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Goforth et al.

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[54] **TENSION MEANS FOR AERIAL TRAMWAYS**

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[52] **U.S. Cl.** **104/117,** 254/178

[51] **Int. Cl.** **B61b 7/14**

[58] **Field of Search** 104/114, 112, 117; 254/135, 178

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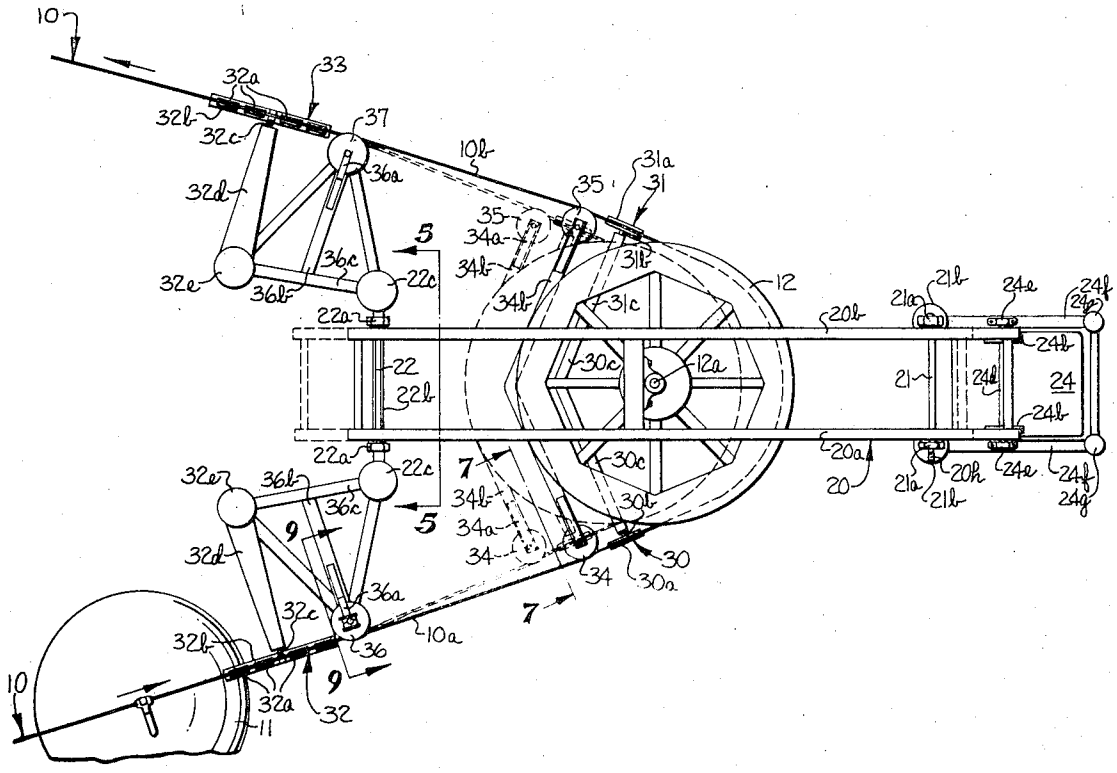
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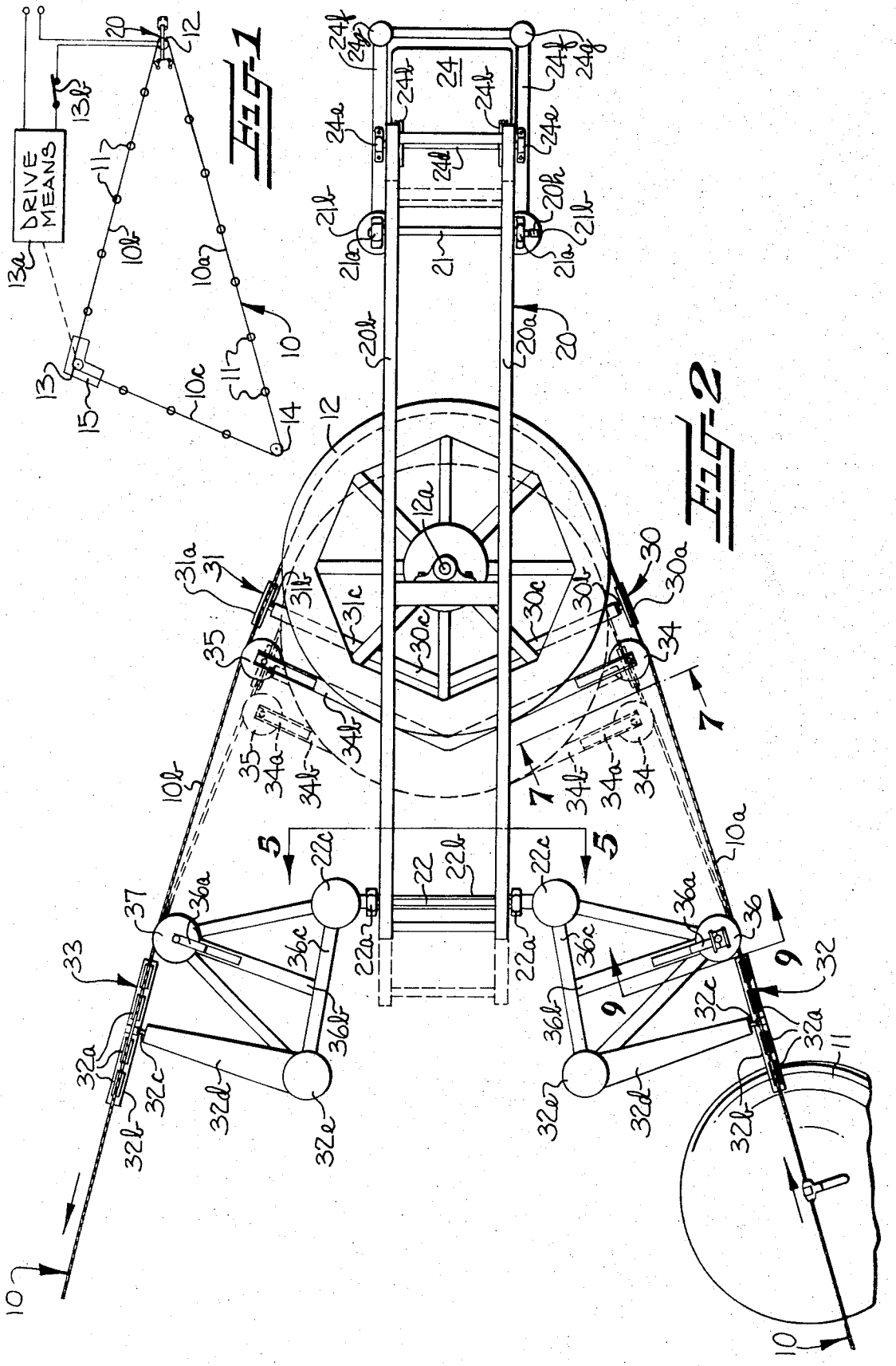
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Attorney—Warley L. Parrott et al.

