Sept. 5, 1944. A. L. MEDENWALD 2,357,443

PLATFORM OR LOAD SUSPENSION

Filed Dec. 30, 1943 3 Sheets-Sheet 1

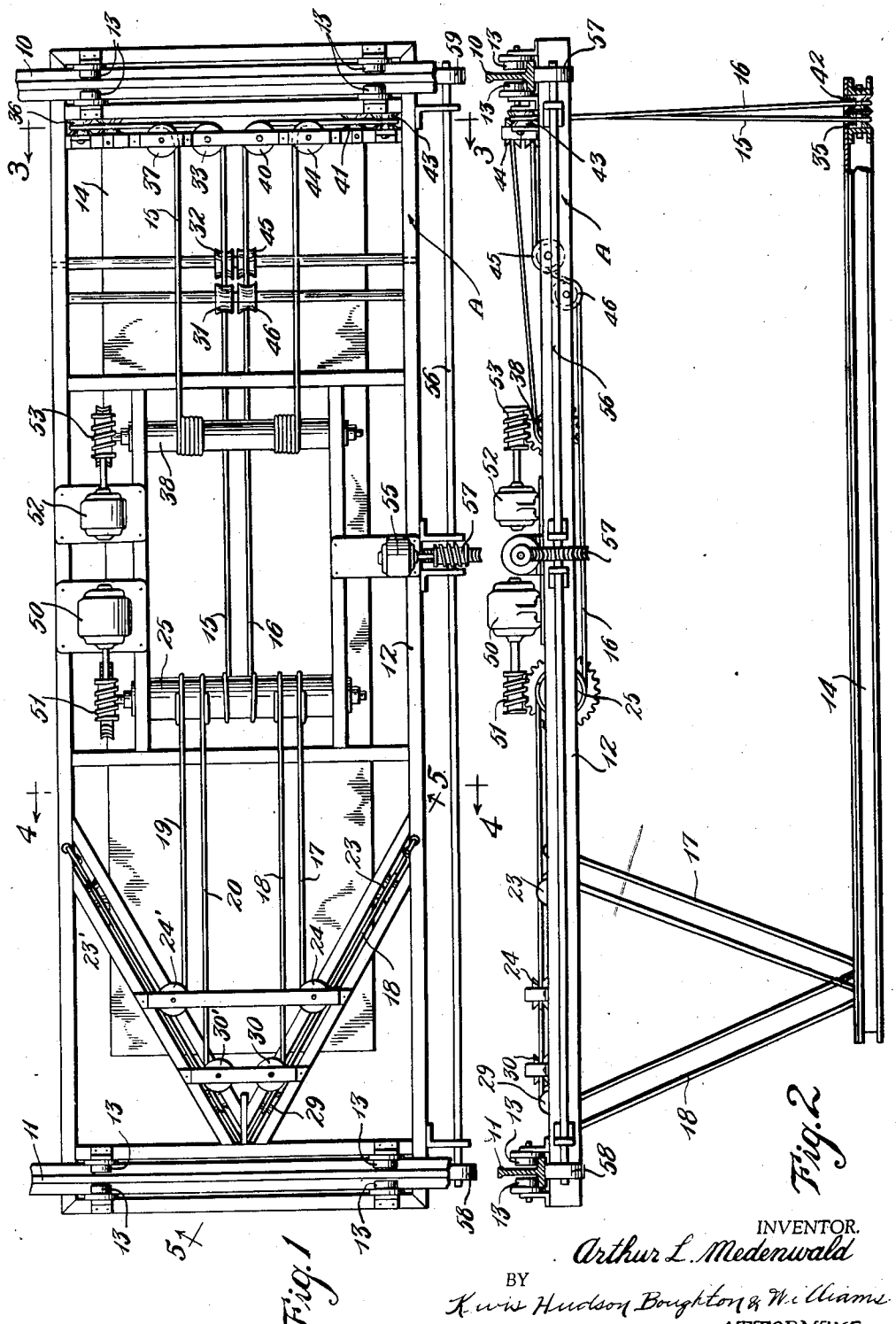


Fig. 1

Fig. 2

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Filed Dec. 30, 1943 3 Sheets-Sheet 2

