

Nov. 21, 1967

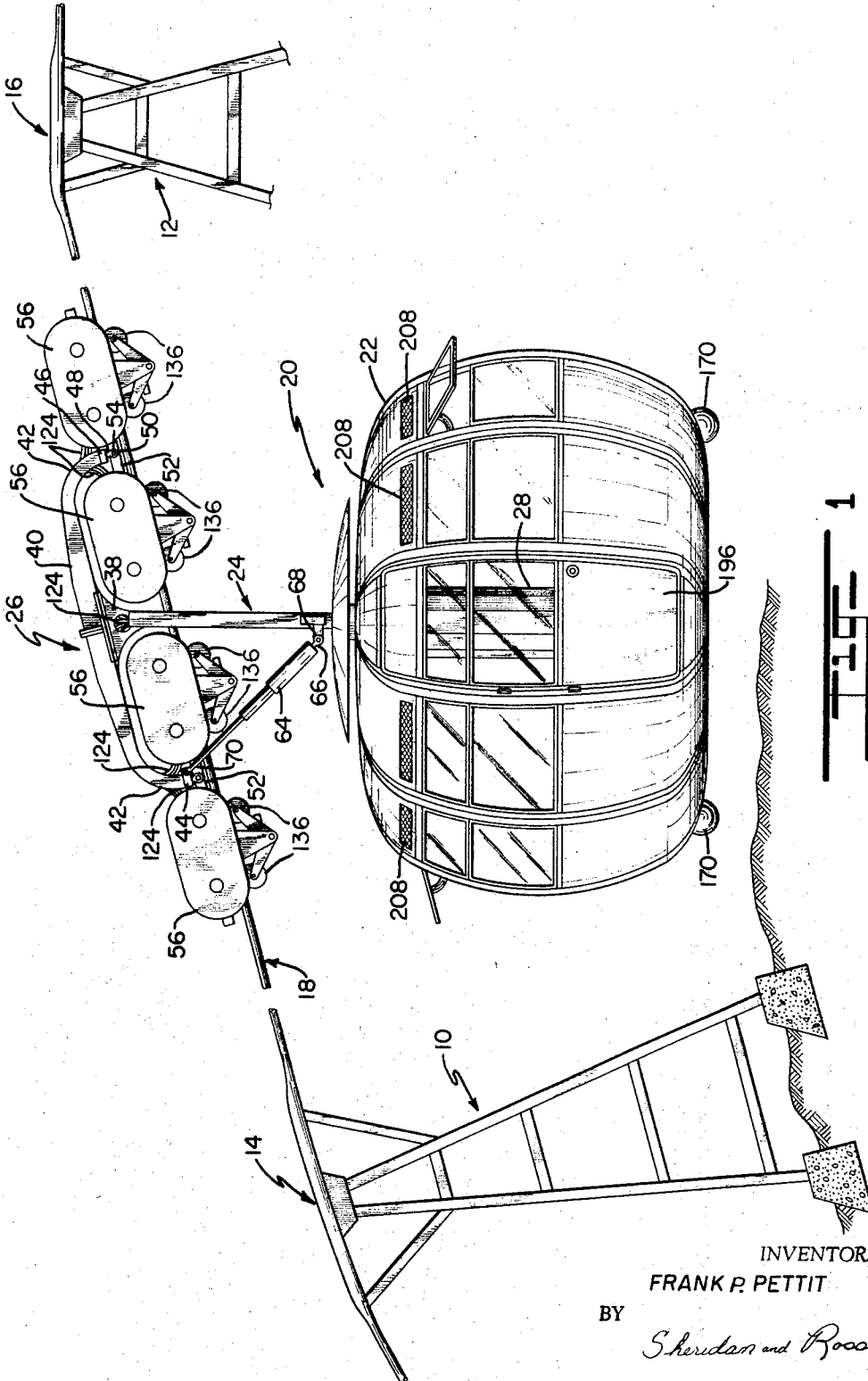
F. P. PETTIT

3,353,503

AERIAL TRAMWAY SYSTEM

Original Filed July 15, 1963

7 Sheets-Sheet 1



Nov. 21, 1967

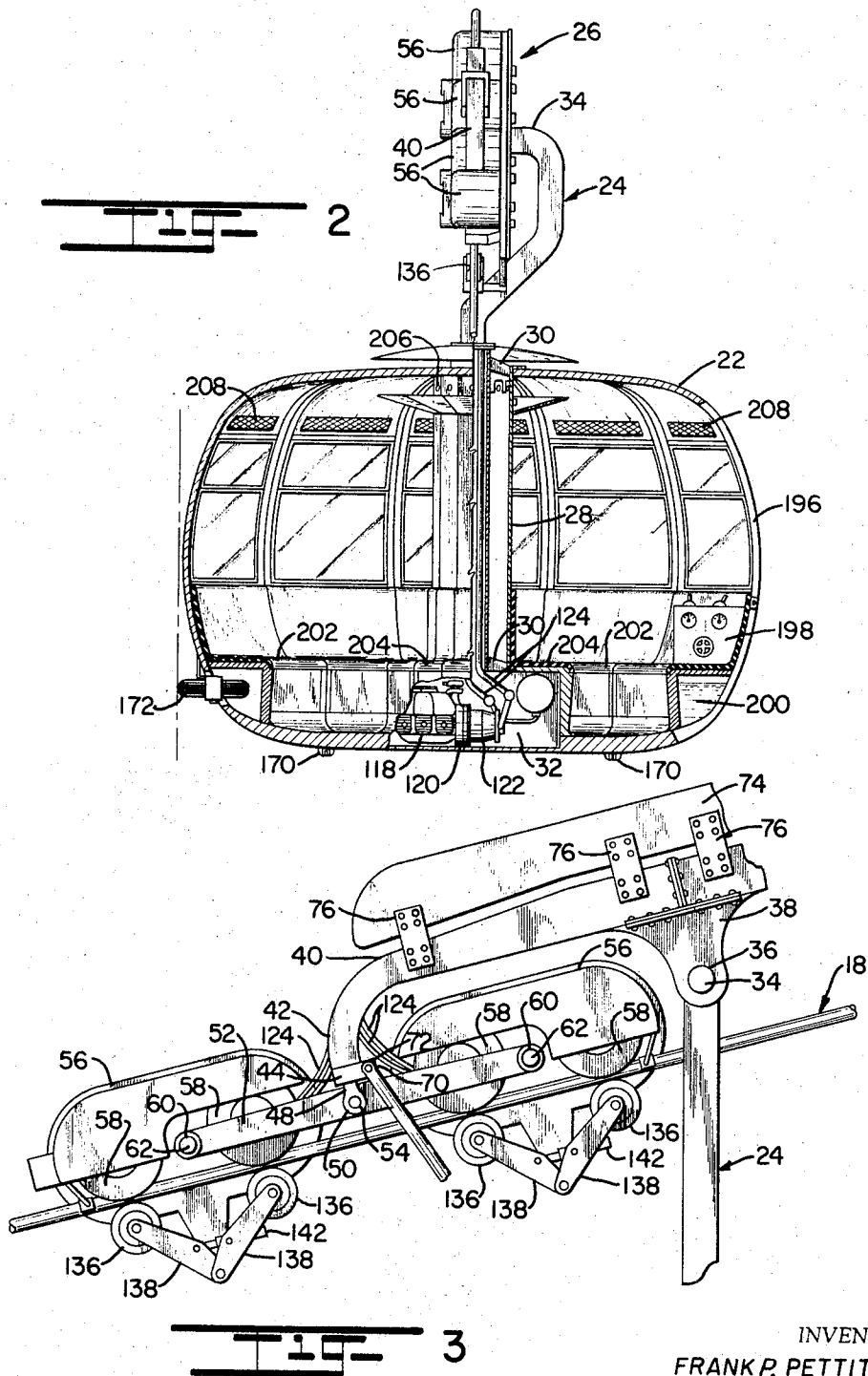
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7 Sheets-Sheet 2



