United States Patent

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[54] **FLEXIBLE LADDER**
14 Claims, 6 Drawing Figs.

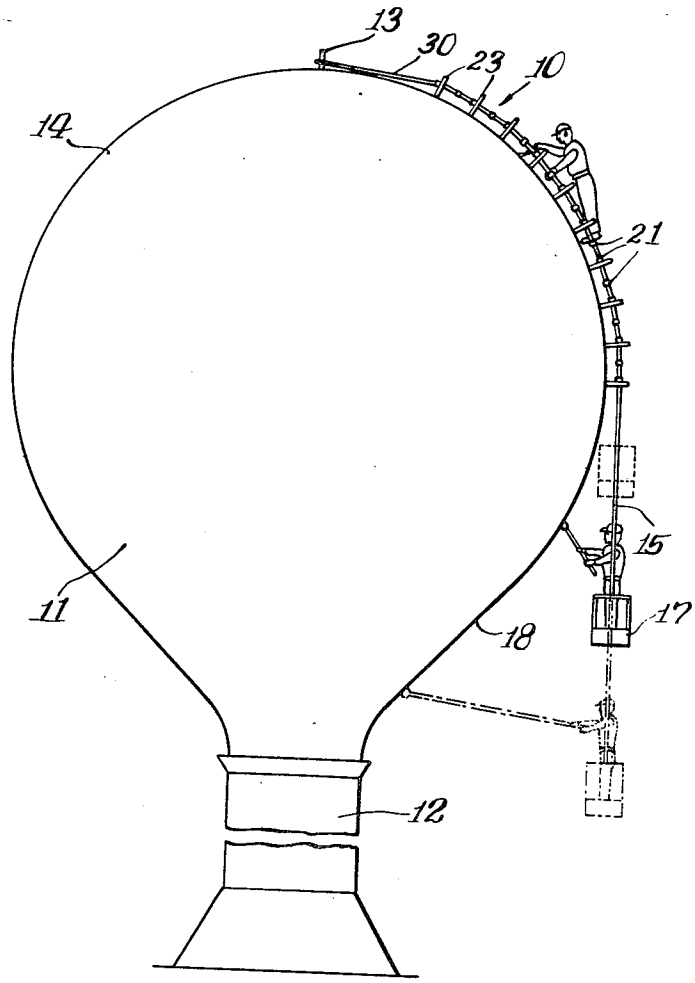
[52] **U.S. Cl.** **182/150, 182/198**
[51] **Int. Cl.** **E06c 1/397, E06c 1/56**
[50] **Field of Search** 182/197, 198, 150, 12, 13, 14, 93

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ABSTRACT: A ladder for use such as in painting spherical structures permitting facilitated movement of the ladder about the structures for facilitated work on the structures such as painting thereof. The ladder includes wheel means for permitting facilitated movement thereof about the structures and includes flexible side members to provide for accommodation of the ladder to the spherical configuration.



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SHEET 1 OF 2

Fig. 1.