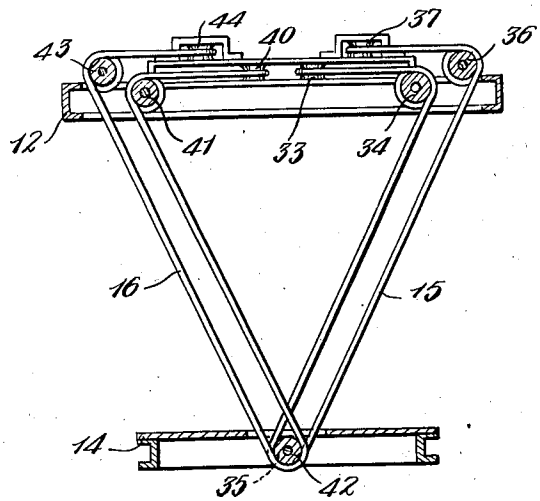


Fig. 3

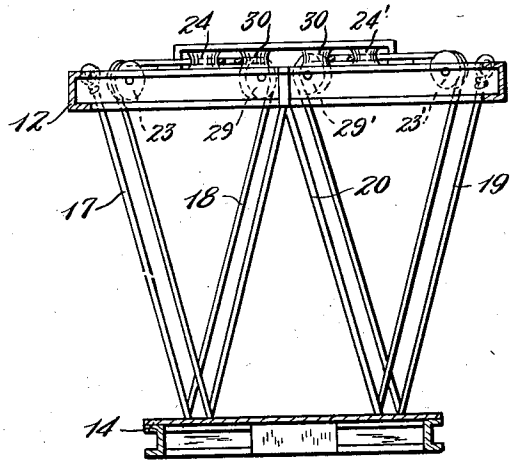


Fig. 4

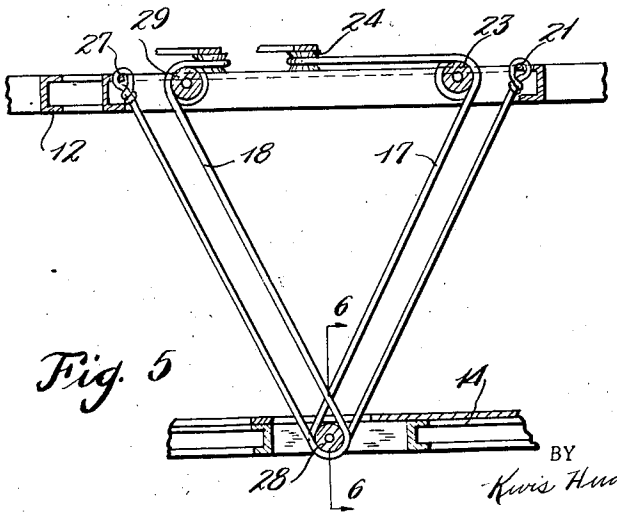


Fig. 5

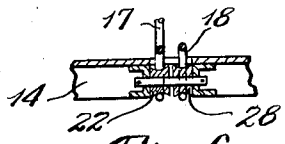


Fig. 6

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PLATFORM OR LOAD SUSPENSION

Filed Dec. 30, 1943 3 Sheets-Sheet 3

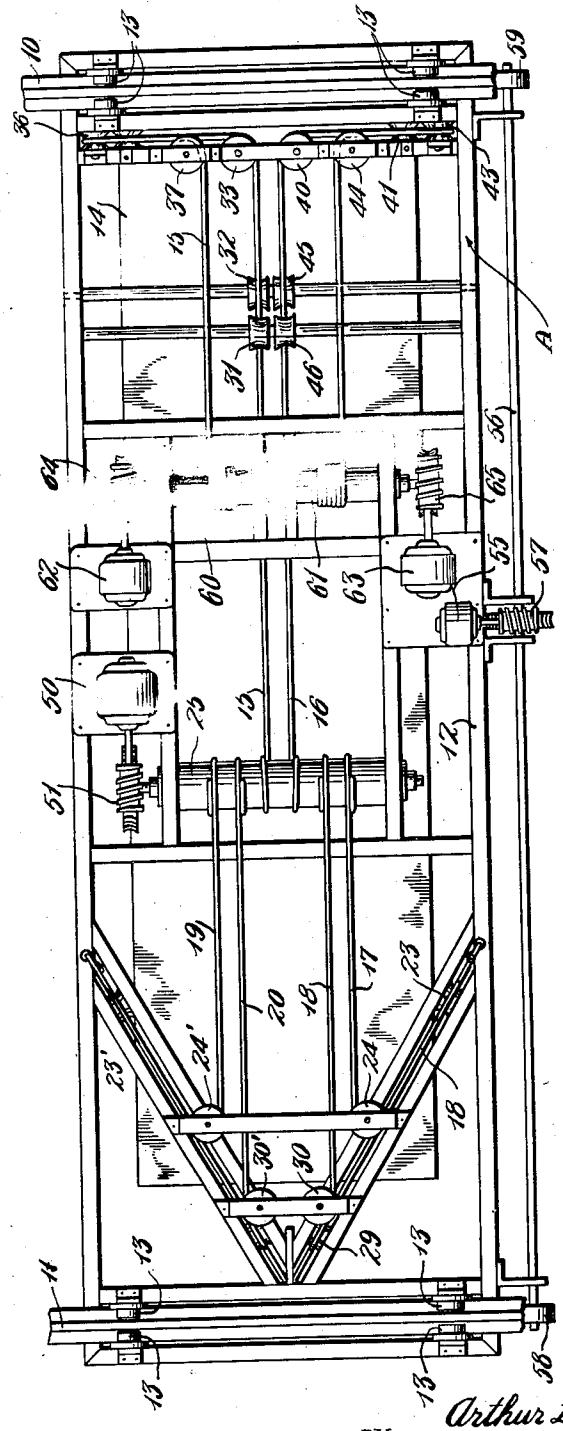


FIG. 7

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Patented Sept. 5, 1944 2,357,443

UNITED STATES PATENT OFFICE

2,357,443

PLATFORM OR LOAD SUSPENSION

Arthur L. Medenwald, Los Angeles, Calif., assignor, by mesne assignments, to The Cleveland Crane & Engineering Company, Wickliffe, Ohio, a corporation of Ohio

Application December 30, 1943, Serial No. 516,206

22 Claims. (Cl. 212—126)

The present invention relates to means for suspending and moving loads, platforms and the like, and in certain respects is an improvement on the load supporting and moving means disclosed and claimed in my Patent No. 2,164,128 issued June 27, 1939. This application is a continuation in part of my co-pending application Serial No. 402,888 filed July 17, 1941 and abandoned February 11, 1944.

The principal object of the present invention is the provision of improved and novel load supporting and moving devices wherein the load is suspended from an overhead support by cables in such a manner that the load can be tilted but will not swing or rotate about a vertical axis.

Another object of the invention is the provision of an improved and novel load suspending and moving device wherein the load is suspended from an overhead support by cables, which not only serves as the suspending means but also as guy-wires to prevent rotation about a vertical axis and lateral movement or swinging of the load, and which includes means for raising or lowering, and/or tilting the load as desired.