[57] **ABSTRACT**

Apparatus for tensioning an aerial tramway endless cable having three or more runs or reaches such that adjacent or opposing runs diverge from a corresponding supporting pulley whose supporting carriage is biased outwardly so as to move inwardly and outwardly in accordance with variations in the load on the cable. Tracking means is provided for maintaining the diverging opposing runs in proper engagement with corresponding cable supporting roller means adjacent the pulley to ensure that the cable will not creep off of the roller means as the divergence angle of the opposing runs of the cable tends to vary coincident with the movements of the carriage.

11 Claims, 9 Drawing Figures




DRIVE MEANS
FIG-1
FIG-2

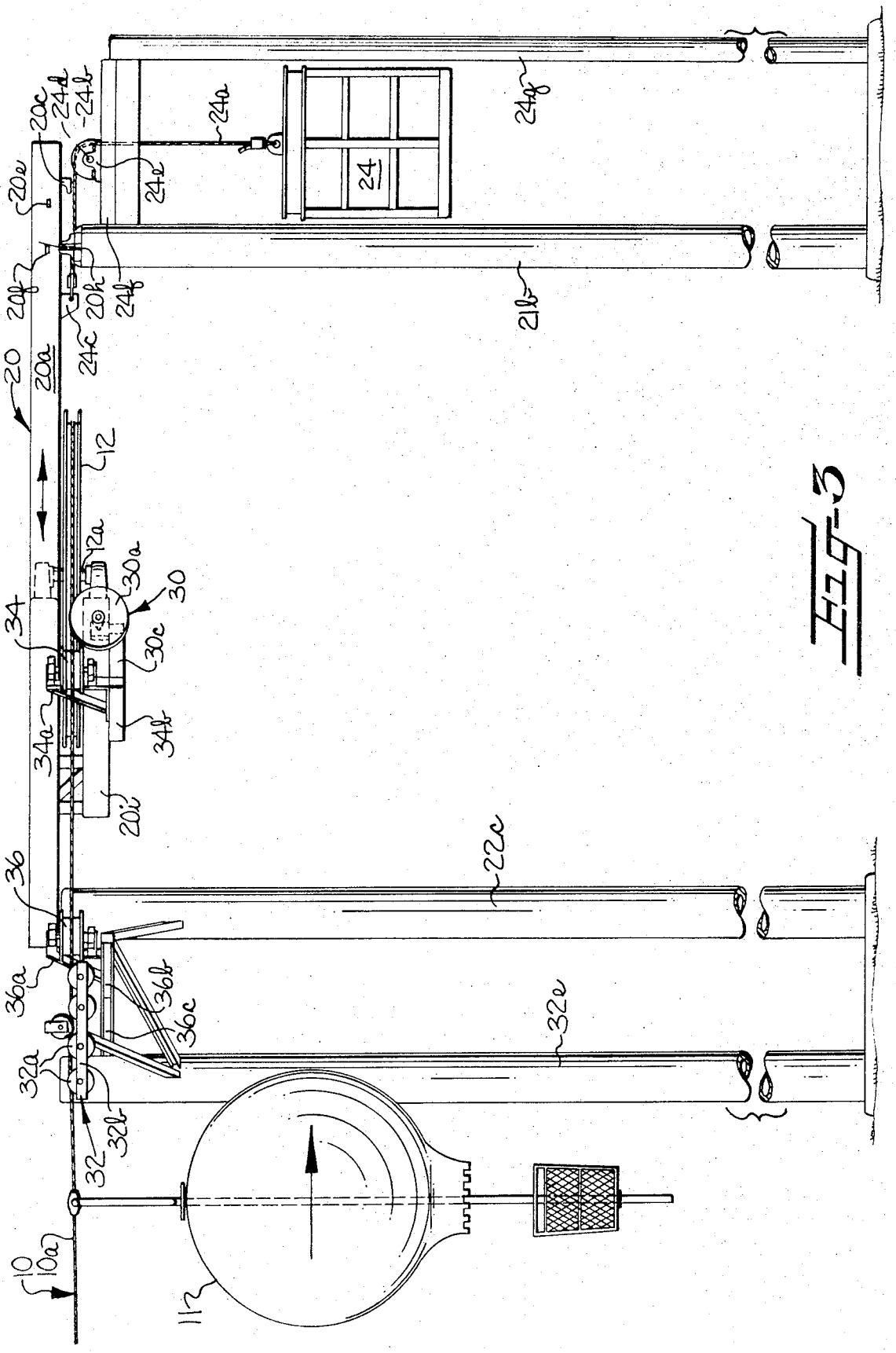

20
20a
20b
20c
20d
20e
20f
24
24a
24b
24c
24d
24e
24f
24g
21b
12
12a
30
30a
30c
34
34a
34b
20i
22c
36
36a
36b
36c
32a
32b
32
32e
10
10a
11

