An endless cable (49) is tensioned between two support structures (3a, 3b) in an elongated loop. A cable carriage (33) is suspended from the cable (49) at all times. Each segment of the cable passes through the cable carriage around two drive sheaves (41). Each drive sheave (41) is associated with it a disc brake assembly (45, 47). The cable (49) is driven by a bull wheel mechanism (15) which is located at the base of one of the support structures. As the endless cable (49) is driven, the two segments travel in opposite directions. When the disc brakes (45, 47) on one side of the carriage (33) are engaged, the drive sheaves (41) are immobilized on one segment of the endless cable and the carriage is carried along in the direction that the grasped segment of the endless cable (49) is travelling. A camera dolly is also attached to the carriage.
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NOVEL AERIAL CABLEWAY
AND METHOD FOR FILMING SUBJECTS IN MOTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a cable operated aerial tramway and more particularly to a system for supporting and conveying equipment, such as photographic and video equipment, in either direction along an aerial path defined by a cable.

2. Description of the Related Technology

The challenge of continuously filming moving objects traveling over moderate to long distances has, up to the present time, fostered a number of techniques, none of which have been entirely satisfactory. According to one method, a series of fixed location cameras spot the traveling subject at a distance and rotate as the subject approaches and moves past -- much in the way that downhill skiing events are currently filmed. According to another method, a camera is mounted on a ground vehicle that travels along side the subject. In still another method, the filming is done from an aircraft, for example, a helicopter.

Unfortunately, each of the known methods for filming an object as it travels over a distance has significant attendant disadvantages. The use of a series of fixed cameras which rotate to follow the subject as it passes by has the disadvantage that for the filming of a subject that travels over considerable distances, a large number of cameras and camera operators are necessary. Further, for each camera, the subject is, for the most part, at some distance from the camera and is only near the camera as it passes by the fixed location, often at considerable speed. The use of ground vehicles has the disadvantage of being severely limited to smooth and firm terrain and is entirely unsuitable for the filming, for example, of downhill skiing events. While the use of rails to carry a vehicle over rough or
unsteady terrain has had wide use, even the use of rails is limited to a certain range of terrain. The use of aircraft has the disadvantage of often being, for safety reasons, too distant from the action to achieve closeups or other desired footage.

Attempts have been made to avoid the aforementioned disadvantages through the use of systems in which a camera is suspended from, and travels along, one or more cables. However, these systems have had the disadvantages of being too noisy and too heavy, of not being able to move back and forth along the same line, or not having sufficient power, speed, acceleration, deceleration, and responsiveness in both directions, or not having sufficiently smooth starting and stopping for the obtaining of good start and end filming frames.

**SUMMARY OF THE INVENTION**

It is an object of the present invention to provide a system for filming moving subjects travelling over a distance which avoids the disadvantages heretofore encountered.

According to the present invention, a cable operated, cable suspended, aerial tramway adapted for use in filming moving objects, avoids all the disadvantages encountered with the prior methods. The present invention is also contemplated for a variety of other industrial, commercial, and recreational applications.

According to an advantageous feature of the invention, a main support or suspension cable may be provided which is tensioned between two support structures. A cable carriage may be mounted on the cable by two suspension sheaves, and a plurality of idler and drive sheaves may be mounted on the cable carriage. A dolly adapted for carrying equipment and/or people may be suspended from the carriage. According to a further feature of the invention, the dolly may be adapted to carry filming equipment, a camera operator and a dolly operator. A camera operator’s
station may be built onto the dolly to support the camera operator and filming equipment.

Displacement of the carriage/dolly assembly in either direction along the suspension cable is accomplished through the use of a bull wheel mechanism which drives an endless drive cable. The endless drive cable travels in an elongated loop and passes through the carriage on both segments of its loop. As the cable is driven, one segment passes through one side of the carriage in one direction and the other segment passes through the other side of the carriage in the opposite direction. Each segment of the endless drive cable passes through one side of the carriage by threading through the plurality of sheaves mounted on the carriage.

The interaction between the sheaves and the endless drive cable, described below in the detailed description, is such that there is no slippage. Thus, when the sheaves are prevented from rolling, i.e. braked, the carriage has effectively frictionally engaged or gripped the endless drive cable. The camera dolly is caused to move in one direction by application of the brakes to the sheaves on one side of the carriage. The cable on that side of the carriage is effectively gripped and the carriage is carried along in the direction in which the gripped segment of the cable is traveling. To move in the opposite direction, the segment of the loop currently gripped is released by disengaging the sheave brakes on that side and the sheave brakes on the other side of the carriage are applied, and the segment of the cable traveling in the opposite direction is thus gripped. The sheave brakes are variable. This enables the operator to control the acceleration and deceleration of the camera dolly to the extent that starting and stopping become very smooth resulting in excellent start and end filming frames.