Another object of the present invention is the provision of a novel and improved carrier for an overhead tramrail system wherein the load is suspended by cables in such a manner that it can be tilted but will not swing or rotate about a vertical axis.

Another object of the invention is the provision of a novel and improved carrier for an overhead tramrail system wherein the load is suspended by cables, which not only serve as the suspending means but also as guy-wires to prevent rotation about a vertical axis and lateral movement or swaying of the load and which includes means for raising or lowering, and/or tilting the load as desired.

The invention resides in certain details of construction and combinations and arrangements of parts, and further objects and advantages will be apparent to those skilled in the art to which the invention relates from the following description of the preferred embodiment described with reference to the accompanying drawings forming a part of this specification in which similar reference characters designate corresponding parts, and in which

Fig. 1 is a plan view of a carrier for an overhead monorail system embodying the present invention;

Fig. 2 is a side elevational view of the carrier shown in Fig. 1;

Fig. 3 is a sectional view approximately on the line 3—3 of Fig. 1;

Fig. 4 is a sectional view approximately on the line 4—4 of Fig. 1;

Fig. 5 is a sectional view approximately on the line 5—5 of Fig. 1;

Fig. 6 is a sectional view approximately on the line 6—6 of Fig. 5; and

Fig. 7 is a view similar to Fig. 1 but showing a carrier of modified construction.