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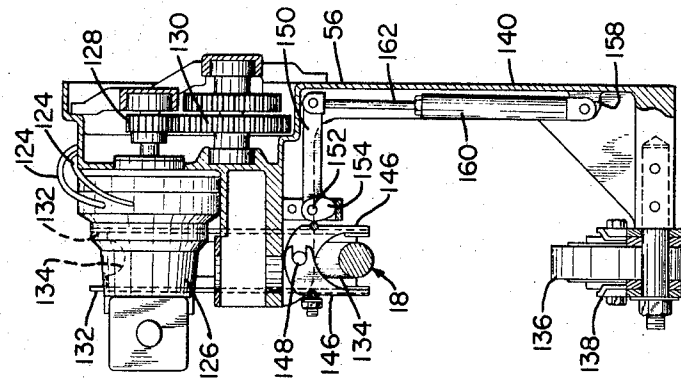
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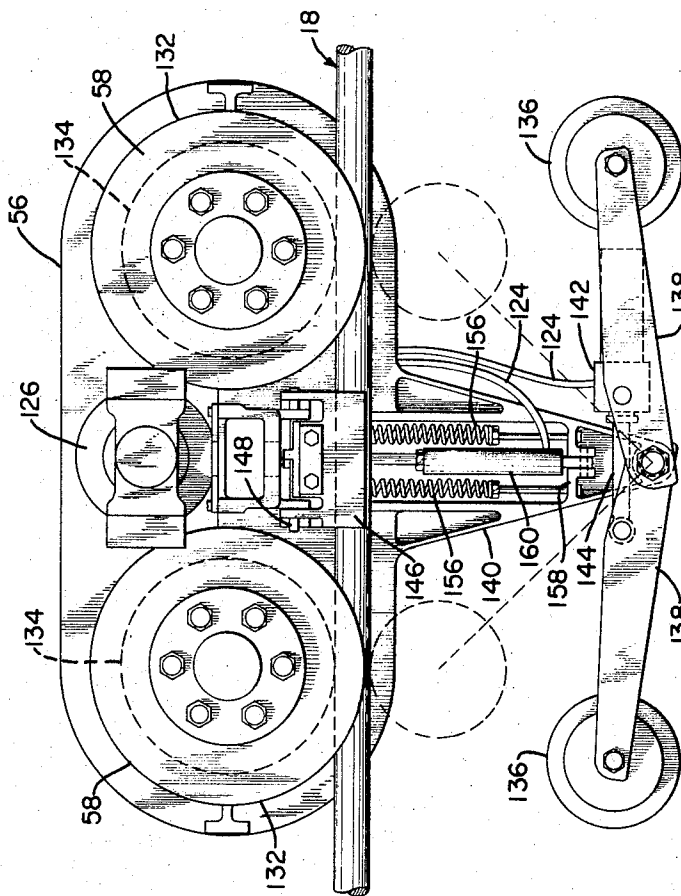
AERIAL TRAMWAY SYSTEM