FIG-3

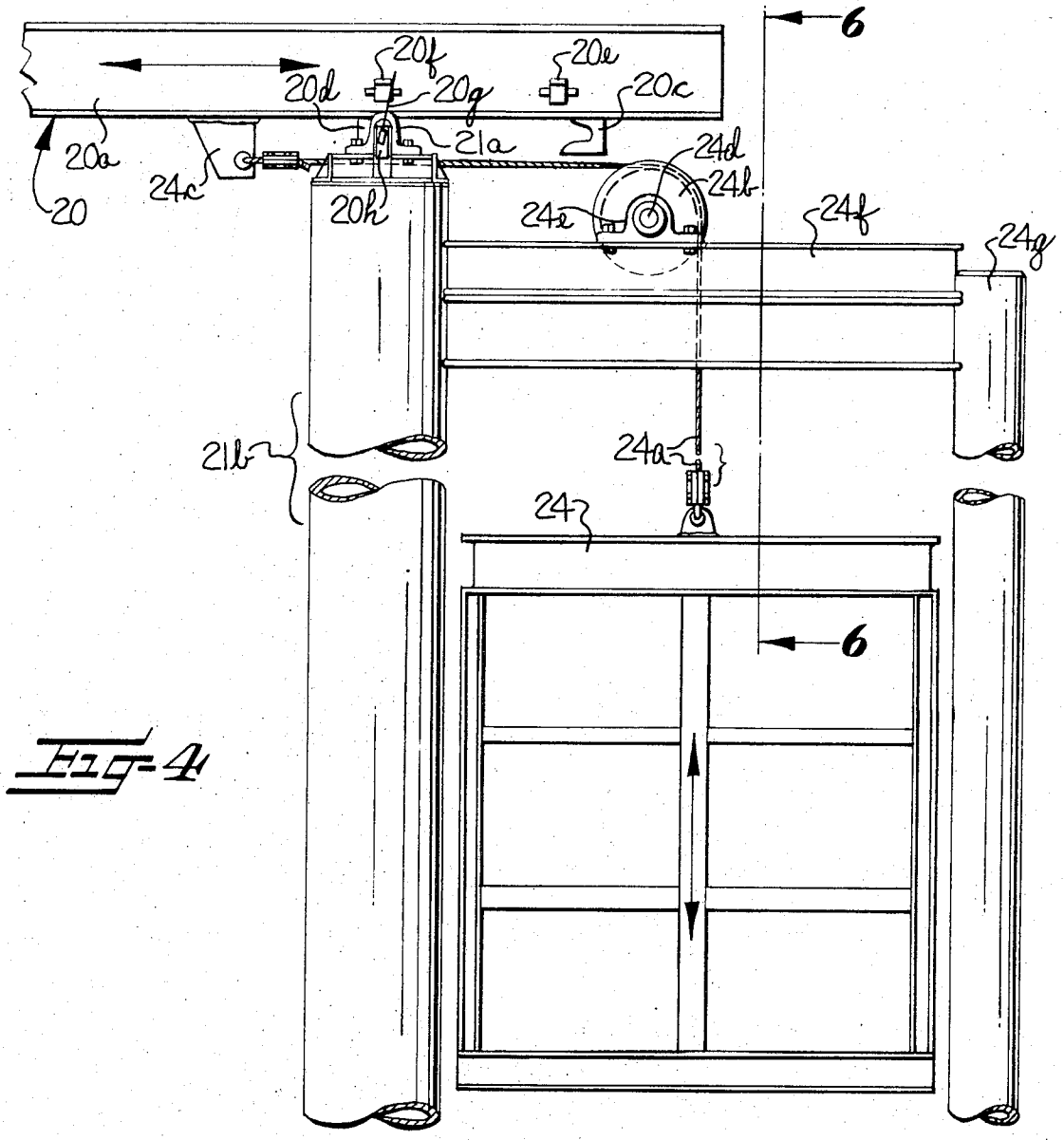

6
20f
20e
20d
20g
20c
21a
20a
24d
24c
24b
20
20h
24e
24f
24g
21b
24a
24
6

Fig-4

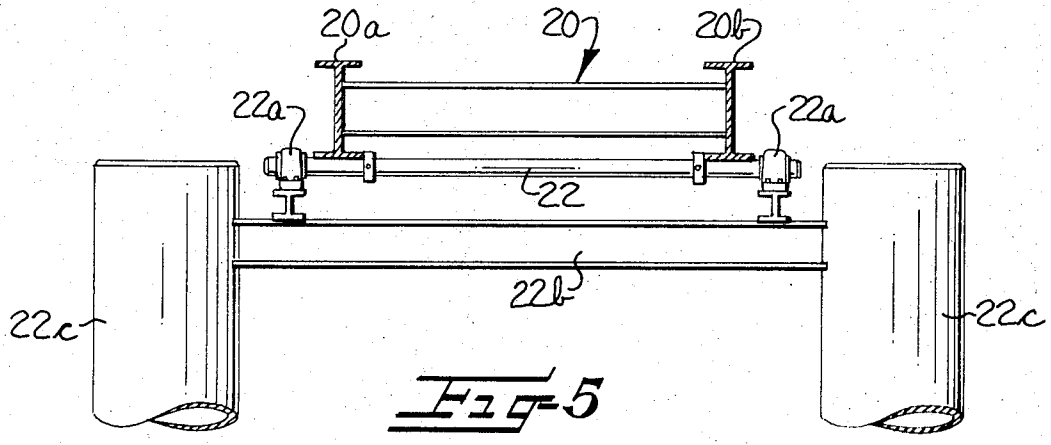

20a
20
20b
22a
22a
22
22b
22c
22c

Fig-5

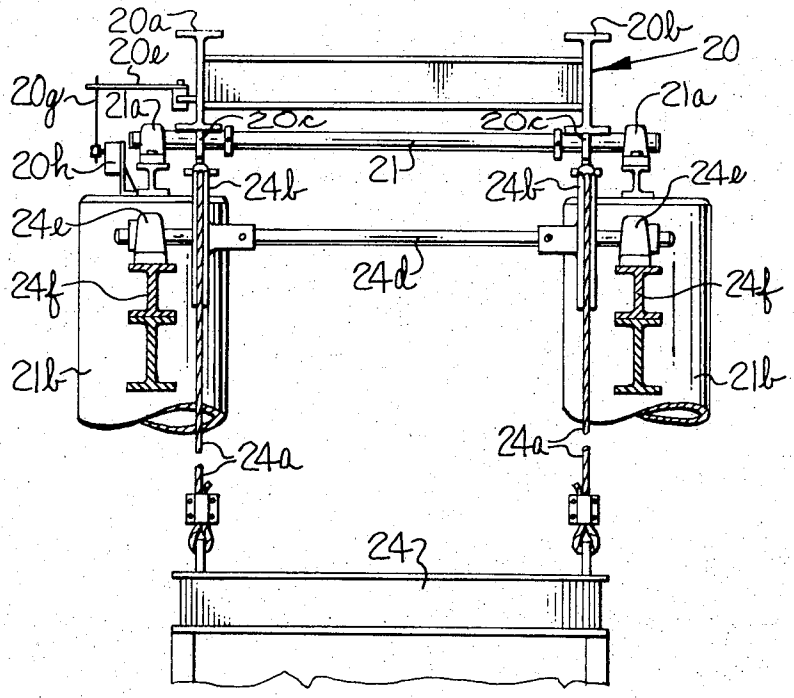


Fig-6

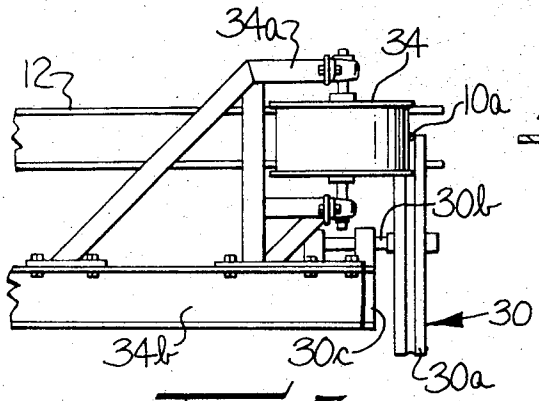


Fig-7

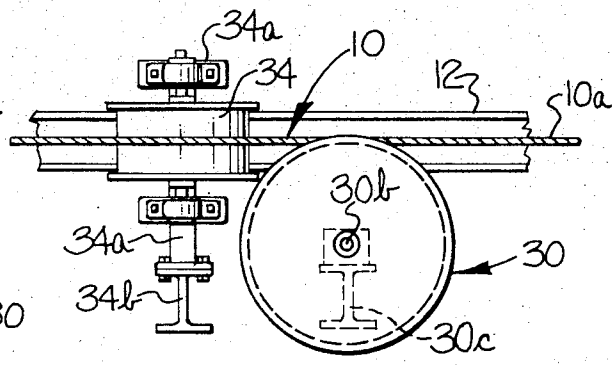


Fig-8

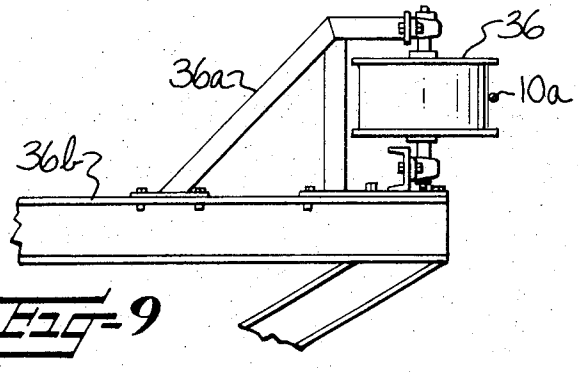


Fig-9

TENSION MEANS FOR AERIAL TRAMWAYS

This invention relates to aerial tramways for transporting loads from place to place and is particularly concerned with passenger-carrying tramways for ski lifts and other amusement transportation.

Generally, amusement types of aerial tramways heretofore utilized include elevated load-supporting endless cables mounted on a pair of spaced pulleys with suitable intervening supporting rollers spaced between the pulleys, and wherein opposing runs of the cable are disposed in substantially parallel relationship. Tramcars, chairs or other passenger carriers are suspendingly supported by the cable and therefore are subject to swinging motion which imposes varying load forces on the cable. More importantly, the loading on the cable varies according to the number of passenger carriers which may be occupied, according to the number of passengers aboard the various carriers, and during loading and unloading operations. Therefore, it is common practice to provide some form of yieldable tension means for the cable so as to keep the same from sagging excessively between adjacent supports therefor and to prevent breaking of the cable or overstressing of the supports for the pulleys about which the cable is entrained. A known and preferred type of tension means for this purpose is in the form of a movable carriage on which one or the other of the cable pulleys is mounted, with a counterweight connected to and applying outward force to the pulley carriage.