Referring to the drawings, the reference character A designates generally a carrier for an overhead tramrail system supported on and adapted to travel along the supporting rails 10 and 11 suspended from the superstructure of the building within which the tramrail system is housed in a manner well known in the art. The carrier A comprises a supporting structure or frame 12 generally rectangular in shape and provided at opposite ends with track-engaging wheels 13 by means of which the supporting structure or frame 12 is supported on and travels along the rails 10 and 11.

The load, in the present instance a platform designated by the reference character 14, is suspended from the supporting structure or frame 12 by three pairs of tackles or cables 15, 16; 17, 18; and 19, 20. The tackles or cables of each pair are angularly positioned with respect to each other and the pairs of tackles or cables lie in intersecting substantially vertical planes, as will be hereinafter more readily apparent, and not only serve as the suspending means but as guy-wires for preventing lateral movement or swinging of the load or platform 14, as well as rotation thereof about a vertical axis.

The platform 14 disclosed is elongated as viewed in plan, and the right-hand end, see Figs. 1 and 2, is supported by the pair of tackles or cables 15, 16 connected to the platform adjacent to its longitudinal centerline. The vertical parts of the tackles or cables 15, 16 lie substantially in a vertical plane at right angles to the length of the platform. The other end of the platform 14 is supported by the other two pairs of tackles or cables 17, 18 and 19, 20 connected adjacent to the sides of the platform. The tackles or the vertical parts of the pairs of cables 17, 18 and 19, 20 lie in planes which intersect each other substantially upon a plane passing through the longitudinal center line of the platform.

One end of the cable 17 is connected at a point 21 to one side of the supporting structure or frame 12, see Fig. 5. From this point the cable 17 extends downwardly and inwardly to the side of the

platform 14 where it passes around a sheave 22 rotatably connected to the platform, then upwardly and outwardly in a direction substantially parallel to the first part of the cable and around a sheave 23 rotatably supported in the supporting structure or frame 12 near the point 21 at which the end of the cable 17 is connected to the frame. From the sheave 23 the cable extends inwardly towards the center of the frame 12 where it passes around a sheave 24 also rotatably connected to the frame 12. From the sheave 24 the cable extends to about the center of the frame 12 where it is connected to a cable drum 25. It will be observed that the tackles or cables are connected to the supporting structure 12 and to the platform 14 in such a manner that they form an inverted isosceles triangle.

The other cable 18 of the pair of cables 17, 18 is connected to the supporting structure or frame of the carrier at a point 27 which is spaced from the point 21 where the cable 17 is connected thereto. From its point of connection with the frame 12 the cable 18 extends downwardly and outwardly to the platform 14 where it passes about a sheave 28 rotatably connected to the platform coaxially with the sheave 22, then upwardly and inwardly in a direction substantially parallel to the first part of the cable and around a sheave 29 rotatably supported in the frame 12 near the point 27 at which the end of the cable is connected thereto. From the sheave 29 the cable passes around a sheave 30 also rotatably connected to the frame 12 and then to the cable drum 25.

The construction is such that as the drum 25 is rotated both cables 17 and 18 are simultaneously taken up and let out equally. If desired the ends of the cables 17, 18, other than the ends connected to the cable drum 25, could be connected to the platform 14 at or adjacent to the place where the sheaves 22 and 28 are connected. However, the mechanical advantage obtained by the construction or tackle shown in the drawings would be lost. As will be understood by those skilled in the art to which the invention relates, any well-known tackle or sheave arrangement, other than that shown, may be employed to obtain any desired mechanical advantage inherent therein.

The pair of tackles or cables 19, 20 are connected to the cable drum 25 and to the side of the platform 14 opposite to that to which the tackles or cables 17 and 18 are connected in a manner similar to that in which the cables 17, 18 are connected to the cable platform 14 and the cable drum 25 just described. The description will not be repeated but corresponding sheaves are designated by the same reference characters with a prime mark affixed thereto.