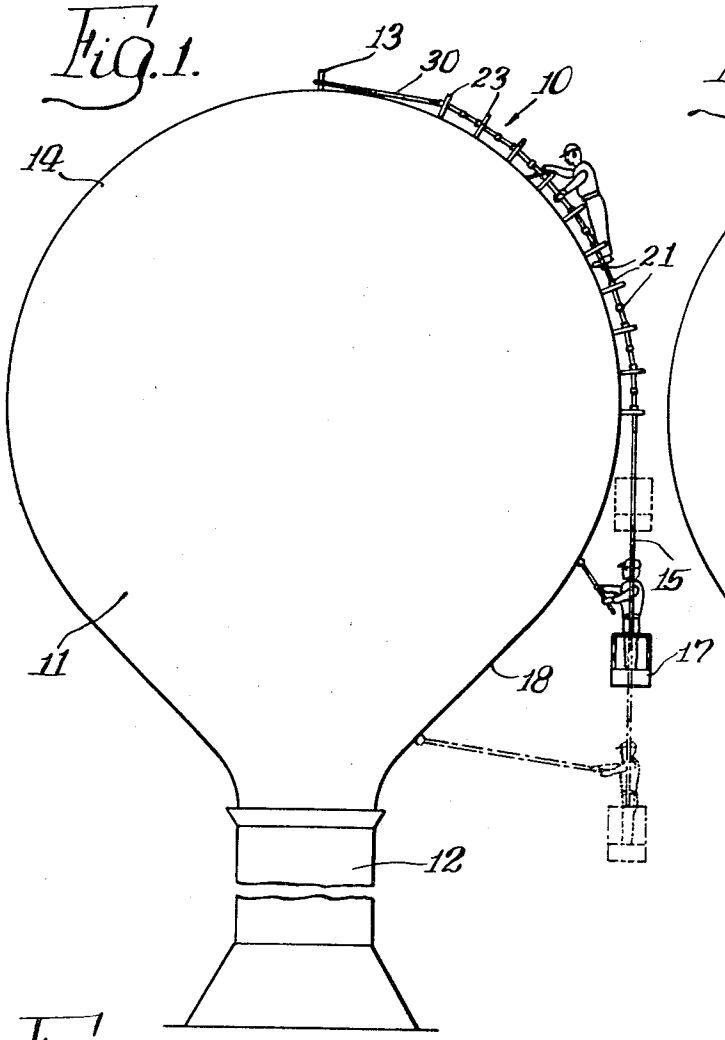


Fig. 2.

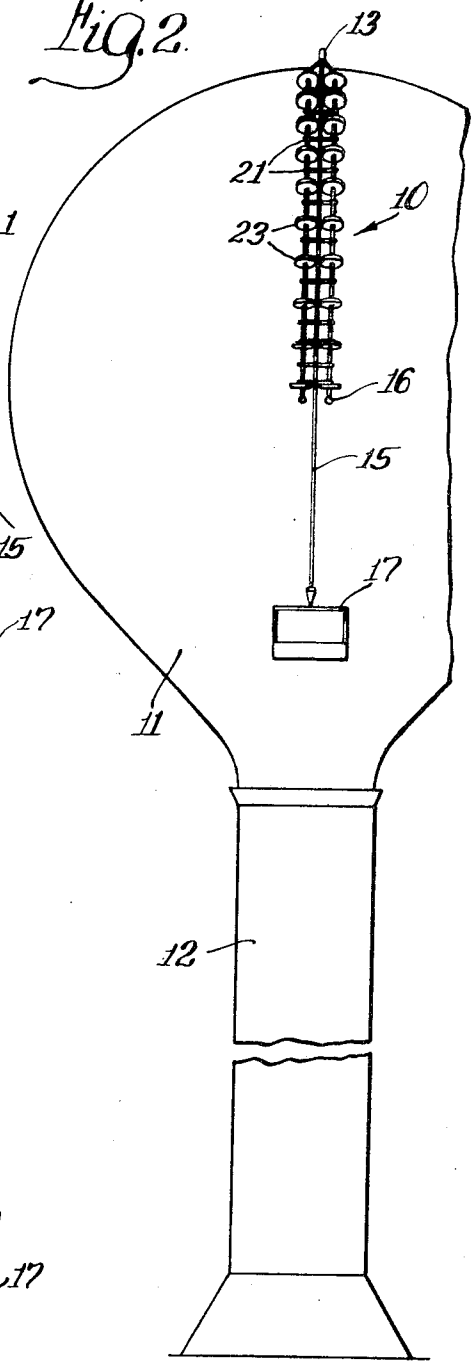
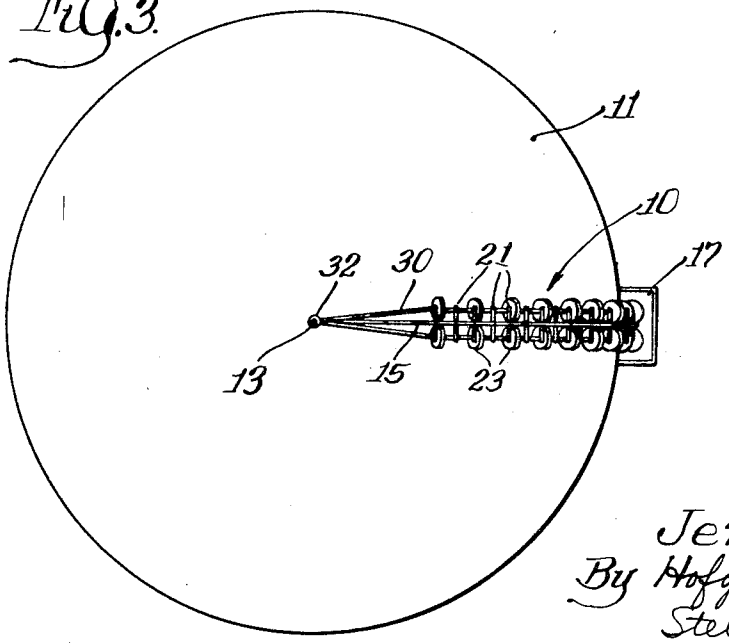