Now, we have devised an aerial tramway whose load-supporting endless cable is provided with at least three runs such that adjacent opposing runs extend in diverging relationship from each cable supporting pulley. However, difficulties have been encountered in utilizing a tension means of the general type mentioned above, in that the corresponding diverging runs of the cable would tend to slip or creep off of the necessary supporting rollers upon which the portions of the diverging runs adjacent the movable pulley are supported. It is apparent that such a condition would present a safety hazard.

It is therefore an object of this invention to provide an improved apparatus for tensioning a load-supporting endless conveyor cable, wherein an outwardly biased movable carriage means rotatable supports a tension pulley which engages and forms a bight in the cable and from which opposing runs of the cable extend in diverging relationship, and wherein novel tracking means is provided for maintaining the opposing runs of the cable in proper engagement and alignment with supporting roller means adjacent the pulley throughout any inward and outward movement of the pulley and its carriage means incident to variations in the load on the cable.

In its preferred embodiment, the invention includes a first pair of supporting roller means rotatable on substantially horizontal axes closely adjacent diametrically opposite portions of the tension pulley and supporting respective opposing runs of the cable thereon, with a second pair of roller means also rotatable on substantially horizontal axes spaced a substantial distance from the first roller means and also supporting the respective opposing runs of the cable thereon. Although the angle of divergence of the opposing runs of the cable tends to vary with inward and outward movement of the carriage means and its pulley, as effected by variations in the load on the cable, novel tracking means is provided