Original Filed July 15, 1963

7 Sheets-Sheet 4



8



7

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AERIAL TRAMWAY SYSTEM

Original Filed July 15, 1963

7 Sheets-Sheet 5

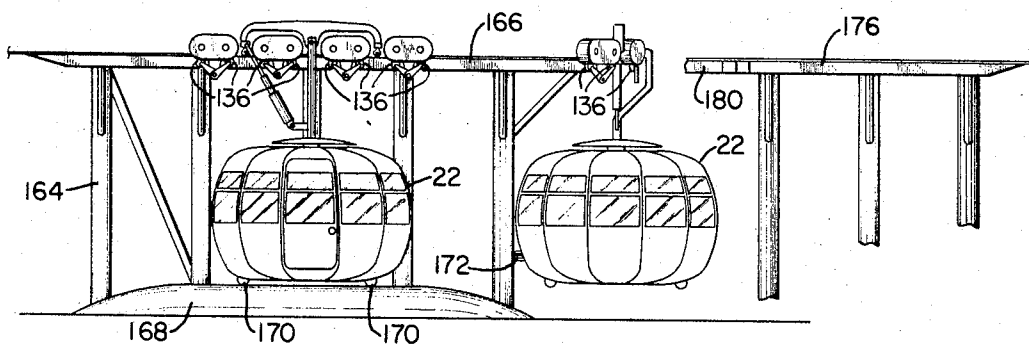


FIG. 9

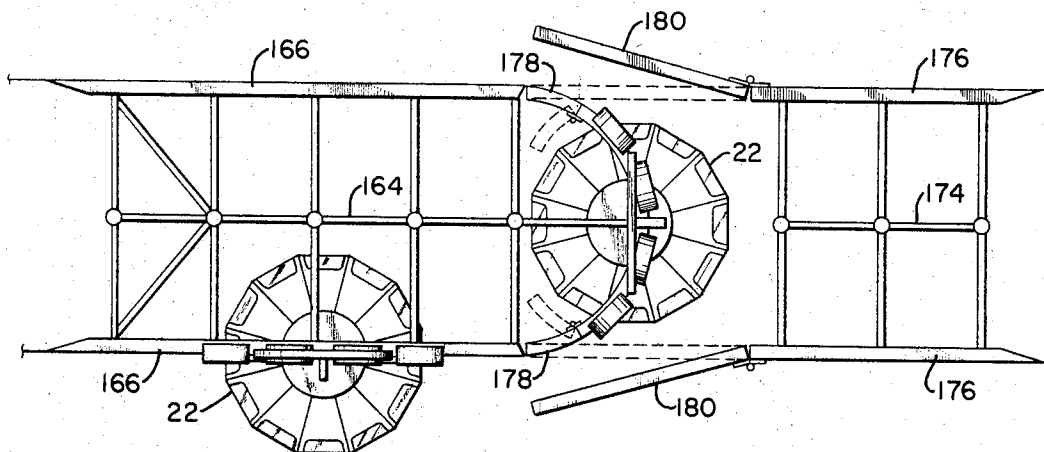


FIG. 10

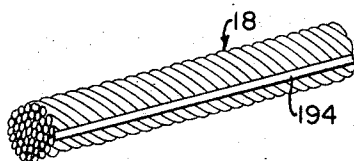


FIG. 12

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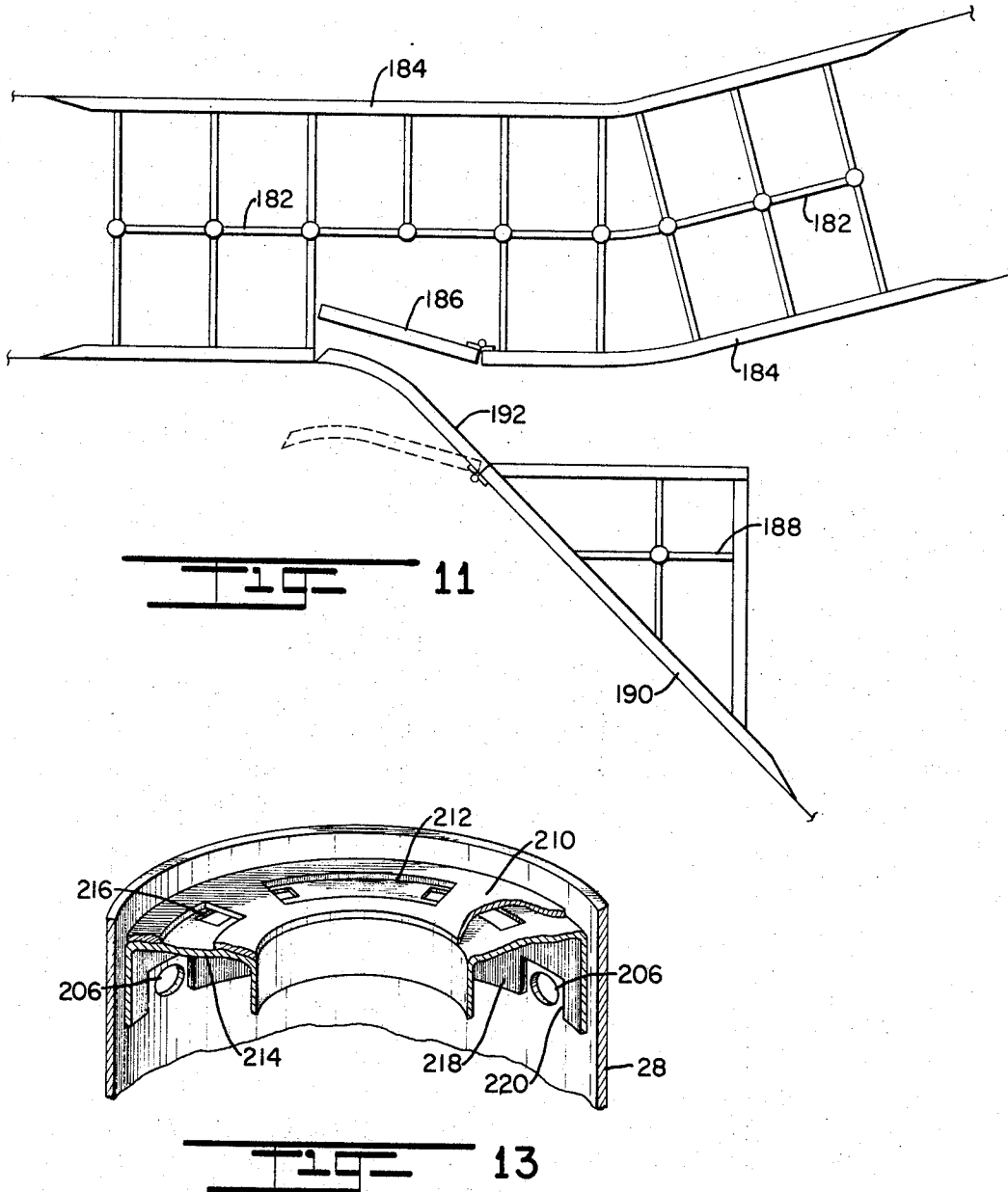
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AERIAL TRAMWAY SYSTEM

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7 Sheets-Sheet 3



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3,353,503

AERIAL TRAMWAY SYSTEM

Original Filed July 15, 1963

7 Sheets-Sheet 7

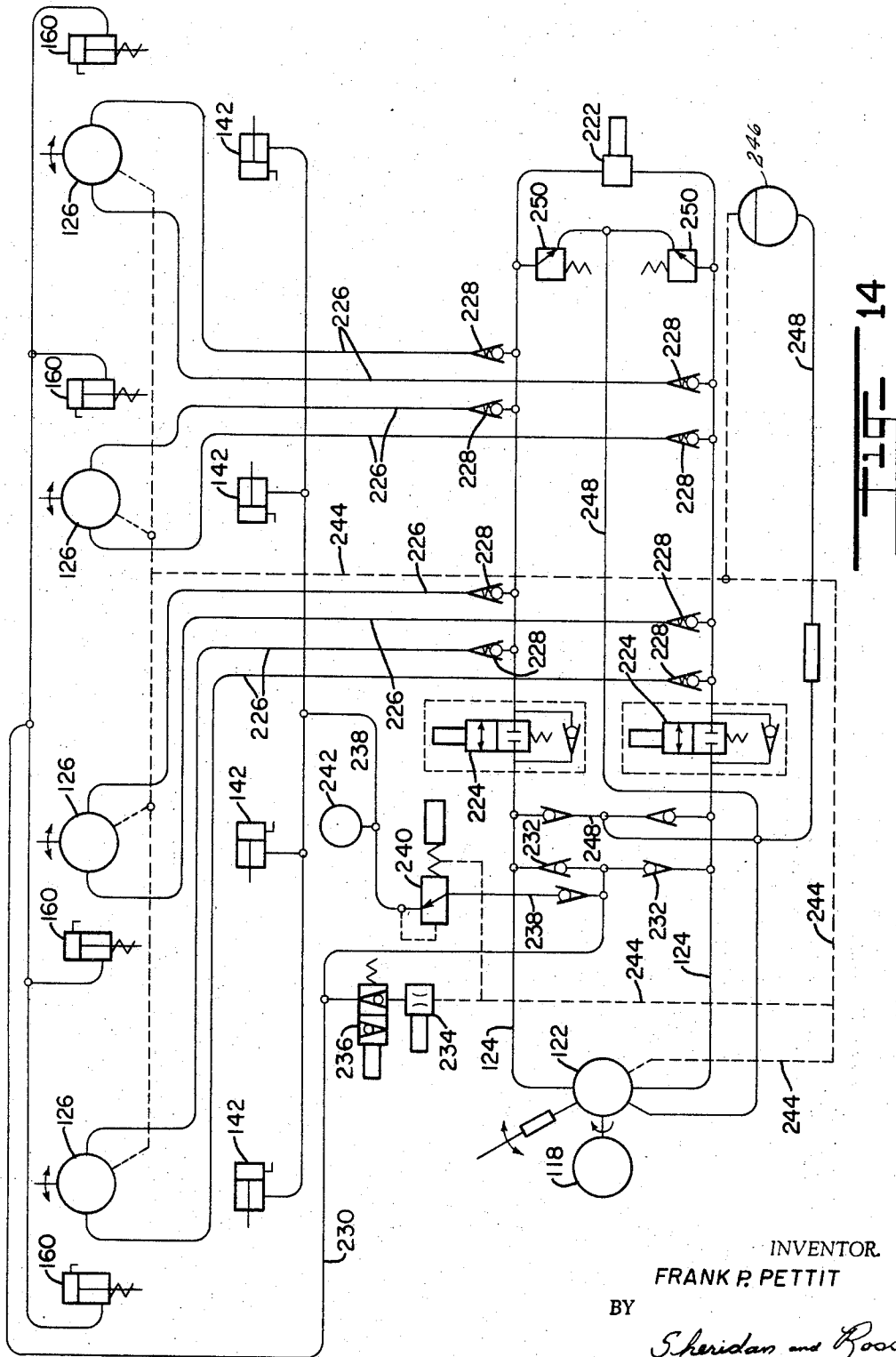


FIG. 14

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1

3,353,503

AERIAL TRAMWAY SYSTEM

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Continuation of application Ser. No. 294,824, July 15, 1963. This application Apr. 21, 1966, Ser. No. 544,315 17 Claims. (Cl. 105—150)

This application is a continuation of my application Ser. No. 294,824, entitled, "Aerial Tramway System" filed in the U.S. Patent Office on July 15, 1963, now abandoned.