Fig. 3.



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Fig. 4.

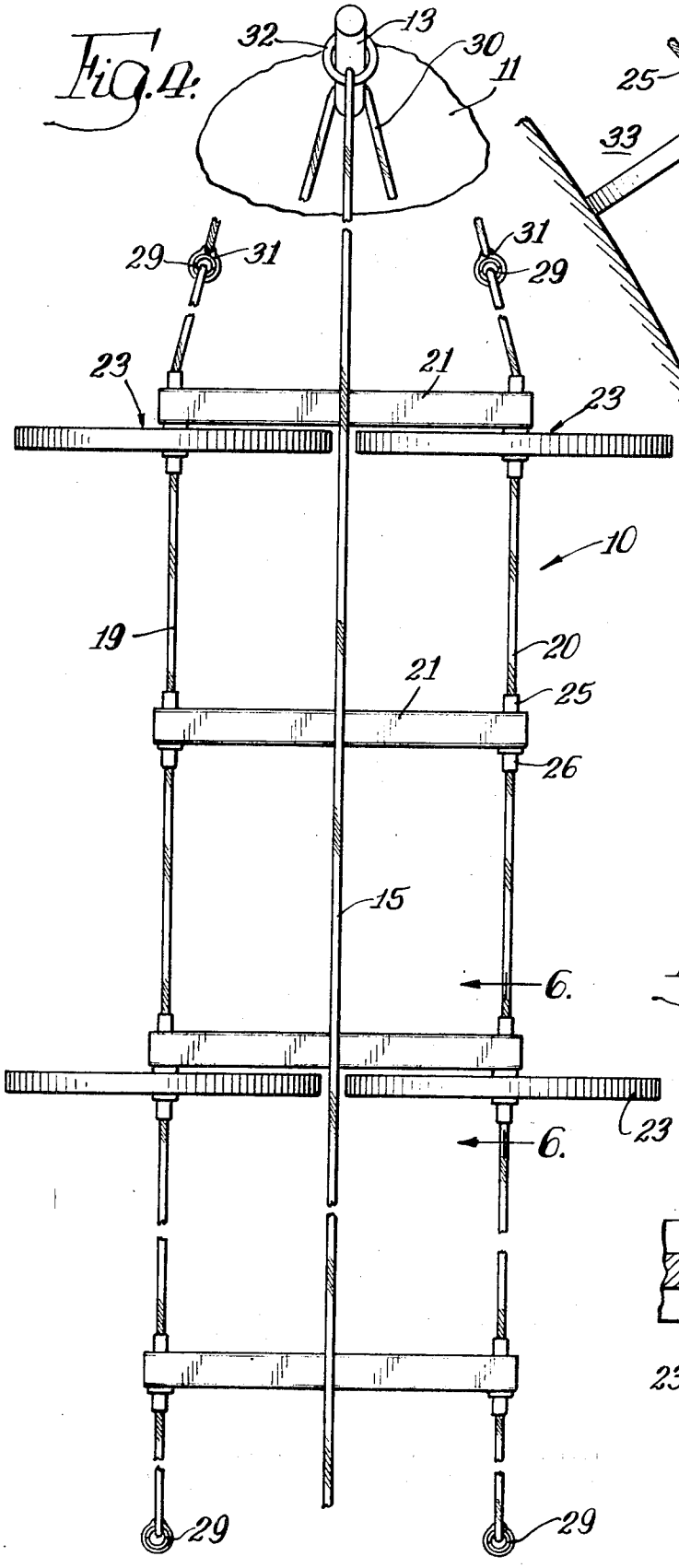