A cableway according to the invention herein disclosed has the advantage of being able to smoothly accelerate to and maintain speeds of up to 45 mph during horizontal operation. During downhill operation the system can achieve speeds of up to 55 mph downhill with rapid retrieval of the carriage and dolly back to the top of the run. The camera dolly and
the camera operator’s station are each capable of full 360° rotation and there is virtually no system vibration during operation. The entire system is quiet, light, portable and requires less than one day to set up for operation.

It is noted that the aerial tramway system herein disclosed and claimed will be useful in a number of industrial, commercial, and recreational applications. Nothing herein is intended to limit the scope of protection sought for this novel cable tramway system.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a tower type set up with contouring winch optionally controlling the tension on both main support line and drive line.

FIG. 2 is a end view of an alternative embodiment of a support tower with bullwheel and countouring winch.

FIG. 3 is a side view of the support tower of FIG. 2.

FIG. 4a is a side view of a support tower with a suspended take-up and tension assembly.

FIG. 4b is an overhead view of the suspended take-up assembly shown in FIG. 4a.

FIG. 4c is an overhead view of the tower base and main support rope spool shown in FIG. 4a.

FIG. 5 is a side view of a stadium type set up, with suspended bullwheel and take-up assemblies, and showing optional unmanned camera dolly.

FIG. 6 is an overhead view of the stadium type set up shown in FIG. 5.

FIG. 7 is a side view of the bullwheel cable drive side of the stadium type set up shown in FIG. 5.

FIG. 8 is a top view of the bullwheel cable drive side of the stadium type set up shown in FIG. 5.
FIG. 9 is a side view of the take-up side of the stadium type set up shown in FIG. 5.

FIG. 10 is a top view of the take-up side of the stadium type set up shown in FIG. 5.

FIG. 11 is a side view of the bullwheel cable drive side of an alternative embodiment of the stadium type set up.

FIG. 12 is a side view of a "four-drive sheave" embodiment of the cable carriage and camera dolly with the suspension cable and endless drive cable passing through it.

FIG. 13 is a schematic view of the drive assembly of the embodiment of FIG. 12, showing the relative positions of the drive and idler sheaves and the path followed by the endless drive cable as it passes through the carriage.

FIG. 14 is a top view of the cable carriage of FIG. 12.

FIG. 15 is a side view of a "two drive sheave" embodiment of the cable carriage and camera dolly with the suspension cable and endless drive cable passing through it.

FIG. 16 is a schematic view of the drive assembly of the embodiment of FIG. 15, showing the relative positions of the drive and idler sheaves and the path followed by the endless drive cable as it passes through the drive assembly.

FIG. 17 is a view of the dolly platforms from above.

FIG. 18 is a view of a preferred embodiment of the dolly platforms from above.

FIG. 19a is a side view of one embodiment of an unmanned carriage and camera dolly.

FIG. 19b is a side view of a second embodiment of an unmanned carriage and camera dolly.

FIG. 19c is a top view of the unmanned carriage and camera dolly shown in FIG. 19b.

FIG. 20 is a perspective view of the back stay cable tensioning mechanism.
FIG. 21 is a close-up view of the back stay cable tensioning mechanism.

FIG. 22 is an end view of a preferred embodiment of the invention, with the retractable remote camera in a raised position.

FIG. 23 is an end view of the embodiment of FIG. 21, with the retractable remote camera in a lowered position.

FIG. 24 is a cut-away view of another embodiment of the invention.

FIG. 25 is a side view of an auxiliary brake actuator and cable bracket with interior parts shown with dashed lines.

FIG. 26 is an end view of the auxiliary brake actuator shown in FIG. 25.

FIG. 27 is an overhead view of the auxiliary brake actuator and cable bracket shown in FIG. 25.

FIG. 28 is a perspective view of an auxiliary brake control lever.

FIG. 29 is an end view of an auxiliary brake control lever, shown attached to a dolly operator’s seat support.

FIG. 30 is an overhead view of an auxiliary brake control lever, shown attached to a dolly operator’s seat support.

FIG. 31 is a side view of the auxiliary brake control lever and dolly operator’s seat support shown in FIG. 30.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

According to the invention a main support rope 1 is strung between two support structures at a tension of 1,000 to 20,000 lbs. The main support rope must be light and strong and is preferably manufactured from synthetic extended chain fibers, covered by a nylon sheathing. According to the preferred embodiment, the support rope may be of the type commercially available under the designation 1 1/8" Spectron #2. A second length of cable, over twice the length of the main support cable, may be spliced to form an endless drive cable 49 which may be strung
between the two support structures. Like the main support cable, the endless drive cable 49 may be a galvanized steel cable or preferably synthetic extended-chain fiber rope. According to the preferred embodiment the endless drive cable may be of the type commercially designated as 3/8" Spectron #12. The tension of the endless drive cable 49 may be between 500 and 1,500 lbs.

