicted as engaging track means 18 which is located adjacent to the upper edge of the surface. Alternatively, the track means can be attached to the vertically disposed surface or any other surface above the vertically disposed surface. Desirably, the track means provides support for the frame means for vertical forces, e.g., to counteract gravity, and for a lateral force in a direction perpendicular and away from the surface to counteract the torsional forces to which the frame means is subjected. The track means upon which frame means 12 rides may be, for example, a rail or a groove. The rail can be rigid and in sections or somewhat flexible to permit forming a track means which approximates the horizontal contour of the vertically disposed surface. The track means may be per-

manently secured to a horizontal surface above and adjacent to the vertically disposed surface or it may be detachable. Affixing means suitable for enabling removal of track means 18 are, for example, vacuum cups, magnets, clamps, or other fastening devices.

Wheel means 20 are affixed to frame means 12 and are adapted to contact track means 18. The wheel means are preferably designed such that vertical forces and lateral forces developed by the frame means are counteracted by the contact of wheel means 20 with the track means. Beneficially, the wheel means are rotatably mounted on the frame means to enable the frame means to easily move in a horizontal direction around a curved track. It may be desirable under certain conditions to provide a safety lock means in association with wheel means 20 to prevent disengagement of the wheel means and the track means. A suitable safety lock means is, for example, a latch means which is adapted to ride in a groove located in the side of the track means and thus restrict vertical movement of the wheel means with respect to the track. Rather than a wheel means to engage track means 18, other contact means which are preferably low in frictional contact, such as ball bearing devices, slide runner devices, air cushion means adapted to support the frame means by a cushion of air, etc.

The frame means is preferably adapted to contact track means 18 and to contact the vertically disposed surface in order to provide support for the work means. As depicted, wheel means 26 are provided which are affixed to a lower rigid support member and contact the vertically disposed surface. The wheel means reduce friction of movement when the frame means moves or is moved in a horizontal direction along the upper edge of the vertically disposed surface. Instead of wheel means, other suitable means such as ball bearing devices, slide runner devices and the like may be employed.

Affixed to frame means 12 are pulley means 22 which are adapted to receive flexible vertical support members 24. The flexible vertical support members 24 depend from the frame means and are affixed to work means 16. Preferably, the frame means is adapted to at least partially receive the work means into its interior and thereby enable the work means to reach or surpass the upper edge of the vertical surface. Thus, pulley means 22 are desirably located to the interior of the frame means on upper rigid support members 14, and the frame means is free from rigid support members or the like which would interfere with the upward movement of the work means. Rather than providing pulley means 22 on frame means 12, other means may be employed to affix the flexible vertical support members. For instance, a winch means may be provided on the frame means to receive the flexible vertical support members and, in combination with a power source, be used to vary the depending length of the support members, and hence, the vertical position of the work means. On the other hand, a securing means may be employed to attach the support member to the frame means. To obtain a further mechanical advantage, a block and tackle arrangement may be used.

Flexible vertical support member 24 can be, for example, a cable, chain, band, flexible track or other suitable device. The vertical support member is attached to work means 16. If a power means is provided on the frame means for gathering and releasing flexible verti-

cal support means 24, the vertical support means may be securely affixed to the work means. As depicted in the Figure, the flexible, vertical support means is securely attached to work means by affixing means 28.

The flexible vertical support means extends upward to and over pulley means 22, and downward to the work means whereat the support means is affixed to winch means 30. Winch means 30 are preferably provided on both sides of work means 16 and are desirably interconnected by rigid shaft means 32. The winch means are powered by a hoist drive means 34 contained on work means 16. Desirably the hoist drive means employed to activate the winch means comprises a power source and a drive train means which is provided with a self-braking gear drive. When, for instance, the work means is a scaffold or other device where the winch means are relatively widely separated, the rigid shaft means may be desirably replaced with separate hoist drive means for each winch means. Control of the separate hoist drive means may be manual control, or the hoist drive means may be electrically interconnected to insure equal response by each hoist drive means.