Fig. 5.

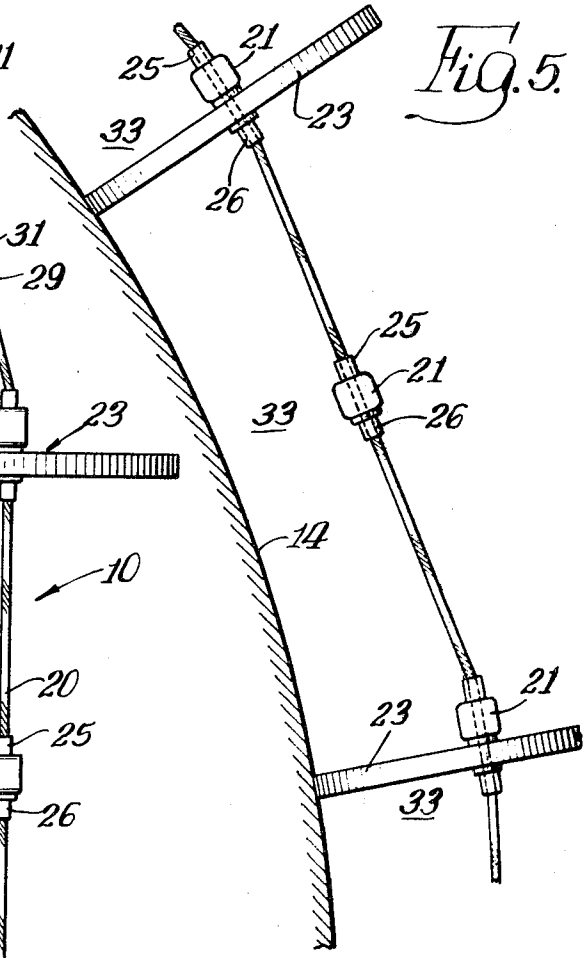
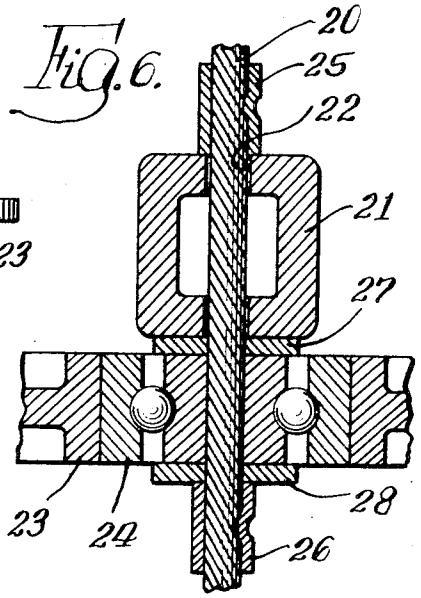


Fig. 6.