According to one embodiment, the support structures may be A-frame towers, 3a and 3b, constructed of a series of trapezoidal segments 7 of diminishing widths and adapted to be mounted on top of one another. A variety of selected tower heights may be achieved, depending on the number of trapezoidal segments that are mounted on top of one another. The trapezoidal segments 7 are preferably manufactured of aluminum, quickly and easily transported and assembled into the A-frame towers. Alternatively, the A-frame towers may be constructed with two columns of stackable tower tubes 142. At the top of the tower, the two columns of tower tubes may be connected with a "tower top" 143. The bottom of each of the two columns of tower tubes may be connected to tower base outriggers 144 through tower tube swivel connectors 145. The two tower base outriggers may be connected by the tower base 146. The tower columns may also be secured to one another at intermediate heights by tower cross braces 147.

The A-frame towers may be secured in the upright position during operation of the system by at least one back stay cable 6 secured, at one end, to the towers and anchored at the other end, to the ground, boulders, trees or other structures by various known methods.

When towers are used as the support structures, main support rope tower sheaves 9a and 9b may be mounted near the top of each tower. Two sets of end sheaves 11a&c and 11b&d are mounted just beneath the main support rope tower sheaves 9a and 9b. A contouring winch may be located at or near the base of one of the towers. The contouring winch 5 may be driven by any conventional power source. According to a preferred embodiment, a gasoline engine 10 may be connected to a
hydraulic pump 12 which in turn powers, via hydraulic hoses 14, a hydraulic motor 4 that may be coupled to the contouring winch 5. Alternatively, an electric motor 199 may be used in place of the gasoline engine 10 to power the hydraulic pump as shown in FIGs. 7 and 8.

According to one embodiment using towers, shown in FIG. 2-4, the main support rope is wound around the contouring winch 5, leaves the contouring winch, passes up and through a support rope tower sheave 9a and over to the support rope tower sheave 9b at the top of the opposite tower. The main support rope 1 may then pass down to a bollard or cleat 26 to which the main support rope 1 is fastened or otherwise secured in place. The main support rope 1 may then pass away from the cleat and onto a spool 28 around which the remaining length of the main support cable 1 is wound. When this embodiment is used, the contouring winch may share a tower with either the bullwheel drive assembly or the take-up assembly.

According to a second embodiment using towers, shown in FIG. 1, the contouring winch may be used to simultaneously adjust the tension on the main support rope and on the endless cable. According to this embodiment, the contouring winch 5 shares the same tower as the take-up assembly. According to this embodiment, the main support rope 1 attaches to a pulley block 16. A first winch rope 18 may be secured to the side of the contouring winch, pass through the pulley block 16 and pass down onto the contouring winch spool. A second pulley block 20 may be suspended by a cable 24 from a take-up sheave 13 mounted near the middle of the tower. Cable 24 may be attached to one side of the take-up sheave 13, pass down through pulley block 20 and back up to attach to the opposite side of the take-up sheave 13. A second winch rope 22 may be secured to a second side of the contouring winch, pass up and through the second pulley block 20 and down onto the contouring winch spool. By winding and unwinding the contouring winch 5, the tension on the main support rope and the endless cable may be adjusted simultaneously.
According to yet another embodiment, shown in FIG.s 5-10, the contouring winch may be located on a platform-type support structure 148, for example in a stadium or in other situations where towers would not be necessary or desirable. According to this embodiment, the main support rope 1 is wound around the contouring winch 5, leaves the contouring winch and goes directly to a bollard or cleat 26 attached to the opposite support structure. The main support rope 1 may be wrapped around the cleat 26, or otherwise secured in place. The main support rope 1 may then pass away from the cleat and onto a spool 28 around which the remaining length of the main support cable 1 is wound.

The endless cable may be driven by a bull wheel 15 which may be located at the base of a tower, attached to a platform type or other support structure, or suspended from the main support rope. The bull wheel 15 may be driven by any type of power system. According to a preferred embodiment of the invention the bull wheel 15 may be 20 inches in diameter and may be powered by a gasoline engine 17 which drives a hydraulic pump 19 which in turn powers, via hydraulic hoses 21, a hydraulic motor 23 coupled to the bull wheel 15. The gas powered hydraulic drive system preferably may be enclosed in a thick foam housing and preferably rests inside a shelter such as a trailer or a snowcave. Alternatively, an electric motor 199 may be used in place of the gasoline engine 10 as shown in FIGs. 7 and 8. The hydraulic hoses 21 carry hydraulic fluid from the hydraulic pump 19 to power the hydraulic motor 23 which is coupled to the bull wheel 15. A bull wheel brake mechanism 30 may be coupled to the bull wheel for use when it is desired to lock the endless cable in place. The bull wheel brake mechanism is preferably of the disc brake/caliper type. According to a preferred embodiment of the invention, speed and directional control instructions for the power system are received via telemetry from a remote operator. Accordingly, a battery powered radio receiver/modem, an interface board and an output board, may be electronically coupled to the power system, and contained within a weatherproof housing.
As mentioned above, the bullwheel may be suspended from the main support rope. According to this embodiment, a bull wheel support trolley 149 may be suspended from the main support rope 1 by two support trolley sheaves 150a and b. Each support trolley sheave may be connected to one end of a vertical member 151a and b. The other ends of the vertical members are connected by a transverse bull wheel support member 152. A bearing 153a is mounted on the top of the transverse bull wheel support member, and the bull wheel may be mounted on top of the bearing. The bullwheel is also coupled to a hydraulic motor mounted to the underside of the transverse bull wheel support member. The bull wheel may be powered by the hydraulic motor as described above.