One end of the cables 15, 16 which supports the right-hand end of the platform 14 as viewed in Figs. 1 and 2, is connected to the cable drum 25 in a manner similar to that in which the pairs of cables 17, 18 and 19, 20 are connected thereto, except for the fact that since they leave the drum in the opposite direction they are underneath the drum as viewed in the drawings. From the cable drum 25, the cable 15 extends to the right as viewed in Fig. 1, passing underneath a sheave 31 and over a sheave 32, which sheaves raise the cable to the top of the frame 12. From the sheave 32 the cable passes around a sheave 33 and then transversely of the frame 12 to a sheave 34 rotatably supported in the upper rear corner of the frame. From the sheave 34 the cable extends downwardly and inwardly to the platform 14 where it passes around a sheave 35 rotatably connected to the platform 14 adjacent the longitudinal center line thereof. From the sheave 35 the cable extends upwardly and outwardly in a direction substantially parallel to the downwardly extending part of the cable to a sheave 36 rotatably connected to the frame 12, then inwardly towards the center of the frame 12 where it passes about a sheave 37 and then to a cable drum 38 rotatably supported in the frame 12.

The other cable 16 of the pair of cables 15, 16 is connected to the cable drums 25 and 38 and to the platform 14 in a manner similar to that in which the cable 15 is connected thereto, except that after passing over a sheave 45, underneath a sheave 46, and around a sheave 40 corresponding to the sheave 36, the cable passes over a sheave 41 similar to the sheave 34, except for the fact that the former is rotatably connected to the frame 12 at the front right-hand corner whereas the latter is connected to the frame at the rear right-hand corner. From the sheave 41 the cable extends downwardly and inwardly to the platform 14 where it passes about a sheave 42 rotatably supported coaxially with the sheave 31, then to a sheave 43 corresponding to the sheave 36, then to the sheave 44 and back to the cable drum 38.

The cable drum 25 is adapted to be rotated in opposite directions by a reversible electric motor 50, the actuation of which may be controlled in any conventional manner. The motor 50 is connected to the cable drum 25 through a self-locking worm and worm wheel drive 51. However, any suitable drive connection may be employed. The cable drum 38 is adapted to be rotated in opposite directions by a reversible electric motor 52 connected thereto by a self-locking worm and worm wheel drive 53 in a manner similar to that in which the motor 50 is connected to the drum 25. In operation, the load or platform 14 can be raised and lowered by actuation of the motor 50 and can be tilted either as a separate operation or simultaneously with the raising and lowering by actuating the motor 53. As shown, the isosceles triangles formed by the pairs of tackles or cables 15, 16; 17, 18; and 19, 20 are identical when the load or platform is level. The platform 14 will remain level so long as the tackles or cables are let out and taken up uniformly.

The carrier A shown can be moved along the rails 10 and 11 either manually or by power means. In the embodiment shown the carrier is adapted to be moved by an electric motor 55 supported on the frame 12 and operatively connected to a transversely extending shaft 56 by a worm and worm wheel drive 57. The shaft 56 is rotatably supported in the frame 12 and extends substantially the full length of the frame and at its outer ends it is provided with a pair of wheels 58 which engage the under surface or flange of the rails 10 and 11. The wheels are preferably provided with rubber or like friction surfaces so as to increase their traction.

In the preferred construction shown and described herein, one end of the load or platform is adapted to be tilted by operating the cable drum 38. However, it is to be understood that this may be applied to more than one end of the load or platform and that constructions or means for letting out and taking up the pairs of cables at different rates of speed other than that shown

can be employed. For example, the cable drum 38 can be eliminated and the ends of the cables which are shown connected thereto anchored to the supporting structure 12 and the section of the cable drum 25 upon which the other ends of the cables 15, 16 are wound made larger in diameter than the sections upon which the other cables are wound. Alternatively the cable drum 38 can be eliminated in the manner mentioned above and the single cable drum 25 replaced by a plurality of cable drums driven through a differential mechanism so constructed and arranged that all of the drums can be simultaneously rotated by one motor and one or more of the cable drums rotated by a second motor. The second motor may be operated alone, in which event only the cable drum or drums connected thereto will be rotated, or simultaneously with the operation of the first motor, in which event the rotation produced by the second motor will be superimposed upon the rotation effected by the first motor.