FLEXIBLE LADDER

BACKGROUND OF THE INVENTION

1. Fleld of the Invention

This invention relates to ladders and in particular to ladders adapted for movement relative to nonplanar surfaces.

2. Description of the Prior Art

In conventional ladder constructions, side members formed of rigid elongated elements are provided for supporting a plurality of longitudinally spaced rungs at preselected intervals. Such rigid ladder constructions have a limitation in the usefulness thereof where they are employed other than against flat upright walls. Thus, for example, in ladders and scaffolding utilized in painting and repair of ships, flexible ladders utilizing chains and the like for the side members are conventionally employed.

Another problem found in the use of conventional ladders is difficulty of movement of the ladder along the wall surface. To avoid need for such movement, scaffolds employing horizontal supports have been utilized. Further, certain ladder constructions have been developed wherein wheels have been associated with the ladders at opposite ends thereof for permitting rolling movement of the ladder ends against the supporting surfaces. In one known construction for working on spherical structures, scaffolding has been employed comprising a plurality of rigid sections articulated to have limited conformation to the spherical surface and provided with with wheel drives for driving the articulated scaffolding circumferentially about the spherical surface.

The known ladder structures for use with such spherical surfaces are relatively complex and expensive and of substantial weight effectively limiting the usefulness thereof.

SUMMARY OF THE INVENTION

The present invention comprehends an improved ladder construction utilizing flexible side members provided at spaced intervals with pairs of freely rotatable wheel elements. The wheel elements may be juxtaposed to selected ones of the rungs of the ladder. The wheel elements may be retained in position on the side members by suitable securing means. More specifically, the means for maintaining the disposition of the wheel elements longitudinally of the side members may further be cooperatively utilized for maintaining the disposition of the rungs.

The ladder may include a cable extending along the centerline thereof between the opposed wheel pairs for supporting a cage or the like subjacent the lower end of the ladder. Thus, in use, the ladder may be placed against the upper surface of a spherical or domed structure, such as a water tank ball, to extend from the top post thereof. The cage may be hung to be disposed at the level of the undersurface of the ball with the rungs serving as the means for supporting the cage-supporting cable to extend downwardly from the ball post.

The wheels are preselected to provide sufficient spacing of the rungs from the ball surface to define a toe space providing facilitated use of the ladder by a user standing on the rungs. The rungs may be formed of square section tubular material for improved support of the user. The wheels may comprise ball bearing wheels for improved movability of the ladder.

The upper end of the ladder may be provided with suitable hook elements for connecting an upper support cable between the ladder and the upper post of the ball.

The means for retaining the wheels and rungs on the side members may comprise constrictible clamp elements adapted to be compressibly locked to the cable at the preselected intervals.

BRIEF DESCRIPTION OF THE INVENTION

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing wherein:

FIG. 1 is a fragmentary side elevation of a ladder structure embodying the invention utilized in painting a ball structure;

FIG. 2 is a fragmentary front elevation thereof;

FIG. 3 is a top plan view thereof;

FIG. 4 is a fragmentary enlarged front elevation of the ladder and means for securing the ladder to the ball post;

FIG. 5 is a fragmentary side elevation of the ladder with the wheel elements thereof engaging the ball surface; and

FIG. 6 is a fragmentary enlarged section taken substantially along the line 6—6 of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the exemplary embodiment of the invention as shown in the drawing, a ladder construction generally designated **10** is shown for use with a spherical structure such as ball **11** carried on a vertical stem **12**. Such structures conventionally known as ball-type water structures are well known in the art. Such structures include an upper post **13** at the top of the upper spherical surface **14** thereof. Conventionally, means are provided for permitting access to the top of the ball through the inside thereof, permitting ladder **10** to be brought upwardly through the ball and subsequently hung from post **13** in the arrangement shown in FIGS. **1–3** or may be extended through the conventional upper manhole of the ball and secured to internal structure such as the ship's ladder conventionally provided within the ball to provide such access.