In a preferred embodiment, the bull wheel support trolley may be indirectly secured to the support structure by a cable 154, attached at one end to the vertical member closest to the support structure and attached at its other end to a tirfir 155a or other tension device such as a come-along, which in turn is connected to the support structure.

According to a related embodiment, shown in FIG. 11, the bull wheel may be coupled to an electric motor 156 which is mounted to the underside of the transverse bull wheel support member 152. An electrical control cable 157 connects the electrical motor to a power source and/or an operator. FIG. 11 also illustrates an alternative embodiment in which no contouring winch is used on the main support rope. According to this embodiment, the main support rope may be tied off or otherwise secured to a main support rope shackle 158 or other device attached to the support structure, in the case of FIG. 11, a wall 159.

The take-up assembly may also be suspended from the main support rope. According to this embodiment, the take-up sheave is mounted on a take-up sheave support trolley 160 suspended on the main support rope by two support trolley sheaves 150c and d. Each support trolley sheave may be connected to one end of a vertical member 151c and d. The other ends of the vertical members are connected by a transverse take-up sheave support member 161. A bearing 153b is mounted on the
top of the transverse take-up sheave support member, and the take-up sheave may be mounted on top of the bearing. A spring loaded counterweight 162 may be attached to the vertical member closest to the support structure and the spring loaded counterweight is connected to a tirfir 155b through a cable. The tirfir, in turn, may be connected to the support structure. The tirfir is used to set the desired drive line tension. The spring loaded counterweight maintains the tension on the drive line when the main support line is contoured. It should be noted that the device may be operated without either the counterweight or the tirfir, as long as the trolley is somehow secured to the support structure to prevent it from travelling along the main support line towards the bull wheel.

According to an alternative embodiment, shown in FIG. 4, the take-up sheave may be suspended from the take-up sheave support trolley by the drive cable 49. According to this embodiment, the take-up sheave support trolley is suspended from the main support line 1 as described above. In addition, a cross member 163 is perpendicularly mounted on the transverse take-up sheave support member and two cross member sheaves 164a and b are mounted at opposite ends of the cross member. The endless cable passes over the cross member sheaves and down to the suspended take-up sheave 13. A counterweight 165 may be suspended from the suspended take-up sheave through a counterweight attachment 166. Like the spring loaded counterweight shown in FIG.s 9-10, the counterweight shown in FIG. 4 serves to maintain the desired drive line tension when the main support line is contoured. According to the embodiment shown in FIG. 4, a tension cable 167 is attached at one end to the take-up sheave support trolley and at its other end to a tirfir 155c or other device for setting the desired drive line tension, and for preventing the trolley from travelling along the main support line towards the bull wheel support trolley.

According to a further embodiment of the invention, there may be provided an overhead support assembly 168 for providing additional support to the main support rope when the bull wheel assembly and/or
take-up assembly is suspended therefrom. A representative overhead support assembly, shown in FIG. 7, may include a quick release sheave 169, for supporting the main support rope, connected to a tirfir 155d or similar tensioning device for setting the desired tension or "lift", and a cable 170 connecting the tirfir to an overhead support structure.

It is contemplated that tower support structure, platform support structure, wall support structure, suspended and non-suspended bull wheel assembly, suspended and non-suspended take-up assembly, and contouring winch may be used together in a variety of combinations, depending on the filming location, existing support structures available at the site, type of "shot" wanted, and the extent to which fast set up and unobtrusiveness are desired.

According to the invention a cable carriage 33 may be provided. According to a preferred embodiment of the invention, a dolly or other support structure is attached to the carriage. According to a further feature of the invention, a camera dolly 51, adapted for use in filming moving objects, may be provided. A central post 53, preferably made of aluminum, may attach at a pivot point 55 at the center of the underside of the carriage. The central post 53 extends downward from its attachment point 7 to 10 feet, and attaches to the center of a dolly operator's rotational platform 57.