in the form of first tracking members engaging proximal surfaces of the opposing runs of the cable adjacent the pulley, but located further from the pulley than the first pair of roller means, and a pair of second tracking members also engages proximal surfaces of the opposing diverging runs, but occupy fixed positions adjacent the aforementioned second roller means and are spaced between the first tracking members and the second roller means so that, although the angle of divergence of the opposing runs of the cable may vary between the first and second tracking members, the angle of divergence of those portions of the opposing runs extending between the tension pulley and the first tracking members on the one hand, and extending between the second roller means and the second tracking members on the other hand, remain substantially constant throughout normal movement of the carriage means and its pulley.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanyings drawings, in which

FIG. 1 is a schematic plan view of an aerial tramway showing the improved tension apparatus for the endless conveyor cable thereof;

FIG. 2 is an enlarged plan view of the cable tensioning apparatus with the carriage means and its pulley shown occupying their outermost positions in solid lines and occupying their innermost positions in broken lines;

FIG. 3 is a side elevation looking up at the lower side of FIG. 2, with portions of the supporting standards broken away;

FIG. 4 is an enlarged fragmentary elevation of the upper right-hand portion of FIG. 3;

FIG. 5 is an enlarged fragmentary elevation, partially in section, taken substantially along line 5—5 in FIG. 2;

FIG. 6 is a rear elevation of the carriage, partially in section, taken substantially along line 6—6 in FIG. 4;

FIG. 7 is an enlarged fragmentary elevation of one of the tracking means and adjacent supporting roller means for the cable taken substantially along line 7—7 in FIG. 2;

FIG. 8 is a fragmentary elevation looking at the right-hand side of FIG. 7; and

FIG. 9 is an enlarged fragmentary elevation showing another of the tracking means for a corresponding run of the cable and being taken substantially along line 9—9 in FIG. 2.