This invention relates to aerial tramway systems and is directed particularly to improvements in the construction of both the elevated trackway and the passenger carrying vehicle which result in greater economy and convenience of maintenance as well as flexibility in construction, arrangement, and operation.

In general, it may be said that there are two types of aerial cableway systems in use at the present time. Both employ a series of towers laid out in a substantially straight line, each tower having one or two supporting arms depending on whether it is a monocable or bicable system. In the simpler system, a single continuous loop of cable is strung over the supports of the various towers and it moves longitudinally over pulleys or rollers on these supports, following a closed course.

Each vehicle is provided with an upwardly extending support rod having a reversely bent end which is secured in fixed manner to the cable and extends directly upward therefrom so that the connection can pass over the support pulleys. Succeeding vehicles are secured in the same manner in fixed, spaced relation, and all vehicles travel with the cable whether occupied or not because of the difficulty of removing those which are not needed. A large, fixed power plant is required at one end of the loop and drives a large "bull wheel" which in turn drives the cable. Since the entire cable must move continually and the full load of all the vehicles is applied in tension to all portions of the cable at times, it is necessary to limit the length of the loop and the weight of the vehicles. If the length of the course is great it is necessary to use several loops and to load and unload passengers at their junctions. This system is usually restricted to vehicles with a capacity of one or two passengers.

The more complicated system employs a fixed carrier cable which is also in the form of a closed loop although it does not travel around the course. The vehicles use a similar suspension rod, but the rod ends are provided with rollers or wheels to roll along the cable. A second cable, known as a "hauling" cable is attached at spaced intervals to the vehicles and hauls them along the carrier cable. A similar power plant and bull wheel at one end of the loop provide the motive power. In this type also, the weight of all the vehicles is applied in tension to all portions of the carrier cable.

The constant flexing of the moving cables induces a great deal of internal friction, thus considerably shortening their life. While the carrier cable of the second type does not travel, it flexes to a considerable extent at the points where it passes over the tower saddles and thus is also subject to internal friction and deterioration.

Since each of the systems described above requires a traveling cable which must follow a predetermined closed course, it is practically impossible to provide any arrangements for a turnaround in mid-course or a switching of any single vehicle from one course to another, both of which features would be highly desirable. It is also impossible to reverse the direction of travel of one vehicle without reversing all of them.

2

In addition to those mentioned above there are other features which it would be very desirable to incorporate in aerial tramways, particularly those which have a very large volume of passenger traffic. The vehicles should be independently operable and should therefore have self-contained power supplies. They should be capable of operation on very steep slopes without slippage. The course should be continuous from source to destination but should be capable of a substantial change of direction at any tower in order to follow the most practical path dictated by the contour of the terrain. It should be possible to expand the course with minimum modification of existing structure and without increasing ground power requirements.

The most important factor to be considered is safety. In addition to provisions for prolonging the life of the cable by adequate maintenance, there should be provisions for continuous inspection. In the event of actual cable failure the design should be such as to minimize the likelihood of endangering more than one vehicle. Most of the requirements set out above have not been met at all by the conventional tramways presently in use and the others have been taken care of only partially. The present invention fully meets all of the above requirements and possesses many other advantages which will be pointed out hereinafter. In general outward appearance both the trackway and the vehicle resemble conventional practice but they differ greatly in their detailed construction and arrangement of parts and the manner in which they cooperate with each other.

The trackway includes a series of towers of conventional construction, preferably A-frame or tripod design with lateral arms depending on whether the installation is mono-cable or bi-cable. Lengths of pre-stressed high strength suspension cable are strung between the towers and are securely anchored at each tower. While a single continuous piece of cable can extend to as many towers as desired so long as it is rigidly gripped at each tower to make the spans effectively individual, this introduces several complicating factors in repair and replacement. The preferred arrangement, which has been found to be highly satisfactory, employs discrete spans of cable between each pair of towers, with their ends securely anchored thereto.

The section of rigid track is mounted on each tower and the adjacent ends of two successive spans of cable are secured to the ends of the rigid track to provide a continuous path. The rigid track is considerably larger in thickness and in width than the cable so it is provided with a portion extending along its upper side which is sized and shaped to approximate the cable, and transition members provide for a smooth changeover. The rigid track may be bent in the vertical or horizontal plane or both, so it is possible to change the direction of the course to any desired extent at any tower. At the end of the course the rigid track usually is formed in a 180 degree horizontal curve to serve as a turnaround. Since the tower track is rigid, it can be made in several sections, some of which can be movably mounted. It is therefore possible to build switches at any tower to connect with branch tracks or with intermediate turnarounds.

The trackway construction briefly and generally described above makes it possible to utilize a new type of vehicle having many advantages not utilizable with the older, conventional systems. In general, a preferred form of the vehicle includes a passenger carrying cabin of generally spheroid shape to minimize sway-producing wind resistance. A suspension support member, preferably tubular, extends vertically and centrally of the cabin, terminating some distance above the bottom of the cabin. A carriage is mounted to the upper end of the suspension support member for rotation thereon about a laterally ex-

tending horizontal axis. The carriage is quite elongate in the direction of travel and includes a plurality of trucks carrying a plurality of wheels. The various elements of the carriage are articulated for relative movement in pitching and yawing directions but not in rolling directions. Consequently the carriage can follow vertical and horizontal curvatures of the trackway with all of the wheels in firm engagement at all times and with the cabin suspended in neutral vertical attitude.

At least some of the carriage wheels are drive wheels for the purpose of propelling the vehicle along the trackway. Power supply means is located in the lower central portion of the cabin and power transmission means extend upward therefrom along the suspension support member to the carriage and thence to the drive wheels. Any suitable type of power supply and transmission may be used but it has been determined that maximum reliability, efficiency, flexibility, and convenience may be achieved with the presently preferred hydraulic system. An internal combustion engine is mounted in the lower central portion of the cabin to drive a directly connected variable displacement pump. Fluid conduits extend from the pump to fixed displacement hydraulic motors mounted on the trucks and geared to the drive wheels. With this arrangement each vehicle contains its own power supply and is self propelled.

A hollow column surrounds the suspension support and extends from ceiling to floor of the cabin, forming a part of the supporting and rigidifying structure. A bench seat is built around the column and another bench seat is built around the inner wall of the cabin to provide maximum seating capacity for any given size of cabin. Air inlets are provided around the periphery of the outer wall and air vents are provided in the wall of the column near its upper end. The engine is preferably air cooled, and the column communicates with the engine compartment. A fan operated by the engine draws cooling air from the column and forces it over the engine, at the same time accomplishing ventilation of the cabin.