The present invention also contemplates the provision of means for letting out and taking up the tackles or cables of any one of the pairs of tackles or cables at different speeds so as to move one or more ends or parts of the load laterally, that is from side to side. For example, it will be apparent that the right-hand end of the load or platform shown in Figs. 1 and 2 may be moved within certain limits, of course, in a horizontal plane or sideways by taking up one of the tackles or cables 15 or 16 by letting out the other tackle or cable. One suitable arrangement for accomplishing this result is illustrated in Fig. 7 which shows a carrier similar in construction to the carrier shown in Figs. 1 to 6, inclusive, except for the fact that the drum 38 of the latter carrier has been replaced by two separate drums 60 and 61 driven by individual reversible electric motors 62 and 63, respectively. The electric motors 62 and 63 are connected to the drums 60 and 61 by worm and worm wheel drives 64 and 65, respectively, similar to the drive 52. The motors 62 and 63 can be operated either simultaneously or individually. When operated simultaneously, the operation of the device will be the same as the operation of the device shown in Fig. 1. When the motors 62 and 63 are operated individually, the right-hand end of the supported structure will move laterally, etc. The modified construction just referred to is of particular advantage where it is desired to align some part of a device carried by the supporting structure 41 with some other device which is either stationary or capable of limited movement only.

From the foregoing description of the preferred embodiment of the invention, it will be apparent that the objects heretofore enumerated and others have been accomplished and that there has been provided a novel means of suspending and moving a load or platform wherein the cables or tackles which suspend the load not only act as the suspending means but also as guy-wires to prevent rotation about a vertical axis and lateral movement or swinging and wherein the load can be raised or lowered and tilted either as a separate operation or simultaneously with its raising and lowering.

As shown the respective cables of each pair are connected to the supporting structures at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane. Generally speaking the greater the area of this triangle and thereby the spacing of the points at which the respective cables of each pair are connected to the supporting structures, the greater the stability of the suspension. The respective cables of each pair are connected to the supported structure or load at substantially the same point but spaced from and disaligned with respect to the points at which the other pairs of cables are connected thereto. In other words the points at which the pairs of cables are connected to the supported structure form a triangle, generally speaking, and the respective cables of each pair are angularly disposed to each other and the respective pairs of cable lie in non-parallel generally vertical planes. While the preferred embodiment of the invention has been described in considerable detail, it is to be understood that the invention is not limited to the specific form of suspension shown or to overhead carriers, and it is the intention to hereby cover all modifications and alternative constructions that come within the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, I claim:

1. In apparatus of the character referred to, a supporting structure, means comprising three pairs of cables for suspending a supported structure from said supporting structure, means for operatively connecting the respective cables of each pair to one of said structures at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the other of said structures so that the respective cables of each pair are connected to said last named structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, a single drum for simultaneously letting out and taking up said pairs of cables, and a second drum for letting out and taking up one pair of cables independently of another of said pairs of cables.

2. In apparatus of the character referred to, a supporting structure, means comprising three pairs of cables for suspending a supported structure from said supporting structure, means for operatively connecting the respective cables of each pair to one of said structures at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the other of said structures so that the respective cables of each pair are connected to said last named structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, means for letting out and taking up said pairs of cables simultaneously, and means for letting out and taking up one of said cables independently of another of said cables.

3. In apparatus of the character referred to, a supporting structure, means comprising three

pairs of cables for suspending a supported structure from said supporting structure, means for operatively connecting the respective cables of each pair to one of said structures at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the other of said structures so that the respective cables of each pair are connected to said last named structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, and means for simultaneously letting out and taking up a plurality of said cables at different rates of speed.

4. In apparatus of the character referred to, a supporting structure, means comprising three pairs of cables for suspending a supported structure from said supporting structure, means for operatively connecting the respective cables of each pair to one of said structures at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the other of said structures so that the respective cables of each pair are connected to said last named structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, and means for letting out and taking up one of said pairs of cables independently of another of said pairs of cables.

5. In apparatus of the character referred to, a supporting structure, means comprising three pairs of cables for suspending a load or member from said supporting structure, means for operatively connecting the respective cables of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the load or member so that the respective cables of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes. means for letting out and taking up said pairs of cables simultaneously, and means for letting out and taking up one of said cables independently of another of said cables.

6. In apparatus of the character referred to, a supporting structure, means comprising three pairs of cables for suspending a load or member from said supporting structure, means for operatively connecting the respective cables of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the load or member so that the respective cables of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, and means for simultaneously letting out and taking up a plurality of said cables at different rates of speed.

7. In apparatus of the character referred to, a supporting structure, means comprising three pairs of cables for suspending a load or member from said supporting structure, means for operatively connecting the respective cables of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the load or member so that the respective cables of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, and means for simultaneously letting out and taking up a plurality of said pairs of cables at different rates of speed.