The movement of work means 16 over the vertically disposed surface is facilitated by casters 36 which are mounted on the work means so as to bear a significant amount of the force of contact of the work means with the surface. The casters are rotably mounted and are affixed to the work means by clamps 38. Clamps 38 permit the casters to be positioned either a greater or lesser distance from the work means, and the positioning can be done manually or remotely. The casters can be positioned to control the attitude of the work means. It is readily seen that by the use of casters, the use of complex positioning mechanisms required when a frame means is supported on the terrain surrounding the vertically disposed surface is avoided. For many applications, the continual readjustment of the casters is unnecessary to provide the desired spatial relationship between the vertically disposed surface and the work means. The casters are depicted as being in a lateral position on the work means. Other placements of the casters can be made; for instance, a set of three casters may be employed on the work means in a triangular configuration. It is apparent that other suitable devices may be employed in lieu of the casters. For example, roller bearing devices, slide runner devices, air cushion devices, etc. may advantageously be used. When, for example, a spray head is supported by the apparatus of the present invention, air cushion devices are beneficially employed to prevent contact of the work means with the treated surface.

The apparatus of FIG. 1 is provided with horizontal track means 40 which contacts work means 16. The horizontal track means serves to force the work means into contact with the vertically disposed surface. In addition, the horizontal track means may be engaged and employed to provide a friction contact or other essentially non-slipping contact to enable the propulsion of the work means in a horizontal direction. The horizontal track means can be, for example, a cable, chain, band, rigid or flexible track, or other suitable device. Forcing the contact of the work means and the vertically disposed surface can be accomplished by providing a means to shorten the track means. Such a means can be located away from the work means and on the track means, for example, a turnbuckle, or it can be located on the work means. For instance, when a cable

is used as the horizontal track means, tension can be created by providing pulley means 42 which is stationarily positioned away from the work means. Pulley means 44 is provided on work means 16 and is adapted to be activated in a direction essentially perpendicular to the surface. Activation means 46 is employed to move pulley means 44. Suitable activation means are, for instance, pneumatic or hydraulic cylinders or pneumatic or hydraulic rotary actuators. Track means 48 is provided to guide pulley means 44 in the desired direction and assist the support of pulley means 44. Beneficially, pulley means 42 and pulley means 44 can be cable sheaves, each with three grooves. The cable can be threaded on the side furthest from the surface of one sheave, across to and around the second sheave and back to and around the first sheave and across over the last groove of the second sheave. By increasing the distance, in any desirable direction, between pulley means 42 and pulley means 44, the tension in the cable can be increased.

Another function which can be provided by pulley means 42 is to engage with the horizontal track means to propel the work means in a horizontal direction. The desired contact of the track means and pulley means 42 can be obtained by several means. For instance, increasing the tension in the track means may increase the frictional contact sufficiently for the desired contact. A freely rotatable pulley can be provided which is adapted to be drawn towards pulley means 42 in such a manner that the track means is forced into contact with pulley means 42 to provide the desired contact. In another mode, a chain and sprocket system may be used for the horizontal track means and pulley 42 wherein rather than frictional contact, linking contact is formed. A power source for pulley means 42 is located in motor housing 50.

Attached to the vertically disposed surface on opposing sides of the work means are horizontal track securing means 52. The securing means may be permanently attached to the surface or they may be detachable. Attachment means include vacuum cups, magnets, clamps and the like. Securing means 52 can be in the form of a grooved track wherein the point of attachment of horizontal track means can be quickly adjusted to the desired height. Clamp means 54 are affixed to the horizontal track means and are adapted to ride in the general track and be positioned at the desired location. Clamp means 54 can be manually positioned, or they may be automatically positioned. Rather than providing a grooved track means, a clamp means can be directly affixed to the surface by, for example, employing vacuum cups, magnets, clamps and the like. When the vertically disposed surface is for example a cylindrical conservation tank, a horizontal track means may be provided which is an endless cable around the tank and contact the work means and the tank. By tensioning the cable, the desired force can be exerted upon the work means to provide its contact with the surface. Securing means which fasten the cable to the tank may not be required since the cable does not support the weight of the work means and the work means can be adapted to support the weight of the cable. A particularly advantageous means of increasing the tension in such a cable is by the use of a means which attaches to the end portions of the cable and draws in at least one end of the cable until the circumference formed by the cable is the desired distance to provide the desired tension.