According to one embodiment, shown in FIGS. 1 and 12, the cable carriage may include a main support chassis 35 and a drive assembly 37. This embodiment is referred to herein as the "four drive sheave" embodiment. According to a second embodiment, shown in FIG. 15, the drive assembly may be mounted on the central post. This embodiment is referred to herein as the "two drive sheave" embodiment. The main support chassis 35 may be a contoured aluminum beam, 16 to 20 feet in length. According to a preferred embodiment of the invention, the main support chassis 35 is a 16 foot aluminum beam which is capable of being disassembled into two four foot sections and one eight foot section to make the system more portable. Main support rope sheave assemblies 39a
and 39b may be attached 16 feet apart at the ends of the main support chassis 35 to support the carriage 33 on the main support cable 1. The main support rope sheave assemblies 39a and 39b may include one or more sheaves arranged in series at each end of the main support chassis 35. According to an advantageous embodiment of the invention, a single sheave may be mounted at each end of the main support chassis 35. The main support rope sheaves 39a and 39b may be easily detachable to allow the placement of the chassis 35 on the main support cable 1 in less than 5 minutes and without tools. Main support sheaves may be preferably machined to receive 1 1/8 synthetic extended-chain fiber rope such as that commercially available under the designation Spectron #2.

According to the "four drive sheave" embodiment, a drive assembly 37 may be mounted on the chassis 35 and may include two sets of drive sheaves 41a and b and 41c and d, one set on each side of the main support chassis, and two sets of forward and aft idler sheaves 43a and b and 43c and d for guiding the endless drive cable to and from the drive sheaves. The drives sheaves on each side of the carriage may be offset from one another to compensate for 360 degree wind of endless drive cable. A motorcycle brake disc 45a-d and at least one caliper 47a-d may be mounted on each drive sheave 41a-d. According to a preferred embodiment of the invention, the brake discs on one side of the carriage 33 may be equipped with 1 additional caliper each, 47e and 47f. The calipers may be preferably capable of quick release to reduce the need for bleeding and to allow for safer shipping or transport at the set-up location. According to the preferred embodiment, the cable carriage may weigh as little as 120 pounds.

Referring to FIG.s 1 and 12-14, for example, the endless drive cable 49, driven by the bull wheel mechanism, runs from the bull wheel 15 up through a tower sheave 11d mounted on a support structure and then over to one side of the carriage 33. It passes through the carriage by passing under an idler sheave 43b and by then wrapping 180 degrees around two separate drive sheaves 41b and 41a for a total cumulative
wrap of 360 degrees. The endless drive cable then exits the carriage by passing under another idler sheave 43a and continues away from the carriage to a tower sheave 11a attached at the top of the opposing support structure and passes through a take-up sheave 13. The cable continues back up and through a second tower sheave 11b at the top of the same support structure and back to the opposite side of the carriage as previously mentioned. Again, it passes through the carriage passing under an idler sheave 43d and by wrapping 180 degrees around two separate drive sheaves 41d and 41c for a total cumulative wrap of 360 degrees. As the cable leaves the sheaves on the carriage it passes under a fourth idler sheave 43c and continues to the tower sheave 11c at the top of the tower with the bull wheel drive system and back down to the bull wheel 15. The endless drive cable 49 may be tensioned at between 500 and 1,500 lbs, preferably 750 lbs. The tension on the endless drive cable, combined with the 360° wrap configuration of the drive cable around the drive sheaves 41a-d, minimizes slippage of the carriage along the drive cable and maximizes climbing ability during inclined applications while requiring less energy to drive the sheaves than other alternative configurations.

According to the "two drive sheave" embodiment, a drive assembly may be mounted on the central post 53 and may include drive sheaves 41e and 41f, one on each side of the central post and oriented parallel to the main support chassis 35. Two sets of forward and aft idler sheaves 43e and f and 43g and h may be provided on the central post, below the drive sheaves, for guiding the endless drive cable to and from the drive sheaves. The position of each idler sheave may be adjustable along an axis perpendicular to the central post to allow for adjusting the amount of contact that the drive cable has with the drive sheaves. The positions of the idler sheaves may be moved toward and away from the axis of the central post so that the amount of drive cable/drive sheave contact may be adjusted from about 10° to about 260°. A motorcycle brake disc 45e and 45f and at least one caliper 47g and 47h may be mounted on each drive sheave 41e and 41f. According to a preferred embodiment of the
invention, brake disc 45e may be equipped with an additional caliper 47i. The calipers may be preferably capable of quick release to reduce the need for bleeding and to allow for safer shipping or transport at the set-up location. According to the preferred embodiment, the cable carriage may weigh as little as 120 pounds.

Referring to FIG.s 5, 7-10, 15 and 16, for example, the endless drive cable 49, driven by the bull wheel mechanism, runs from the suspended bull wheel 15 over to one side of the carriage 33. It passes through the drive assembly by passing under an idler sheave 43g, wraps 10 to 260 degrees around drive sheave 41e and then exits the carriage by passing under another idler sheave 43e and continues away from the carriage to suspended take-up sheave 13 at the opposite side of the run. The cable passes around the suspended take-up sheave and returns to the other side of the of the carriage as previously mentioned. Again, it passes through the drive assembly passing under an idler sheave 43f, wrapping over drive sheave 41f for 10 to 260 degrees. The cable then passes under idler sheave 43h and continues to the suspended bull wheel. The endless drive cable 49 may be tensioned at between 500 and 1,500 lbs, preferably 750 lbs. The advantages of this system is that it allows for extremely stable, smooth shots. The less contact between drive cable and drive sheave results in fewer braking vibrations. However, there is a trade-off: the less the degrees of wrap, the further from the central post the idler sheaves need to be which results in greater tendency to rock. Our experiments have shown an idler position resulting in 150° of wrap on the drive sheave gives the best results in term of maximizing drive efficiency and minimizing braking vibrations.