Referring more specifically to the drawings, the elevated load-supporting endless conveyor cable of the tramway is broadly designated at **10** and suspendingly supports thereon a plurality of spaced apart passenger carriers or tramcars **11**. As shown in FIG. 1, cable **10** is entrained about a plurality of spaced apart relatively large flanged pulleys mounted on substantially vertical axes, there being three such pulleys shown in this instance designated at **12, 13** and **14**. Each of the pulleys engages and forms a corresponding bight in cable **10**, thus causing the cable **10** to have three runs **10*a***, **10*b***, **10*c***, such that adjacent opposing runs of cable **10** extend from each pulley **12, 13, 14** in diverging relationship.

Pulley **13** may be driven by a suitable electrically controlled drive means shown schematically at **13*a*** in

FIG. 1, and which may be activated and deactivated by a manually operable switch 13*b* interposed in an electrical circuit to drive means 13*a*. Pulleys 13, 14 may be supported in a wall known manner on respective masts or standards, not shown, and a suitable loading platform 15 may be provided adjacent and below pulley 13 to facilitate the loading and unloading of passengers with respect to the passenger carriers 11.

In order to maintain cable 10 under predetermined but yieldable tension, the invention includes a tension apparatus, of which pulley 12 is a part, and which biases pulley 12 outwardly with respect to the adjacent opposing diverging runs 10*a*, 10*b* of cable 10. In this regard, it should be noted, with reference to FIG. 2, that the opposing runs 10*a*, 10*b* of cable 10 extend at an acute included angle of divergence which preferably is no more than about 30° to 45°.

Pulley 12 is rotatably supported, as at 12*a*, by an elongate substantially horizontally disposed carriage means 20 whose opposing side rails 20*a*, 20*b* are supported upon outer and inner rollers or shafts 21, 22, respectively disposed outwardly of and inwardly of pulley 12, and arranged to permit inward and outward movement of the carriage means 20 along a path substantially bisecting the angle between opposing runs of cable 10. Outer shaft 21 is journaled in bearings 21a mounted on the upper ends of a pair of laterally spaced standards or posts 21*b*, and inner shaft 22 is journaled in bearings 22*a* mounted on a transverse frame member 22*b* suitably secured to a pair of laterally spaced standards or posts 22*c*.

A predetermined outward force is applied to carriage means 20, and thus to tension pulley 12, by a counterweight means 24 (FIGS. 2, 3, 4 and 6) connected to the lower ends of a pair of cables 24*a* which extend upwardly and partially around respective grooved pulleys 24*b* and then inwardly, where they are connected to anchor elements 24*c* suitably secured to and depending from the opposing side rails 20*a*, 20*b* of carriage means 20 (FIG. 4). Pulleys 24*b* are mounted on a common transverse shaft 24*d* journaled in a pair of bearings 24*e*. Bearings 24*e* are secured on respective rearwardly extending bars or frame members 24*f* whose inner or front portions are suitably secured to the respective standards 21*b*, and whose rear portions are suitably secured to additional respective standards 24*g*.

In order to limit the extent of inward and outward movement of carriage means 20, a pair of longitudinally spaced, hook-shaped limiting abutments 20*c*, 20*d*, is suitably secured to and depends from the rear portion of each side rail 20*a*, 20*b* and straddles outer shaft 21. Thus, in the event of carriage means 20 being moved inwardly, from right to left in FIGS. 2, 3, and 4, beyond its desired safe range of movement, outer abutments 20*c* will engage and be restrained by shaft 21. Conversely, in the event of outward movement of carriage means 20 beyond the desired safe range of movement thereof, inner abutments 20*d* will engage and be restrained by shaft 21. There are various reasons why carriage means 20 may tend to move beyond the desired safe limits, such as by breakage of conveyor cable 10 or counterweight cables 24*a*, overloading of conveyor cable 10, or by accidental lateral displacement of cable 10 out of engagement with any supporting members which may be provided to normally bow the cable above or below a straight line between adjacent pulleys 12, 13, 14. As a further safety measure, whenever carriage means 20 moves beyond safe limits, such that either abutment 20*c*, 20*d* engages shaft 21, respective switch actuating abutments 20*e*, 20*f* (FIGS. 4 and 6) on carriage means 20 will engage and move a finger 20*g* to actuate a normally closed switch 20*h* interposed in the electrical circuit to the drive means 13*a* (FIG. 1) and thereby stop further movement of conveyor cable 10.