This means is operable on tanks having diameters up to 110 feet or more.

FIG. 2 depicts another embodiment of the apparatus of the present invention in which like members retain the same number. The support means of FIG. 2 is suitable for primary movement of work means 16 in a vertical direction with means for horizontal movement. Track means 56 is employed instead of horizontal track means 40 and passes from frame means 12, over freely rotatable pulley means 58 extending from work means 16, to track securing means 60. As shown, track securing means 60 is attached to the vertically disposed surface by means of a vacuum cup. Beneficially, a grooved track means can be employed to receive a securing means which is affixed to the track means so that the track means can be easily positioned. By positioning the securing means automatically, the horizontal movement of frame means 12, track means 56 and the securing means can be coordinated.

Frame means 12 is adapted to have a means to receive track means 56. Affixed to an upper rigid member 14 is pulley means 62. Desirably, track means 56 passes over pulley means 62 and around pulley means 64 and back to pulley means 62. Pulley means 64 is connected to tensioning means 66 affixed to frame means 12. Tensioning means 66 can be, for example, pneumatic or hydraulic cylinders, springs or the like, and serves to move pulley means 64 toward or from pulley means 62 thereby altering the length, and hence tension, of track means 56 extending from the frame means to track securing means 60.

Horizontal movement of the apparatus is effected by driving wheel means 20 on the frame means with horizontal drive means 68. Another means to effect horizontal movement is, for example, to provide a drive wheel on work means 16 which contacts the surface with sufficient frictional contact that movement can be imparted to the apparatus. Wheel means 26 on frame means 12 may be provided with a drive means to effect horizontal movement. Wheel means 20 rides on track means 18. Track means 18 is illustrated as being detachable. Track means 18 is mounted on track base 70 which can be segmented so as to provide bridge sections over any irregularities which may be present on the upper surface. The track base is freely positioned on the upper surface and is connected to rigid member 72 which extends inwardly to a point where it is secured to the upper surface. For instance, rigid member 72 can be securely affixed to the upper surface by vacuum cup means 74. Vacuum cup means 74 has vacuum line 76 exiting from it and provides the suction to hold the vacuum cup to the surface. Other fastening means may also be used such as magnets, clamps and the like. Rigid member 72, being in a spaced away relationship from track base 70, assists in counteracting lateral forces developed on the track means by reason of frame means 12 and work means 16 suspended therefrom.

In another embodiment, rather than counteracting lateral forces by a track means, a counter weight or other means can be provided on frame means 12 to counteract the weight of the frame means and work means supported therefrom. Thus, a fulcrum can be achieved at wheel means 20. Beneficially, wheel means 20 can be adapted to ride directly on the upper surface and a lateral support member can be positioned between, for example, the upper rigid members of frame

means 12 and a point on the surface inward from the frame means. If the vertically disposed surface forms a conservation tank or the like with a circular cross-section, the point of contact can be the center of the described circle and horizontal movement of the apparatus in a horizontal direction around the tank can be around the point of contact. The member from the fulcrum to frame means 12 counteracts the lateral force component working on the apparatus.