Control of the bull wheel speed and control of the sheave brakes may be effected via telemetry by either a ground-based operator or an operator situated on a support structure which is suspended from the carriage.

The idler sheave and drive sheave grooves are preferably machined to receive 3/8" synthetic extended-chain fiber rope such as that
commercially available under the designation Spectron #12. Back-up or alternative sheaves may be machined to receive 1/4" galvanized steel rope.

When the bull wheel drive system is engaged, the endless drive cable is driven through the carriage in two opposite directions. It passes through the carriage on one side going in one direction and the other side going in the opposite direction. When the system is set up on a grade and none of the brakes are applied, the carriage will travel down the cables under the force of gravity whether or not the bull wheel drive system is engaged. Alternatively, when the system is set horizontally, and the bull wheel drive system is engaged while none of the sheave brakes are applied, all drive sheaves and all idler sheaves will spin freely and the carriage will remain at rest.

According to a preferred embodiment of the invention, a dolly or other support structure is attached to the carriage. According to a further feature of the invention, a camera dolly 51, adapted for use in filming moving objects, may be provided. A central post 53, preferably made of aluminum, may attach at a pivot point 55 at the center of the underside of the carriage. The central post 53 extends downward from its attachment point 7 to 10 feet, and attaches to the center of a dolly operator's rotational platform 57. The central post may be equipped with sleeves which enable extension of the central post. The dolly operator's station may be a circular platform 5 feet in diameter. A circular bearing 59 may be mounted on the central post 53, several inches above the surface of the dolly operator's platform. Two square aluminum bars 61a and 61b, may be attached to the circular bearing 59 and each independently may extend 2 1/2 to 4 feet away from one another in opposite directions. An adjustable sliding bracket 63, to which may be attached a dolly operator's seat 65, may be mounted near the end of one bar 61a. Attached near the end of the other bar 61b is the camera operator's circular platform 67. A vertical post 69, which bears the camera mount 71 at its top, may be attached at the center of the camera operator's platform 67. The camera mount 71 may be a standard film
industry ball or flat receiver. A second circular bearing 73, to which may be attached a double elbow post 75, may be mounted near the bottom of the vertical post 69. A camera operator's seat 77 may be mounted to the top of the double elbow post 75.

The camera operator, by virtue of the circular bearing 73, may rotate a full 360° about the vertical post 69 as he sits in the camera operator's seat simply by using his feet to walk himself about the camera operator's platform. The dolly operator, by virtue of the circular bearing 59, may rotate both himself and the camera operator's station a full 360° about the central post 53 by using his feet on the dolly operator's platform to force himself and the camera operator's platform in either direction around the central post.

According to a preferred embodiment of the invention, an assistant camera operator's station may be mounted on the camera dolly. According to this embodiment a third aluminum bar 61c is attached to the circular bearing 59. Further according to this embodiment, aluminum bars 61a,b,c may be attached to the circular bearing 59 at 120° intervals for balance. An assistant camera operator's chair 65b may be mounted on a sliding bracket. The sliding bracket may be mounted on the aluminum bar 61c.

A handle bar assembly 79 may be attached to the first circular bearing 59 and extend upward to a comfortable position for the dolly operator. A motorcycle-type twist grip assembly 81 may be mounted on the left hand side of the handle bars. The twist grip assembly 81 remotely controls the gas powered bull wheel drive system via telemetry. Two switches may be mounted on the twist grip assembly. Switch A is a start/stop toggle for controlling the gas powered engine. Switch B selects control between the gas engine and the hydraulic motor. When Switch B is in a first position, the twist grip may be used to control the rpms of the gasoline engine, which in turn controls amount of hydraulic pressure available to the hydraulic motor. When Switch B is in a second position, the twist grip may be used to control the power output of the hydraulic
motor which directly controls the bull wheel's angular velocity. The twist
grip assembly may be wired to an interface board and a radio
transmitter/modem with an antenna. This on-board telemetry system is
battery powered and, except for the twist grip assembly and antenna, is
contained in a weatherproof housing.

Motorcycle-type clutch/brake assemblies 91 may be attached to both
the left hand grip and the right hand grip. The right hand clutch/brake
assembly may be set to control either all sheave brakes at once or it may
be set to control sheave brake(s) on only one side of the carriage. When
the right clutch/brake assembly is set to control all sheave brakes, the left
clutch/brake assembly is set to independently control only the sheave
brake(s) on one side of the carriage. When the right clutch/brake
assembly is set to control the sheave brake(s) on one side of the carriage,
the left clutch/brake assembly is set to control the sheave brake(s) on the
opposite side of the carriage.