Because the vehicle is self propelled it is essential that the drive wheels maintain good frictional contact with the cable and with the rigid track. To insure such contact under all conditions the carriage is provided with a set of pressure rollers underlying the drive wheels and arranged to engage the under side of the cable. Fluid motors continuously force these rollers into pressural contact with the cable, and the pressure can be varied to meet the need. This enables the vehicles to climb at angles as steep as 45 degrees, and the gripping pressure can be made great enough to crush and remove any ice which may form on the cable. Obviously, when the carriage reaches a section of rigid track the pressure rollers must separate or retract from the wheels sufficiently to accommodate the greater thickness. For this purpose an accumulator is provided in the line leading to the fluid motors to absorb the backflow while maintaining the gripping pressure.

As stated above, the spheroidal shape of the cabin minimizes its wind resistance. It actually reduces it to about 40 percent of the equivalent flat plate area. The carriage is generally rectangular and approaches flat plate form. Its keel area is almost entirely above the cable, which is the effective pivot for rolling motion, and serves to counteract a large part of the rolling force on the cabin resulting from a lateral wind.

Various other advantages and features of novelty will become apparent as the description proceeds in conjunction with the accompanying drawings, in which:

FIG. 1 is a side elevational view of the novel tramway system including a pair of towers, a span of cable strung between them, and a vehicle suspended on the cable;

FIG. 2 is an end elevational view, partly in section, of the vehicle of FIG. 1;

FIG. 3 is a side elevational view of a part of the carriage of FIG. 1;

FIG. 4 is a side elevational view of details of the connection between the cable and the rigid track with thickness-transition means secured in place;

FIG. 5 is a top plan view of the connection of FIG. 4;

FIG. 6 is an end elevational view of the thickness-transition means;

FIG. 7 is a side elevational view of one of the trucks of the carriage, showing the emergency braking means and the pressure rollers;

FIG. 8 is an end elevational view, partly in section, of the device of FIG. 7;

FIG. 9 is a side elevational view of a terminal, including a loading station and a turnaround;

FIG. 10 is a top plan view of the terminal of FIG. 9 including additional trackage and switching means;

FIG. 11 is a top plan view of a set of towers and trackage illustrating a curve in the main course, a branch line, and switching means;

FIG. 12 is a perspective view of a section of pre-stressed, stranded wire suspension cable provided with a condition indicating stripe for inspection purposes;

FIG. 13 is a perspective view of a mixing damper mounted in the cooling air induction column of the cabin; and

FIG. 14 is a schematic diagram of the hydraulic power system of the vehicle.

The general arrangement of the aerial tramway system of this invention is illustrated in FIG. 1, in which two spaced towers 10 and 12 in a series of such towers along a selected course are each provided with a section of rigid track 14 and 16 respectively. Between these two sections is strung a length of pre-stressed, high strength suspension cable 18 the ends of which are firmly gripped by sockets connected to the ends of the rigid track sections. The vehicle 20 includes a passenger cabin 22, a suspension support member 24, and a carriage 26, the latter serving to support and propel the vehicle along the trackway by means described in detail hereinafter.

The support member 24 is preferably tubular and includes a lower straight section which passes vertically and axially through the center of the cabin which has a generally spheroidal shape. Member 24 is surrounded by a hollow column 28, which forms a part of the structure of the cabin, and is secured thereto by webs 30. It will be noted that members 24 and 28 both terminate above the bottom of the cabin to provide a compartment 32 for the components of the power supply. The upper end of member 24 has a goose neck shape terminating in portion 34 which extends laterally and horizontally and is cylindrical to serve as a journal pivotally carried in bore 36 which extends laterally through web 38 of the primary equalizer beam 40, best seen in FIG. 3, which forms an important element of carriage 26. Thus the cabin has relative pitching freedom with respect to carriage 26 so that it can always hang in a neutral vertical position but it is restrained against rolling or yawing motion with respect to the carriage.

The primary equalizer beam 40 is generally U-shaped with its legs 42 extending downwardly as seen in FIGS. 2 and 3. Attached to the end of each leg are bearing blocks 44 and 46, each being provided with a vertical bore for the reception of the shank 48 of eye 50 for rotation of the latter about a vertical axis. Secondary equalizer beams 52 carry laterally extending pins 54 journaled in eyes 50 for rotation about a horizontal lateral axis. Thus each secondary equalizer beam is mounted on the primary beam for relative pitching and yawing motions.

Each secondary equalizer beam 52 carries at each end a truck 56, which in turn carries a pair of drive wheels 58. Each truck is mounted to a beam end by a block, not shown which is vertically pivoted in the truck and is laterally horizontally pivoted in the eye 60 of the beam by pin 62. Each truck, therefore, has the same freedom of motion with respect to its secondary equalizer

beam as the latter has with respect to the primary equalizer beam. Each pair of wheels in one truck is closely coupled and can pitch and yaw with respect to all of the others. Therefore, with the articulation described the carriage can negotiate very sharp track curvatures whether vertical or horizontal without any of the wheels binding or tending to leave the track.

Hydraulic damping means is provided to stabilize the cabin in pitching with respect to the carriage. A telescoping hydraulic damper or snubber 64 of conventional design is pivotally mounted at its lower end 66 to bracket 68 mounted on member 24. Its other end 70 is pivotally mounted to ear 72 formed on bearing block 44. The metering components within the snubber will permit a gradual change of length so that the cabin can maintain its neutral attitude as the carriage changes its inclination. However, the snubber prevents any sudden change of attitude in pitch which would otherwise result from a gust of wind.

Side winds tend to "roll" the cabin about the cable or rigid track as an axis. The spheroidal shape of the cabin minimizes its wind resistance, reducing it to about 40 percent of the equivalent flat plate area. The carriage on the other hand is non-streamlined and its resistance to a lateral wind is just about equal to the flat plate area of its total vertical outline. Since it is primarily above the cable the lateral effect of its "keel" area very largely counteracts the effect of any side wind on the cabin, thus greatly reducing its roll. To further counteract roll a separate keel 74 may be mounted to equalizer beam 40 by brackets 76 to extend upwardly therefrom.

While some of the advantages of the invention can be obtained even with a continuous length of cable if it is rigidly clamped at each tower to make the spans function individually such arrangement has many disadvantages which outweigh the simplicity of its original installation. In carrying out the present invention a section of rigid track, 14 or 16, is mounted on the supporting arm of each tower. The track may be a solid rolled member or may be of built up construction but, as illustrated in FIGS. 4 and 5, it is a solid section generally similar in form to a railroad rail, having a wide bottom flange 78 and an upstanding web 80. The upper surface 82 is somewhat flattened but has about the same lateral dimension as the cable 18. The end of the rail is rounded at 84 and a portion of the flange 78 is cut away. Lateral bore 86 is formed through the web to receive the pin 88.

The end of cable 18 is enlarged in conventional fashion to form a generally conical abutment. A conical socket 90 fits snugly around the abutment and grips it tightly. The socket is provided with a pair of ears 92 bored to receive pin 88. The pin passing through the track and these ears firmly secures the cable to the track while permitting such rotational movement as occurs in normal use. A conventional fastener is applied to the free end of pin 88 to retain it in place.