In order to support the weight of cable 10 and its passenger carriers 11 adjacent tension pulley 12 while maintaining cable 10 in proper alignment between the flanges of pulley 12, a pair of first cable supporting roller means 30, 31 and a pair of second cable supporting roller means 32, 33 are provided inwardly of that bight of cable 10 engaging pulley 12. The first roller means 30, 31 comprise respective peripherally grooved rollers 30*a*, 31*a* engaged by the respective diverging runs 10*a*, 10*b* which extend over the rollers 30*a*, 31*a*. Rollers 30*a*, 31*a* are rotatable on substantially horizontal axes closely adjacent diametrically opposite portions of tension pulley 12, and the axes of rollers 30*a*, 31*a* also preferably extend substantially perpendicular to the mean angle of divergence of the respective cable runs 10*a*, 10*b*. To this end, grooved rollers 30*a*, 31*a* are fixed on the outer portions of respective shafts 30*b*, 31*b*, rotatably mounted on the outer portions of respective arms 30*c*, 31 *c* (FIGS. 2, 7, and 8) which converge inwardly and are suitably secured to an underframe 20*i* (FIG. 3) of carriage means 20. Underframe 20*i* underlies and extends forwardly of tension pulley 12, and the forward or inner portion of underframe 20*i* is suitably secured to the side rails 20*a*, 20*b* of carriage means 20.

The second supporting roller means 32, 33 are spaced a substantial distance inwardly or forwardly from the first roller means 30, 31, but are spaced a substantially greater distance apart from each other than the first supporting roller means 30, 31 so as to be properly aligned with the mean path of travel of the diverging runs 10*a*, 10*b*. As shown, by way of example, the second supporting roller means 32, 33 are spaced from the first supporting roller means 30, 31 a distance about equal to or slightly greater than the diameter of tension pulley 12.

Each second roller means 32, 33 comprises a series of peripherally grooved rollers 32*a* mounted on substantially horizontal axes in a corresponding frame 32*b*. In this instance, each frame 32*b* rotatably supports four supporting rollers 32*a* over which the corresponding run of cable 10 passes, and each frame 32*b* is pivotally mounted, as at 32*c*, on one end of a cantilever arm 32*d* carried by a standard or post 32*e*.

As tension pulley 12 is caused to move inwardly and outwardly toward and away from pulleys 13, 14 with variations in the load on cable 10, the angle of divergence of the opposing runs 10*a*, 10*b* of cable 10 tend to vary and would, in the absence of some form of compensating means or tracking means, tend to cause cable 10 to slip or creep off the supporting roller means 30–33 to cause an accident. Therefore, according to the invention, tracking means are provided for maintaining a substantially constant divergence angle between at least those portions of the opposing runs 10*a*, 10*b* engaging the respective first and second roller

means to ensure that cable **10** will not creep off of the roller means as tension pulley **12** and its carriage means **20** move inwardly and outwardly. Accordingly, a pair of first tracking members **34, 35** carried by and movable with carriage means **20**, engages proximal surfaces of the opposing runs **10***a*, **10***b* of cable **10** closely adjacent and inwardly of the respective supporting roller means **30, 31**. Similarly, a pair of second tracking members **36, 37** occupy fixed positions closely adjacent and outwardly or rearwardly of the respective second roller means **32, 33** and also engage proximal surfaces of the opposing runs **10***a*, **10***b* of cable **10**. As shown, and as is preferred, each tracking member **34–37** is in the form of a wide flanged pulley or drum supported for rotation on a substantially vertical axis. Each first tracking member or drum **34, 35** is journaled on a respective bracket **34***a* (FIGS. 7 and 8) suitably secured to the outer portion of an arm **34***b*. As shown in FIG. 1, the two arms **34***b* converge inwardly and are suitably secured to the underframe **20***i* (FIG. 3) of carriage means **20**.

The substantially vertical shaft of each second tracking member or drum **36, 37** is journaled on a corresponding bracket **36***a* suitably secured to a cantilever arm **36***b*. Each cantilever arm **36***b* is suitably secured to a cross member **36***c* extending between and suitably secured to the corresponding standards or posts **22***c*, **32***e* (FIGS. 2 and 3).

From the foregoing description, it is apparent that the first supporting roller means **30, 31** (FIG. 2), the first tracking members **34, 35**, tension pulley **12** and carriage means **20** move inwardly and outwardly in fixed relationship relative to pulleys **13, 14** (FIG. 1), the second supporting roller means **32, 33** and the second tracking members **36, 37** in accordance with respective increases and decreases in the magnitude of the load on conveyor cable **10**. During such inward and outward movement of carriage means **20**, although there is a tendency for the angle of divergence between the opposing runs **10***a*, **10***b* to vary from the tension pulley **12** to the other cable supporting pulleys **13, 14**, it should be noted that the only changes effected in the angular positions of the opposing runs **10***a*, **10***b* occur in those portions of the opposing runs **10***a*, **10***b* which are disposed between the respective sets of tracking members **34, 36** and **35, 37**.