8. In apparatus of the character referred to, a supporting structure, means comprising three pairs of cables for suspending a load or member from said supporting structure, means for operatively connecting the respective cables of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the load or member so that the respective cables of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, means for simultaneously letting out and taking up said pairs of cables, and means for letting out and taking up one of said pairs of cables independently of another of said pairs of cables.

9. In apparatus of the character referred to, a supporting structure, means comprising three pairs of cables for suspending a load or member from said supporting structure, means for operatively connecting the respective cables of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the load or member so that the respective cables of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to

each other and the respective pairs of cables lie in non-parallel generally vertical planes, a single drum for letting out and taking up said pairs of cables simultaneously, and a second drum for letting out and taking up one pair of said cables independently of another of said pairs of cables.

10. In apparatus of the character referred to, a supporting structure, means comprising three pairs of tackles for suspending a supported structure from said supporting structure, means for operatively connecting the respective tackles of each pair to one of said structures at spaced points so located that vertical planes embracing the points at which the respective pairs of tackles are connected form a triangle with a horizontal plane, means for operatively connecting the respective tackles of each pair to the other of said structures so that the respective tackles of each pair are connected to said last mentioned structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of tackles are connected thereto whereby the respective tackles of each pair are angularly disposed to each other and the respective pairs of tackles lie in non-parallel generally vertical planes, means for letting out and taking up said pairs of tackles simultaneously, and means for letting out and taking up one of said tackles independently of another of said tackles.

11. In apparatus of the character referred to, a supporting structure, means comprising three pairs of tackles for suspending a supported structure from said supporting structure, means for operatively connecting the respective tackles of each pair to one of said structures at spaced points so located that vertical planes embracing the points at which the respective pairs of tackles are connected form a triangle with a horizontal plane, means for operatively connecting the respective tackles of each pair to the other of said structures so that the respective tackles of each pair are connected to said last mentioned structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of tackles are connected thereto whereby the respective tackles of each pair are angularly disposed to each other and the respective pairs of tackles lie in non-parallel generally vertical planes, and means for simultaneously letting out and taking up a plurality of said tackles at different rates of speed.

12. In apparatus of the character referred to, a supporting structure, means comprising three pairs of tackles for suspending a load or member from said supporting structure, means for operatively connecting the respective tackles of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of tackles are connected form a triangle with a horizontal plane, means for operatively connecting the respective tackles of each pair to the load or member so that the respective tackles of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with the points at which the other pairs of tackles are connected thereto whereby the respective tackles of each pair are angularly disposed to each other and the respective pairs of tackles lie in non-parallel generally vertical planes, and means for simultaneously letting out and taking up a plurality of said pairs of tackles at different rates of speed.

13. In apparatus of the character referred to, a supporting structure, means comprising three pairs of tackles for suspending a load or member from said supporting structure, means for operatively connecting the respective tackles of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of tackles are connected form a triangle with a horizontal plane, means for operatively connecting the respective tackles of each pair to the load or member so that the respective tackles of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with the points at which the other pairs of tackles are connected thereto whereby the respective tackles of each pair are angularly disposed to each other and the respective pairs of tackles lie in non-parallel generally vertical planes, means for simultaneously letting out and taking up said pairs of tackles, and means for letting out and taking up one of said pairs of tackles independently of another of said pairs of tackles.

14. In apparatus of the character referred to, an overhead trackway, a supporting structure movably supported on said trackway, means comprising three pairs of cables for suspending a supported structure from said supporting structure, means for operatively connecting the respective cables of each pair to one of said structures at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the other of said structures so that the respective cables of each pair are connected to said last-mentioned structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, means for letting out and taking up said pairs of cables simultaneously, and means for letting out or taking up one of said cables independently of another of said cables.

15. In apparatus of the character referred to, an overhead trackway, a supporting structure movably supported on said trackway, means comprising three pairs of cables for suspending a supported structure from said supporting structure, means for operatively connecting the respective cables of each pair to one of said structures at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means adapted for operatively connecting the respective cables of each pair to the other of said structures so that the respective cables of each pair are connected to said last-mentioned structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, and means for simultaneously letting out or taking up a plurality of said cables at different rates of speed.