Since the track is a great deal larger than the cable, particularly in thickness, it is necessary to provide means to facilitate the transfer of the carriage between them. For this purpose a thickness-transition member is provided. It comprises a piece of solid bar stock 94, the upper part having the shape and dimensions of the upper part of the track, to which is pivotally attached a tapered, channel-shaped member 96, the latter being secured to the cable by clamp 98. A lower, sloping guide member 100 extends along the lower surface of socket 90 and is secured thereto by clamp 102. Member 94 includes an integral downwardly extending leg 104 with cross bores 106 and 108 near its top and bottom. Bolts 110 pass through these bores and engage side links 112. The lower bolt also passes through ears 114 of guide plate 100. Suitable tubular spacers 116 hold the parts in the proper assembled relation surrounding the reduced mid portion of socket 90 so that the transition member will not be longitudinally displaced.

The motive power for the drive wheels and other powered components of the vehicle originates in compartment 32, shown in FIG. 2. Air cooled engine 118, provided with a flywheel, in casing 120, which rotates with its principal plane substantially in the vertical plane containing the vertical axis of the vehicle and the cable and carriage, drives a variable displacement pump 122, which may be of the wobble plate type and which is reversible to cause fluid flow in either direction. From the pump suitable flexible conduits 124 extend upwardly through the tubular support 24 and through the primary walking beam 40 to the trucks 56.

Some of these conduits lead to the drive motors 126, one of which is provided in each truck. One of these motors, which are positive displacement, reversible hydraulic motors, is shown in FIGS. 7 and 8. The motor shaft carries a gear 128 which drives both wheels of the truck through gearing 130. The wheels 58 each include a pair of disk-like flanges 132 with a rubber tire 134 between them. The tire is contoured to fit the surface of the cable.

Since the wheels 58 provide the sole traction for propelling the vehicle it is essential that they maintain good contact with the cable at all times. To insure this contact, pressure rollers 136 are provided and are adapted to be urged against the under side of the cable to produce a gripping action between the wheels and the rollers. They are rotatably mounted on the outer ends of a pair of toggle links 138 which in turn are pivotally mounted at the lower end of plate 140 which is an extension of truck 56. Cylinder 142 is pivotally connected to one of the links and piston rod 144 is pivotally connected to the other. When the rod is retracted the toggle is collapsed and the links and rollers move to the dotted line position. The hydraulic pressure can be varied to suit the circumstances. In icing conditions the pressure is increased to the point where the gripping action between the rollers and wheels is sufficient to crush and remove ice formations on the cable.

When the carriage reaches a tower the rollers must separate or retract from the wheels sufficiently to accommodate the increased thickness of the transition member and the rigid track. An accumulator, later described, absorbs the backflow from cylinders 142 while maintaining the desired gripping action between wheels and rollers, and also causes the rollers to again approach the wheels as they leave the tower and return to the cable.

In the event of a malfunction of some kind, particularly a hydraulic failure, it is desirable to have an emergency braking means which will act automatically. This is taken care of here by providing on each truck a pair of brake clamp shoes 146 which are pivoted to the truck at 148 and depend on each side of cable 18. A link 150 is pivoted at 152 and is provided with a cam surface 154 to engage the adjacent shoe and urge the two shoes toward each other when it is swung down around its pivot. Two strong coil springs 156 are anchored at their lower ends to bracket 158 and are attached under high tension to link 150 to forcefully apply the brakes. Cylinder 160 is pivotally attached to bracket 158 and its piston rod 162 is attached to the end of the brake applying link 150. When pressure is supplied to the cylinder the piston rod is extended to overcome the action of the springs and hold the brakes in released position. In an emergency the pressure in the cylinder is rapidly released and the springs apply the brakes to prevent any undesired movement of the vehicle.

It was previously pointed out that the engine flywheel, contained in housing 120, is so oriented that its principal plane is substantially in the vertical plane containing the carriage and the vertical center line of the cabin. In this position the gyroscopic effect of the rotating flywheel resists movement in the rolling sense of the cabin. It therefore augments the effect of the keel area of the

carriage in counteracting the rolling tendency of the cabin induced by side winds.

A typical example of a station and a turnaround on the tramway line is illustrated in FIGS. 9 and 10. Tower structure 164 supports rigid track 166 which turns a full half circle to proceed in the reverse direction. Cabin 22 has come to rest at the middle of the platform 168, and its wheels 170 contact the surface to support or steady the cabin during entry and exit of passengers. In the event that there is no platform, as shown at the right of FIG. 9, the stabilizing wheel 172 which is mounted in a horizontal plane extends beyond the wall of the cabin to contact the tower structure and stabilize the cabin for entry and exit.

Additional tower structure 174 and rigid tracks 176 are shown in FIG. 10 to illustrate an intermediate turnaround in a continuing line. Two sections 178 of track 156 are pivoted to swing inwardly to make room for sections 180 of track 176 so that vehicles may either proceed in a straight line to a distant point or turn around at this station and return to the starting point.

A further variation is illustrated in FIG. 11 which illustrates a main double line and a branch single line. Tower structure 182 supports a pair of rigid tracks 184 including both straight and curved portions, together with a pivoted switch section 186. Tower structure 188 supports a single track 190 including a pivoted switch section 192. With this arrangement it is possible to have a main line which may vary in direction at any tower and also provide one or more branch lines, switching from one to another at will.

The advantageous arrangements described above are made possible by the cooperating elements of the present invention. The cable provides the lightest and strongest vehicle support across the spans. The rigid track eliminates the deterioration of cables in flexing at the tower saddles and makes it possible to change direction to any extent at any tower. Moreover it makes possible the intermediate turnarounds and the switches which permit direct or branch additions to the line. The self propelled vehicle is the only type which can make use of these advantages because it is not restricted in direction, scope, or range by the limitations of a traveling or hauling cable.

The type of cable used is illustrated in FIG. 12. The cable 18 is pre-stressed, high strength, bridge suspension cable and is provided with a highly visible colored stripe 194 extending along its length. So long as the cable remains in good, safe condition the stripe retains its normal appearance. However, when the cable begins to deteriorate the stripe becomes distorted and the change is readily observable on inspection. The cable is strung so that the stripe appears along one lateral side, preferably below the horizontal diameter. In this position it is visible to the operator of the vehicle and he may carry out an inspection of the cable on every trip with no extra effort.

The operator's station is adjacent the door 196 as shown in FIG. 2, where he operates the relatively simple console 198 which has only a few controls. The fuel tank 200 is located beneath the seat 202 which extends all around the inner wall except for the door opening. A second smaller seat 204 surrounds column 28 and corresponds in shape with the power supply compartment. The lower end of column 28 is open and communicates with the engine compartment. At its upper end are air vents 206 leading to the interior of the cabin. Inlet vents 208 communicate with the exterior. When the engine is in operation its fan, not shown, draws air down through column 28 and forces it over the engine. The air is drawn into the cabin through vents 208 and from the cabin into the column through vents 206 so that the operation of the engine automatically ventilates the cabin. In very warm weather the windows may also be opened.