On the other hand, since the first tracking members or drums **34, 35** always move inwardly and outwardly in unison with and closely adjacent and inwardly of the respective first roller means **30, 31**, tracking members **34, 35** always maintain a substantially constant divergence angle between those portions of the runs **10***a*, **10***b* extending from the bight of cable **10** in engagement with tension pulley **12**, past the first roller means **30, 31** and to the first tracking members **34, 35**. Similarly, the second tracking members **36, 37** maintain the portions of the opposing runs **10***a*, **10***b* extending from the respective pulleys **14, 13** thereto in respective predetermined paths; i.e., the divergence angle between the latter portions of the opposing runs **10***a*, **10***b* are not subject to variations by the inward and outward movement of carriage means **20** and tension pulley **12**, with the result that the tracking members and drums **36, 37** maintain the respective opposing runs **10***a*, **10***b* of cable **10** in longitudinal alignment with the respective series of rollers **32***a* of the respective second supporting roller means **32, 33**.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

That which is claimed is:

1. Apparatus for tensioning a load-supporting endless cable of an aerial tramway including a tension pulley engaging a bight of said cable and from which opposing runs of said cable extend in diverging relationship, outwardly biased carriage means rotatably supporting said pulley for inward and outward movement in accordance with variations in the load on said cable and in a path substantially bisecting the space between said opposing runs such that the angle of divergence of said opposing runs tends to vary with inward and outward movement of said carriage means and said pulley, a pair of first supporting roller means rotatable on substantially horizontal axes closely adjacent diametrically opposite portions of said pulley and supporting respective runs of said cable thereon, a pair of second supporting roller means rotatable on substantially horizontal axes spaced a substantial distance from said first roller means and also supporting said respective runs of said cable thereon, and tracking means for maintaining a substantially constant divergence angle between at least those portions of said opposing runs engaging the respective first and second roller means to ensure that the cable will not creep off of said roller means as said pulley moves along said path.

2. Apparatus according to claim 1, wherein said first supporting roller means is carried by and movable along said path with said carriage means.

3. Apparatus according to claim 2, wherein said tracking means includes a pair of tracking members also carried by and movable with said carriage means, said tracking members being positioned against the proximal surfaces of said opposing runs and adjacent the respective first roller means, and each of said first roller means being positioned between said tension pulley and the respective adjacent tracking member.

4. Apparatus according to claim 1, wherein said tracking means comprises a pair of first tracking members engaging proximal surfaces of said runs adjacent said tension pulley but located further away from said tension pulley than said first pair of roller means, and a pair of second tracking members also engaging proximal surfaces of said runs, but occupying fixed positions adjacent said second roller means and spaced between said first tracking members and said second roller means.

5. Apparatus according to claim 4, wherein each of said tracking members comprises a pulley mounted for rotation on a substantially vertical axis.

6. Apparatus according to claim 1, wherein said pair of first supporting roller means comprises a pair of peripherally grooved rollers supported by said carriage means for rotation about respective substantially horizontal axes extending substantially perpendicular to the respective opposing runs of said cable.

7. Apparatus according to claim 1, wherein said second pair of roller means each comprises a series of peripherally grooved supporting rollers.

8. Apparatus according to claim 1, including limiting means for limiting the range of movement of said carriage means and including a pair of spaced apart limiting abutments carried by said carriage means, and a stationary member disposed between said limiting abutments and engagable thereby in alternation in the event of inward and outward movement of said carriage means beyond predetermined safe limits for restraining said carriage means against further movement in a corresponding direction.

9. Apparatus according to claim 8, including means for driving said cable, and means operatively associated with said carriage means for interrupting operation of said driving means upon engagement of either of said limiting abutments with said stationary means.

10. Apparatus for tensioning a load-supporting endless cable of an aerial tramway including a tension pulley engaging said cable, outwardly biased carriage means rotatably supporting said tension pulley on a substantially vertical axis and for inward and outward movement in accordance with variations in the load on said cable and in a path substantially bisecting adjacent opposing runs of said cable, a pair of supporting roller means carried by and movable with said carriage means for rotation on respective substantially horizontal axes closely adjacent diametrically opposite portions of said tension pulley and supporting respective ones of said runs of said cable thereon, a pair of tracking members also carried by said carriage means and movable therewith, said tracking members being positioned against the proximal surfaces of said opposing runs and adjacent the respective supporting roller means, each of said supporting roller means being positioned between said tension pulley and the respective adjacent tracking member, and said tracking members serving to maintain the cable runs in alignment with the respective supporting roller means to ensure that the cable runs will not creep off of said roller means as said tension pulley moves along said path.

11. Apparatus for tensioning a load-supporting endless cable of an aerial tramway including a tension pulley engaging a bight of said cable, an outwardly biased movable carriage means rotatably supporting said pulley for inward and outward movement in a horizontal path and in a plane substantially bisecting the space between opposing runs of said cable extending away from said tension pulley, a pair of spaced limiting abutments carried by said carriage means, stationary means normally spaced between said pair of limiting abutments and being engageable thereby in alternation to limit respective inward and outward movements of said carriage means, means for driving said endless cable, and means operatively associated with said carriage means for interrupting operation of said driving means whenever either of said limiting abutments engages said stationary means positioned therebetween.

* * * * *