As best seen in FIG. **1**, ladder **10** is flexible to permit full accurate accommodation thereof to the upper spherical surfaces **14**. A climbing wire **15** may be hung downwardly from the lower end **16** of the ladder and carries a suitable cage **17** of conventional construction. The cage may be winch driven for vertical adjustment on climbing wire **15** as shown in FIG. **1** permitting a person in the cage to have access selectively to different portions of the undersurface **18** of the ball.

As discussed briefly above, ladder **10** is arranged to provide for facilitated movement circumferentially about the ball. Thus, as shown in FIG. **4**, ladder **10** includes a pair of flexible side members **19** and **20** which may illustratively comprise conventional one-fourth inch 6×19 strand preformed plow steel cables. At preselected intervals, such as 1 foot intervals, rungs **21** may be provided on the cables. Illustratively, the rungs may be formed of 1¼ inch square section aluminum tubes having suitable holes **22** spaced slightly from each of the opposite ends therefrom for passing of the cables **19** and **20** therethrough.

At preselected intervals longitudinally of the ladder, wheel elements generally designated **23** are mounted on the respective side cables. Illustratively, the wheel elements may comprise 8 inch rubber wheels having ball bearing center hubs **24**. As best seen in FIG. **6**, the wheels and rungs may be secured to the cables by means of constrictible sleeves **25** and **26** compressibly locked to the cables below and above the wheels and rungs. A suitable washer **24** may be provided between the wheel-bearing hub **24** and rung **21** and a suitable washer **28** may be provided between the wheel-bearing hub **24** and the lower retaining sleeve **26**.

As shown in FIG. **4**, wheels **23** may be provided in association with less than all of the rungs **21**. In the illustrated embodiment, the wheels are provided in association with every other rung. Thus, where the wheels are not associated with the rung, sleeves **25** and **26** are directly juxtaposed to the rung ends for retaining the rung on the cables **19** and **20**. Washers **27** and **28** may comprise conventional brass washers. The lower ends of cables **19** and **20** may be provided with conventional eye splices **29** having suitable plow thimbles. Similarly the upper ends of the cables **19** and **20** may be provided with similar splices **29** having plow thimbles. Connecting cable **30** may be provided at the upper end of the ladder by means of suitable connectors **31** attached to the opposite ends of connecting cable **30** for removable connection of connecting cable **30** to the upper end of the ladder. As shown in FIG. **4**, the connecting cable **30** may be passed around the center post **13** of the ball to support the ladder from the center post. Thus, the ladder is free to move circumferentially about the ball surface **14** by virtue of the rolling of wheels **23** along the surface **14** as shown in FIG. **5** with the connecting cable **30** being

swingable about the post 13. Thus, upon completion of work by the users with the ladder in the position of FIG. 2, the entire ladder may be moved to the left or to the right as desired to reposition the ladder at a desired spaced interval from the original position to permit further work on the ball in the newly accessible area. The entire ball may thusly be worked on by a progressive movement of the ladder about the axis of post 13.

As discussed above, undersurface 18 of the ball may be worked on from the cage 17. As discussed above, cage 17 may by hung from a climbing wire 15 having its upper end connected to the lower eye splices 29 of ladder cables 19 and 20. Cage 17 is thusly supported directly below the ladder and is carried with the ladder upon lateral movement of the ladder circumferentially about the ball. Thus, accessibility to different portions of the ball undersurface 18 is provided by the successive movement of the ladder permitting both the upper surface 14 and undersurface 18 to be completely worked upon with a single circuit of the ball. Vertical adjustment of the cage 17 may be effected by suitable conventional hoist means so that all portions of the ball surface from the top to the bottom thereof may be worked on in each of the ladder positions as shown in FIG. 1.