The invention has two alternative modes of operation: horizontal
operation and downhill operation. Although both the four drive sheave
embodiment and the two drive sheave embodiment may be used for both
horizontal and downhill operation, the four drive sheave embodiment is
most suitable for downhill operation, and the two drive sheave
embodiment is most suitable for horizontal operation. The four drive
sheave embodiment is most suitable for downhill operation because the
360° wrap on each side of the carriage minimizes slippage of the carriage
along the drive cable and maximizes climbing ability during inclined
applications, and the use of four brake discs on four drive sheaves
provides for a high degree of braking force, necessary for high speed
downhill operation. The two drive sheave embodiment is most suitable
for horizontal operation because of the reduced danger of cable sheave
slippage, the reduced need for high braking forces, and the exceptional
shot quality obtainable as a result of the reduced vibrations.

According to a preferred embodiment of the invention, during
horizontal operation, the left hand clutch/brake assembly controls calipers
47a and 47b (four drive sheave embodiment) or caliper 47g (two drive sheave embodiment), and the right hand clutch/brake assembly controls calipers 47c and 47d (four drive sheave embodiment) or caliper 47h (two drive sheave embodiment). During downhill operation, the left hand clutch/brake assembly controls calipers 47a and 47b (four drive sheave embodiment) or caliper 47g (two drive sheave embodiment), and the right hand clutch/brake assembly controls calipers 47c, 47d, 47e, and 47f (four drive sheave embodiment) or calipers 47h and 47i (two drive sheave embodiment).

When both ends of the cable run are at relatively equal elevations, the clutch/brake assemblies at the dolly operator's station are set so that the left hand clutch/brake operates the brakes on one side of the carriage, calipers 47a and 47b (four drive sheave embodiment) or caliper 47g (two drive sheave embodiment) and the right hand clutch/brake handle operates the brakes on the other side of the carriage, calipers 47c and 47d (four drive sheave embodiment) or caliper 47h (two drive sheave embodiment).

In horizontal operation, therefore, the dolly operator causes the sheave brakes to engage the drive sheaves on one side of the camera dolly at a time. Grasping one segment of the drive cable in this manner, by braking the drive sheaves, causes the camera dolly to be carried along in the direction that the grasped segment of the drive cable is travelling. Because the sheave brakes are variable, the dolly operator can smoothly start, stop, and reverse direction of the camera dolly by varying the pressure on the motorcycle-type clutch/brake assemblies. In this manner a camera can be maneuvered back and forth over extended distances at heights from 6 inches to 50 feet, depending on the tower height and degree of catenary, in order to track the action being filmed. Tower height is adjustable by the number of trapezoidal segments 7 or tower tubes used, and the degree of catenary, or "droop," of the cable system is adjustable by changing the tension on the main suspension cable 1 with
the contouring winch 5 or by adjusting the tension on the back stay cables.

In downhill operation, the bull wheel motor may be turned off, and the bull wheel brakes are fully engaged, thus locking the endless drive cable in place. Thus the motionless drive cable effectively becomes two independent cables, thereby doubling the braking strength. The clutch/brake system may be adjusted so that the right hand clutch/brake handle operates the brakes on all of the drive sheaves at once; that is, the right hand clutch/brake handle is connected to calipers 47c, 47d, 47e and 47f (four drive sheave embodiment) or calipers 47h and 47i (two drive sheave embodiment). The left hand clutch/brake handle, as in horizontal operation, operates only the brakes on one side of the carriage, i.e. calipers 47a and 47b (four drive sheave embodiment) or calipers 47g (two drive sheave embodiment). To track downhill action, the dolly operator allows the dolly to travel down the motionless cable through the force of gravity, slowing or stopping the dolly as necessary by squeezing the right clutch/brake handle, thus applying all sheave brakes simultaneously. If at any time the operator wishes for the dolly to travel uphill, the right handle clutch/brake handle is released, the left hand clutch/brake handle is squeezed, the brake on the bull wheel is released, and the bull wheel drive motor is engaged to bring the endless drive cable into motion. Thus, the cable carriage and camera dolly is pulled towards the top by gripping the segment of the endless drive cable which is travelling uphill.

According to the preferred embodiment of the invention, there is also provided a gyro controlled actuator 99. The gyro controlled actuator has the ability to sense when the central post moves outside of vertical as a result of acceleration or deceleration. When it senses such motion or "swing" off the vertical, the actuator sends a signal to a small but powerful motor inside the actuator, a linear hydraulic cylinder, which responds appropriately by causing the actuator to extend or shorten to compensate for the sway. As a result, the dolly is constantly kept vertical and prevented from swaying.
According to another preferred embodiment of the invention, the carriage and dolly are equipped with a ballistic parachute 171. The ballistic parachute may be mounted anywhere on the dolly platform, central post or the carriage chassis. A rip cord 172 may extend from the mounted parachute package to the handle bar assembly 79 at the dolly operators station. If, during operation, whether high speed horizontal operation or downhill operation, the sheave brakes fail, the operator may pull the rip cord to activate a rocket assisted parachute deployment.