FIG. 3 is a top view of schematic representation of a work means having one type of tensioning means operable in the present invention. Like members are designated the same in the figures. As depicted, the work means is adapted to contact a concave surface. Extending angularly, outwardly from the rear of work means 16 are extension arms 78. Preferably, the extension arms are rigidly affixed to work means 16. Brace means 80 is provided between the extension arms and the work means. At the end of extension arms 78 are freely rotatable pulley means 82. Horizontal track means 40 passes to the far side with respect to work means 16 of pulley means 82 and then inwardly toward the work means to pulley means 44 and pulley means 42 and then to the far side of the other pulley 82. Pulley means 42 and pulley means 44 are adapted to alter tension in horizontal track means 40. Pulley means 44 is positioned on extension arm 84, which in turn is pivotally mounted on work means 16. Tensioning means 86 is attached between extension arm 84 and pulley means 42 or the work means in order to move pulley means closer or farther from pulley means 42. Horizontal track means 40 is desirably positioned around pulley means 42 and pulley means 44 such that an increase in distance between those pulley means will increase the tension in the horizontal track means. For example, horizontal track means 40 can be positioned on the inward side of pulley means 44, passed around pulley means 42, back around pulley means 44 and back to the inward side of pulley means 42 wherein the pulley means are sheaves with three grooves. The tension in horizontal track means 40 exerts a force on pulley means 82 which is transmitted through extension arms 78 to work means 16 to put work means 16 into contact with the vertically disposed surface.

FIG. 4 illustrates another tensioning means similar to that of FIG. 3 except that extension arms 78 are probably fastened to work means 16 and tensioning means 88 are provided between extension arms 78 and work means 16 in such a manner that the extension arms can be drawn closer or farther away from pulley means 42. By passing horizontal track means 40 to the outward sides of pulley means 82 and to the inward side of pulley means 42, the tension in the track means can be increased by drawing extension arms 78 closer to pulley means 42. Rather than adapting both extension arms 78 with separate tensioning means, one tensioning means can be adapted to move both arms or one arm can remain stationary. Pulley means 42 and a pulley means 82 can be sheaves and the horizontal track means may be utilized in the manner described in FIG. 3 to increase the tension. The use of the sheaves permits a greater tensioning in the track means to occur for the same relative movement between the pulley means.

The work means can be, for instance, a platform for men, a paint sprayer, a blast head, a sanding device, a

scrubbing device, a blow torch or the like. Particularly advantageous is the combination of the supporting means of the present invention and a tool means which requires a desired contact with a vertically disposed surface. For example, a blast head of the type described in U.S. Pat. No. 3,566,543, issued to Fogel, or my co-pending patent application Ser. No. 229,842, filed Feb. 28, 1972, now U.S. Pat. No. 3,788,010, provides a sealing means between the apparatus and surface being treated in order to prevent the escape of dust, grit or other particulate material to the atmosphere. In order to provide a sufficient seal, a forced contact between the surface and sealing means must be provided, otherwise, the ecological advantages of this type of blast head may not be realized. The present invention as hereinbefore described provides an advantageous support system which provides the necessary force required to obtain a desired seal. Another advantageous use of the present invention is in association with a spray head. In order to obtain a coating on surface which is uniform to prevent sparsely coated sites which may lead to corrosion and to prevent heavily painted sites and thus enhance economy of painting operations, it is desirable to provide a means to position a spray head at a uniform distance from the surface and to mechanically control the movement of the spray head. The present invention provides a means to enable a spray head to be positioned a uniform distance from the surface by use of casters and the tensioning which forces the casters into contact with the surface. Additionally, the spray head can be adapted with a shield means which extends to the surface to prevent the escape of the coating material and fumes, which often have toxic properties and which may be flammable, to the atmosphere.

Other modifications in the system of the present invention can be made. For instance, a blast head can be positioned by the support means to clean a surface. Immediately following, a spray head can be adapted to be supported by the apparatus thus enabling the cleaning and coating operations to operate in conjunction with each other. By such a system, the coating of cleaned surface can immediately be done to prevent recurrence of any corrosion.