Movement of the ladder circumferentially about the ball may be effected by the user on the ladder urging the ladder laterally by application of force against the ball surface 14. Alternatively, the ladder structure may be moved circumferentially by means of a rope (not shown) dropped from the cage to the ground permitting a coworker on the ground to pull the ladder to the desired new position from the ground level. As best seen in FIGS. 1 and 5, wheels 23 space the rungs 21 sufficiently from the ball surface 14 to provide a toe space generally designated 33 inwardly of each rung for facilitated use of the ladder by the user. In the illustrated embodiment, the rungs are approximately 12 inches long where the wheels are 8 inch diameter wheels. As will be obvious to those skilled in the art, different size wheels may be provided for selectively increasing or decreasing the toe space height with suitable corresponding change in the rung length to provide clearance between the paired wheels to accommodate the climbing wire 15 as seen in FIG. 4. The wheels are preferably lightweight wheels and may be provided with rubber tires for improved traction. In the illustrated embodiment, the wheels are disposed subjacent the selected rungs 21 so that the wheels also serve to provide a support for the user's foot projecting inwardly and outwardly of the rung position for further improved utility in the use of the ladder.

The foregoing disclosure of specific embodiments is illustrative of the broad inventive concepts comprehended by the invention.

I claim:

1. In an apparatus for supporting workmen for working on a ball having a topside ball surface, an underside ball surface, an apical support at the top of said topside ball surface, and a stem supporting the ball above the ground, structure comprising:

a flexible ladder having flexible side elements, a plurality of rigid rungs, a plurality of wheels, and securing means for fixedly retaining the rungs at preselected intervals on said side elements and for rotatably mounting the wheels on said side elements at preselected intervals for rotation about the axis of said side elements; and

means for movably connecting a top end of the ladder to a support whereby said ladder may be manually moved circumferentially on the topside ball surface and spacing the rungs away from the topside ball surface sufficiently to define a toe space for a workman's foot resting on the rung and extending from the run toward the topside ball surface.

2. The supporting apparatus of claim 1 wherein said securing means comprises means for mounting a pair of said wheels on the side elements closely adjacent the opposite ends of a rung.

3. The supporting apparatus of claim 1 wherein the securing means cooperatively retain a wheel and one end of a rung in fixed position longitudinally of a side element.

4. The supporting apparatus of claim 1 wherein said wheels are mounted on said side elements in laterally aligned pairs.

5. The supporting apparatus of claim 1 wherein said wheels are mounted on said side elements in laterally aligned pairs and at intervals longitudinally of said side elements at least twice as great as the preselected intervals between the rungs thereon.

6. The supporting apparatus of claim 1 wherein said wheels are provided with tires for engaging the ball surface.

7. The supporting apparatus of claim 1 wherein said ladder has a length preselected to dispose a lower portion thereof at the level of an underside ball surface.

8. The supporting apparatus of claim 1 wherein said connecting means has a length of less than approximately 4 feet.

9. The supporting apparatus of claim 1 further including a cage and means carried by the ladder for supporting the cage below the lower end of the ladder.

10. The supporting apparatus of claim 9 wherein said means for supporting the cage comprises a cable lying against the rungs and having means for connecting a top end of the cable to the support on the topside ball surface and having a lower portion extending to below the bottom of the ladder for supporting the cage.

11. A ladder construction comprising:

a rung having an aperture;

a flexible cable extending through said aperture;

a wheel rotatably mounted on said cable adjacent said rung for rotation about the longitudinal extent of said cables; and

means retaining said rung and wheel against displacement axially of said cable.

12. The ladder construction of claim 11 wherein said retaining means comprises a pair of sleeves secured to said cable one above the uppermost of said juxtaposed rung and wheel and one below the lowermost of said juxtaposed rung and wheel.

13. The ladder construction of claim 11 wherein said wheel is provided with an axial bearing for free rotation thereof about the axis of said cable.

14. The ladder construction of claim 11 wherein the diameter of said wheel is at least approximately 8 inches to define a toe space perpendicular to said rung of at least approximately 4 inches.

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