Means are provided to regulate the amount of ventilation and are illustrated in detail in FIG. 13. Adjacent the top of column 28 a diaphragm 210 extends across the opening between support 24 and the column. Several

peripherally spaced openings 212 are formed in the diaphragm for the passage of air directly from the exterior of the cabin. Immediately beneath the diaphragm is arranged a plate 214 rotatable around the axis of support 24. The plate is provided with spaced openings 216 corresponding to those in the diaphragm so that the plate can be rotated to block the diaphragm openings or to allow regulated amounts of air to enter. The plate is also provided with an outer marginal depending flange 218 which overlaps vents 206. The flange is formed with cutouts or openings 220 spaced around the periphery in the same relation as the vents. The cutouts are arranged with respect to openings 216 so that when the vents are fully open the ports 212 are substantially fully blocked. As less ventilation is needed the plate is rotated and vents 206 are gradually closed off as ports 212 are opened. Thus the amount of ventilation can be varied without reducing the available flow of cooling air to the engine.

The hydraulic system of the vehicle is relatively simple and is illustrated in diagrammatic form in FIG. 14. Engine 118 drives the variable displacement hydraulic pump 122 to which are connected two conduits 124 for forward and reverse flow, the pump being reversible in its pumping action. The two conduits meet at the manually operated bypass valve 222 which is normally closed. Manually controlled, solenoid operated hold valves 224 are inserted in lines 124 to control the operation of the motors. When the valves are opened, fluid flows through the two sets of conduits 226 to the motors 126 which operate the drive wheels 58, the direction of flow being dependent on the direction of output of the pump. Velocity fuses, or flow limiters, 228 are arranged in each of lines 266 to limit the flow to 13 gallons per minute. This prevents runaway action of the motors and also limits the fluid loss in event of a major break in the lines. When valves 224 are closed they prevent operation of the motors and serve as a normal braking means.

Upstream of the hold valves, a branch line 230 taps both conduits 124 to obtain a supply of pressure fluid for the other two major operations. Check valves 232 prevent reverse flow from the branch line. Line 230 leads to the brake hold-off cylinders 160 and has a branch leading to a dual release valve 234, 236. The manual valve 234 may be operated at any time it is desired to apply the brakes. The automatic valve 236 is operated electrically by a signal initiated by a loss of pressure down to a selected minimum such as 25 pounds per square inch in the main system. It may also be initiated by any other selected emergency condition.

Line 238 taps into line 230 to obtain a supply of pressure fluid for the pressure roller cylinders 142. It contains a pressure regulator valve 240 to control the force of the rollers and is connected to accumulator 242 which allows the cylinders to backflow while maintaining substantially constant pressure on the rollers.

On occasion it is desirable to be able to move the vehicle manually or by towing with another vehicle when the engine is off and the hold valves 224 are closed. This can be done by opening bypass valve 222 which allows fluid to circulate through the motors without going to or from the pump.

Various lines 244 lead from the components to the reservoir 246 to return leakage or slip fluid, and lines 248 deliver make-up fluid to the pump from the reservoir and from the pressure relief valves 250.

Among many features and advantages not previously mentioned is the flexibility of operation resulting from the use of self propelled vehicles combined with the unique trackway embodying any desired combination of turnarounds, branch lines, and switches. Any course of travel may be activated individually to satisfy the traffic demands of the moment. Vehicles can be added or subtracted as rapidly as the load factor changes, completely avoiding operation of unoccupied vehicles. Each vehicle

starts and stops independently, eliminating annoying waits after a journey has started. Cable spans are individually loaded and the maximum number of vehicles on a span at one time can be limited as necessary or desirable. Since an entire course of vehicles does not have to be moved at one time with a single power plant, it is possible to operate at much greater speeds. The independent vehicles of this invention are readily operated up to 15 miles per hour with complete ease and safety.

It will be apparent to those skilled in the art that various changes and modifications may be made in the construction and arrangement of parts as disclosed herein without departing from the spirit of the invention, and it is intended that all such changes and modifications shall be embraced within the scope of the following claims.

I claim:

1. A carriage for use in suspending a self-propelled vehicle on an aerial tramway system including spaced towers with lengths of suspension cable strung between them comprising: an elongate support structure extending in the direction of travel of said carriage; a plurality of drive wheels mounted in fore and aft spaced relation on said structure to engage the upper side of said cable to support and propel said vehicle; motor means carried by said structure in driving engagement with said drive wheels; pressure rollers mounted on said structure operative to yieldably pressurally engage the underside of said cable to produce a greater traction, cable-gripping action between the drive wheels and the rollers, said pressure rollers operative to retract away from said cable against the pressure urging them towards said track; a source of fluid under pressure; fluid motor means connected to said rollers to urge them into engagement with said cable; conduit means connecting said pressure fluid source to said fluid motor means; and an accumulator connected to said conduit means to permit said rollers to retract from said wheels to accommodate tracks on said towers which are thicker than the cable while maintaining the desired gripping action.

2. The combination as claimed in claim 1; further including a bracket depending from a portion of said support structure; and a pair of oppositely extending links pivotally connected at their inner ends to the lower end of said bracket; one of said rollers being mounted at the outer end of each link; a fluid actuator in communication with said fluid under pressure including a cylinder connected to an intermediate portion of one of said links and a piston rod connected to an intermediate portion of the other of said links; said actuator being operative to draw said links together in toggle fashion to raise said rollers upward into pressural engagement with said cable.

3. A carriage for use in suspending a self-propelled vehicle on an aerial tramway system including spaced towers with links of suspension cable strung between them comprising: an elongate support structure extending in the direction of travel; a plurality of drive wheels mounted in fore and aft spaced relation on said structure to engage the upper side of said cable to support and propel said vehicle; and emergency braking means including a pair of clamping jaws mounted on said structure and movable toward each other to engage the lateral sides of said cable to grip it frictionally between them and restrain movement of said carriage relative to said cable; said clamping jaws being pivotally connected to and depending from a portion of said support structure to lie along each lateral side of said cable; force multiplying linkage connected to said jaws to constantly urge them toward each other into gripping engagement with said cable; resilient force applying means connected to said linkage to constantly urge said jaws toward gripping position; and fluid motor means connected to said linkage and acting normally with sufficient force to overcome the force with which said jaws are urged against said cable to constantly hold said jaws in disengage position during normal operation of said carriage.

4. The combination as claimed in claim 3; and means to instantaneously deactivate said fluid motor means at any location of said carriage along the cable to allow said resilient means to apply a braking action.

5. The combination claimed in claim 3 in which said fluid motor means is responsive to a drop in said fluid pressure to deactivate and allow said resilient means to apply a braking action.

6. An aerial tramway system including an elongate elevated track and a vehicle suspended from said track by a carriage, said carriage comprising: a primary equalizer beam extending fore and aft of said carriage as respects its direction of travel on said track; suspension means between said vehicle and said carriage having one end connected to said vehicle and the other end to said primary equalizer beam midway of the length of said primary equalizer beam to provide for relative pitching of said vehicle in a vertical plane while preventing rolling motion of said vehicle; a secondary equalizer beam mounted at substantially its midpoint to each end of said primary equalizer beam by a connection operative to permit said secondary equalizer beam to simultaneously rotate horizontally and pitch vertically relative to said primary equalizer beam without relative rolling motion; a truck mounted substantially at its midpoint to each end of said secondary equalizer beam by a connection which permits pitching in a vertical plane with respect to said secondary equalizer beam without rolling; whereby the connections between said secondary equalizer beam, said truck and said primary equalizer beam provide for relative pitching, and the connections between said primary and secondary equalizer beams provide yawing motion of said trucks and prevent relative rolling motion thereof; at least a pair of drive wheels mounted in fore and aft spaced relation on each truck for engagement with the upper side of said track to suspend and propel said vehicle; and motor means to drive said wheels.