16. In apparatus of the character referred to, an overhead trackway, a supporting structure movably supported on said trackway, means

comprising three pairs of cables for suspending a load or member from said supporting structure, means for operatively connecting the respective cables of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means adapted for operatively connecting the respective cables of each pair to the load or member so that the respective cables of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, means for letting out and taking up said pairs of cables simultaneously, and means for letting out or taking up one of said pairs of cables independently of another of said pairs of cables.

17. In apparatus of the character referred to, an overhead trackway, a supporting structure movably supported on said trackway, means comprising three pairs of cables for suspending a load or member from said supporting structure, means for operatively connecting the respective cables of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means adapted for operatively connecting the respective cables of each pair to the load or member so that the respective cables of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, and means for simultaneously letting out or taking up a plurality of said pairs of cables at different rates of speed.

18. In apparatus of the character referred to, an overhead trackway, a supporting structure movably supported on said trackway, means comprising three pairs of tackles for suspending a supported structure from said supporting structure, means for operatively connecting the respective tackles of each pair to one of said structures at spaced points so located that vertical planes embracing the points at which the respective pairs of tackles are connected form a triangle with a horizontal plane, means adapted for operatively connecting the respective tackles of each pair to the other of said structures so that the respective tackles of each pair are connected to said last mentioned structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of tackles are connected thereto whereby the respective tackles of each pair are angularly disposed to each other and the respective pairs of tackles lie in non-parallel generally vertical planes, means for letting out and taking up said pairs of tackles simultaneously, and means for letting out and taking up one of said tackles independently of another of said tackles.

19. In apparatus of the character referred to, an overhead trackway, a supporting structure movably suported on said trackway, means comprising three pairs of tackles for suspending a supported structure from said supporting structure, means for operatively connecting the responsive tackles of each pair to one of said structures at spaced points so located that vertical planes embracing the points at which the respective pairs of tackles are connected form a triangle with a horizontal plane, means adapted for operatively connecting the respective tackles of each pair to the other of said structures so that the respective tackles of each pair are connected to said last mentioned structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of tackles are connected thereto whereby the respective tackles of each pair are angularly disposed to each other and the respective pairs of tackles lie in non-parallel generally vertical planes, means for simultaneously letting out and taking up a plurality of said tackles at different rates of speed.

20. In apparatus of the character referred to, an overhead trackway, a supporting structure movably supported on said trackway, means comprising three pairs of tackles for suspending a load or member from said supporting structure, means for operatively connecting the respective tackles of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of tackles are connected form a triangle with a horizontal plane, means adapted for operatively connecting the respective tackles of each pair to the load or member so that the respective tackles of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with the points at which the other pairs of tackles are connected thereto whereby the respective tackles of each pair are angularly disposed to each other and the respective pairs of tackles lie in non-parallel generally vertical planes, means for letting out and taking up said pairs of tackles simultaneously, and means for letting out and taking up one of said pairs of tackles independently of another of said pairs of tackles.

21. In apparatus of the character referred to, an overhead trackway, a supporting structure movably suported on said trackway, means comprising three pairs of tackles for suspending a load or member from said supporting structure, means for operatively connecting the respective tackles of each pair to said supporting structure at spaced points so located that vertical planes embracing the points at which the respective pairs of tackles are connected form a triangle with a horizontal plane, means adapted for operatively connecting the respective tackles of each pair to the load or member so that the respective tackles of each pair are connected to said load or member at substantially the same point but spaced from and disaligned with the points at which the other pairs of tackles are connected thereto whereby the respective tackles of each pair are angularly disposed to each other and the respective pairs of tackles lie in non-parallel generally vertical planes, and means simultaneously letting out and taking up a plurality of said pairs of tackles at different rates of speed.

22. In apparatus of the character referred to, a supporting structure, means comprising three pairs of cables for suspending a supported structure from said supporting structure, means for operatively connecting the respective cables of each pair to one of said structures at spaced points so located that vertical planes embracing

the points at which the respective pairs of cables are connected form a triangle with a horizontal plane, means for operatively connecting the respective cables of each pair to the other of said structures so that the respective cables of each pair are connected to said last named structure at substantially the same point but spaced from and disaligned with the points at which the other pairs of cables are connected thereto whereby the respective cables of each pair are angularly disposed to each other and the respective pairs of cables lie in non-parallel generally vertical planes, and means for simultaneously letting out and taking up a plurality of said pairs of cables at different rates of speed.

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