I claim:

1. A support apparatus adapted to be used in conjunction with a vertically disposed surface comprising a vertical support frame positioned above at least a portion of said vertically disposed surface; at least one flexible vertical support member attached to said vertical support frame; a depending means adapted to attach to and supported by said flexible vertical support member; positioning means extending from said depending means adapted to contact said vertically disposed surface; and a flexible track means extending in a horizontal direction which contacts said vertically disposed surface at least at one location and which contacts said depending means whereby the contacting of said flexible track means forces said positioning means into contact with said vertically disposed surface.

2. The support apparatus of claim 1 wherein a tensioning means is provided in contact with said flexible track means and is adapted to alter tension in said flexible track means.

3. The support apparatus of claim 2 wherein the tensioning means comprises at least one outwardly extending arm positioned on said blast head adapted to

contact said flexible track means and an engagement means positioned on said blast head which is adapted to contact said flexible track means.

4. The support apparatus of claim 3 wherein two outwardly extending arms are provided on said blast head and said engagement means is positioned on said blast head between said outwardly extending arms.

5. The support apparatus of claim 4 wherein the two outwardly extending arms are pivotably mounted whereby tension is altered by pivoting said outwardly extending arms.

6. The support apparatus of claim 4 wherein the engaging means comprises two sheaves, at least one of which is adapted to be moved with respect to the other whereby the movement of at least one of said sheaves alters the tension in said flexible track means.

7. The support apparatus of claim 1 wherein said vertical support frame is adapted to rest on a track means and said track means is positioned above at least a portion of the vertically disposed surface.

8. The support apparatus of claim 1 wherein said depending means comprises a sprayer means.

9. The support apparatus of claim 1 wherein said depending means comprises a blast head and a sprayer means which operates in conjunction with said blast head.

10. The support apparatus of claim 1 wherein a tensioning means is provided in contact with said flexible track means and is adapted to alter tension in said flexible track means.

11. The support apparatus of claim 10 wherein the tensioning means comprises at least one outwardly extending arm positioned on said depending means adapted to contact said flexible track means and an engagement means positioned on said depending means which is adapted to contact said flexible track means.

12. The support apparatus of claim 11 wherein two outwardly extending arms are provided on said depending means and said engagement means is positioned on said depending means between said outwardly extending arm.

13. The support apparatus of claim 12 wherein the two outwardly extending arms are pivotably mounted whereby tension is altered by pivoting said outwardly

extending arm.

14. The support apparatus of claim 12 wherein the engaging means comprises two sheaves, at least one of which is adapted to be moved with respect to the other whereby the movement of at least one of said sheaves alters the tension in said flexible track means.

15. The support apparatus of claim 1 wherein said vertical support frame is adapted to rest on a track means and said track means is positioned above at least a portion of the vertically disposed surface.

16. A support apparatus to be used in conjunction with a vertically disposed surface comprising a vertical support frame positioned above at least a portion of said vertically disposed surface; at least one flexible vertical support member attached to said vertical support frame; a depending blast head adapted to attach to and supported by said flexible vertical support member; positioning means extending from said blast head adapted to contact said vertically disposed surface; and a flexible track means extending in a horizontal direction which contacts said blast head whereby the contacting of said flexible track means forces said positioning means into contact with said vertically disposed surface.

17. A support apparatus adapted to be used in conjunction with a vertically disposed surface comprising a vertical support frame positioned above at least a portion of said vertically disposed surface; at least one flexible vertical support member attached to said vertical support frame; a depending means adapted to attach to and supported by said flexible vertical support member; a tensioning means comprising at least one outwardly extending arm positioned on said depending means adapted to contact a flexible track means and an engagement means on said depending means which is adapted to contact said flexible track means; and a positioning means extending from said depending means adapted to contact said vertically disposed surface, whereby the contacting of said flexible track means with said tensioning means forces said positioning means into contact with said vertically disposed surface.

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