7. A carriage for use in suspending a vehicle on an aerial tramway system including spaced towers with lengths of suspension cable strung between them, comprising: an elongate support structure extending generally longitudinally in the direction of travel of said vehicle and lying generally in the vertical plane containing a cable to be traversed by said carriage; said structure including a primary equalizer beam extending fore and aft; a pivotal mounting formed substantially midway of the length of said primary equalizer beam and extending laterally and horizontally to pivotally mount said vehicle for relative pitching in said vertical plane while preventing relative rolling; a secondary equalizer beam mounted at substantially its midpoint to each end of said primary equalizer beam, the connections between said beams providing for relative pitching and yawing motion and preventing relative rolling motion; a truck mounted substantially at its midpoint to each end of each secondary equalizer beam, the connections between said secondary equalizer beams, said trucks and said primary equalizer beam providing for relative pitching and the connections between said primary and secondary equalizer beams providing yawing motion of said trucks and preventing relative rolling motion; at least a pair of drive wheels mounted in fore and aft spaced relation on each truck for engagement with the upper side of said cable to suspend and propel said vehicle; and motor means to drive said wheels; the articulation of said carriage provided by the arrangement of said walking beams and trucks and the pivotal mounting of the passenger cabin providing complete flexibility to cause said vehicle to follow trackways curved in both horizontal and vertical planes while maintaining said cabin in substantially vertical neutral position.

8. An aerial tramway system including an elongate elevated track and a vehicle suspended from said track by a carriage, said carriage comprising: a primary equalizer beam extending fore and aft of said carriage as respects

its direction of travel on said track; a pivotal mounting substantially midway of the length of said primary equalizer beam mounting said vehicle for relative pitching in a vertical plane while preventing rolling motion of said vehicle; a secondary equalizer beam mounted at substantially its midpoint to each end of said primary equalizer beam, the connections between said beams providing for relative pitching and yawing motion and preventing relative rolling motion; a truck mounted substantially at its midpoint to each end of each secondary equalizer beam, the connections between said secondary equalizer beam, said trucks and said primary equalizer beam providing for relative pitching and the connections between said primary and secondary equalizer beams providing yawing motion of said trucks and preventing relative rolling motion; at least a pair of drive wheels mounted in fore and aft spaced relation on each truck for engagement with the upper side of said track to suspend and propel said vehicle; and motor means to drive said wheels.

9. A hydraulic power operating system for a self-propelled vehicle adapted for use in an aerial tramway system, comprising: a prime mover, a variable displacement, reversible hydraulic pump driven by said prime mover; two reverse flow conduits communicating with said pump; a control valve in each conduit; a plurality of fixed volume, positive displacement, reversible motors for driving the drive wheels of said vehicle; a pair of supply conduits communicating with each motor, one of each pair being connected to one of said pump conduits; said motors operating in accordance with the direction of delivery of said pump upon opening of said control valves and being locked against rotation upon closing of said valves to serve as a brake against movement of said drive wheels.

10. The combination as claimed in claim 9; and, in addition thereto, a bypass conduit connecting said two pump conduits downstream of said control valves; and a manually controlled valve in said bypass conduit to release said motors for rotation to facilitate non-powered movement of said vehicle.

11. The combination as claimed in claim 9; and, in addition thereto, a brake hold-off cylinder; a brake conduit connected to said cylinder and said pump conduits upstream of said control valves; and a pressure release valve in said brake conduit to release the fluid pressure in said cylinder to permit application of said brake.

12. The combination as claimed in claim 11; said release valve being solenoid actuated in response to pressure loss in the main hydraulic system to cause emergency actuation of said brake.

13. A self-propelled, passenger carrying vehicle for use in an aerial tramway system including spaced towers with lengths of suspension cable strung between them, comprising: a passenger cabin; a hollow tubular suspension support extending generally vertically and centrally through said cabin; the lower end terminating above the bottom of said cabin and the upper end terminating well above the top of said cabin; a carriage attached to the upper end of said support and provided with a plurality of drive wheels adapted to engage the upper side of said cable to support and propel said vehicle; motor means mounted on said carriage to actuate at least some of said drive wheels; a self-contained power source mounted in the lower portion of said cabin below said tubular support; and power transmission means passing through said tubular support and communicating between said power source and said motor means.

14. A self-propelled, passenger carrying vehicle for use in an aerial tramway system, comprising: a passenger cabin having a generally annular cross-section at various vertically spaced horizontal sections; a slender elongate suspension support passing vertically through the center of said cabin; the lower end of said support terminating above the bottom of said cabin; a carriage at the upper end of said support for suspending said vehicle on a tramway track; an air-cooled internal combustion engine

mounted in the lower central portion of said cabin; a hollow column surrounding said support and having a lower end terminating adjacent said engine to supply cooling air thereto and an upper end terminating adjacent the top of said cabin; air vents in the wall of said column in the vicinity of its upper end and communicating with the cabin to draw air therefrom; inlet vents in the outer walls of said cabin for ingress of ambient air; and a fan driven by said engine to draw air through said cabin and said column and force said air over said engine to perform the dual function of ventilating the cabin and cooling the engine.

15. The combination as claimed in claim 14; said column having an inlet opening communicating directly with the exterior; means to vary the proportions of air drawn through the cabin and directly from the exterior.

16. The combination as claimed in claim 14; and, in addition thereto, a diaphragm extending across the upper end of said column; inlet ports in said diaphragm; a rotatable plate mounted beneath said diaphragm in juxtaposition thereto and having inlet ports movable into and out of registry with said first inlet ports; said plate having a depending flange engaging the wall of said column and overlapping the air vents therein; said flange having inlet ports movable into and out of registry with said air vents; said ports and vents being so positioned with respect to each other that the direct inlet ports are closed as the air vents are opened and vice versa; intermediate positions of adjustment of said plate and flange varying the proportions as desired.

17. A self-propelled, passenger carrying vehicle for use in an aerial tramway system including spaced towers with lengths of suspension cable strung between them, comprising: a passenger cabin of generally spheroidal shape having low wind resistance; a suspension support extending upwardly therefrom; a carriage attached to the upper portion of said support and provided with a plurality of wheel carrying trucks in fore and aft spaced relation along the line of travel; drive wheels mounted to said trucks to engage the upper side of said cable to support and propel the vehicle; and generally planar cover members covering the major portions of said trucks and wheels and providing a substantial keel area to largely counteract the rolling effect of lateral wind forces on said cabin; and a keel plate secured to and extending above said carriage to increase the total keel effect thereof and further counteract the rolling effect of lateral wind forces on said cabin; and a self-contained power plant mounted in the lower central portion of said cabin; said power plant having a flywheel mounted with its principal plane lying in a vertical plane substantially parallel to the vertical plane containing said drive wheels and their supporting cable; the gyroscopic effect of said flywheel serving to counteract the rolling effect of lateral wind forces on said cabin.

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13

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14

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