According to yet another embodiment of the invention, the dolly and carriage may be provided with an auxiliary or emergency brake to provide an alternative means of braking in the event operational circumstances warranted. According to the preferred embodiment of the invention, the auxiliary brake may consist of an auxiliary brake actuator, an auxiliary brake actuation cable, and an auxiliary brake control lever.

The operator may facilitate auxiliary or emergency braking by triggering the auxiliary brake through use of the auxiliary brake control lever. The auxiliary brake control lever consists of an auxiliary brake control lever handle 200, which may be attached to the auxiliary brake lever shaft 201 at a 90° angle to the auxiliary control handle’s longitudinal axis by means of the auxiliary brake lever gusset 202. On the opposing end of the auxiliary brake lever shaft is the auxiliary brake bell crank 203. According to a most preferred embodiment, the primary axis of the bell crank is offset 65° from the longitudinal axis of the auxiliary brake control lever handle. The auxiliary brake bell crank has a bore hole 204 whose center is in line with the bell crank primary axis, and which serves as an attachment means for an auxiliary brake actuator cable 212.

According to one embodiment of the invention the auxiliary brake control lever may be located and attached to the lower platform seat support, adjustable sliding bracket 63, by means of two auxiliary brake lever mount gusset 208 positioned parallel to one another and fixably attached to two auxiliary brake lever mount fittings 209. When used in combination with the auxiliary brake lever mount cap 210, the mount
fittings securely position and mate the auxiliary brake lever shaft 201 to the lower platform seat support, adjustable sliding bracket 63. Positioning the auxiliary brake lever in this fashion allows the operator ready and easy access to the auxiliary brake lever handle in the event actuation of the auxiliary brake becomes necessary.

The auxiliary brake control lever actuates the auxiliary brake actuator 211 remotely by means of an auxiliary brake actuator cable 212. According to one embodiment of the invention, the actuator cable may be a balden type which consists of an outer cable sheath 216 and an inner cable 217. The inner cable may be connected at one end to the bore hole 204 and at the other end to the auxiliary brake actuation link 213 located within the auxiliary brake actuator itself. The ends of the outer cable sheath may be securely attached at one end to the auxiliary brake stop bracket 218, which may be attached to the auxiliary brake actuator 211, and at the other end to the auxiliary brake lower cable anchor 214, which may be positioned and attached to the operator's lower platform seat support 63 by two auxiliary brake lower cable gusset 215a and 215b. The lower cable anchor and gusset serve to direct, support and provide operational clearance for the actuator cable so as to insure operational reliability of the auxiliary brake.

Configuration of the actuation cable in this manner enhances operational precision and reliability by ensuring the inner actuator cable experiences no external stress. Additionally, the outer cable sheath operates as a circumferential guide thereby preventing deformation of the inner actuator cable. This facilitates the continuous exercise positive control over the force applied to, and the position of the auxiliary brake bottom brake shoe 219.

In the preferred embodiment, the auxiliary brake actuator may be secured atop the carriage by known means so as to engage the suspension cable 1 for braking purposes. The brake actuator may consist of two brake side plates 220 oriented and fixed parallel to one another by means of a brake side plate spacer 221 disposed between the two brake side plates
and affixed by known means. The brake actuator accomplishes auxiliary braking by engaging the suspension cable 1 between a fixed auxiliary brake top shoe 222 and a displaceable auxiliary brake bottom shoe 219.

The top auxiliary brake shoe 222 may be disposed between and fixedly secured to both auxiliary brake side plates 220 by known means. According to a preferred embodiment, auxiliary brake top shoe guides 223 may be provided and may be fixedly attached to the upper interior surfaces of both auxiliary brake side plates by known means. According to this embodiment, the upper brake shoe may be provided with upper brake shoe guide pins 224 and the top shoe guides may be provided with matching guide pin slots 225. According to this embodiment the top brake shoe 222 is secured to the side plates by introducing the auxiliary brake upper brake shoe guide pins 224 into receptacle upper brake shoe guide pin slots 225 situated in the inner face of the auxiliary brake top shoe guides 223. Configuration of the auxiliary brake top shoe mounting assembly in this fashion permits direct integration of the suspension cable into the brake actuator housing from above. Thus there is no need to thread the suspension cable through the auxiliary brake actuator housing prior to securing the suspension cable at either ends of the cable run. This facilitates easier, and therefore more efficient on site assembly times.

The displaceable bottom auxiliary brake shoe 219 is likewise disposed between the auxiliary brake side plates 220. In contrast to the top shoe, however, it may be attached in a mobile fashion to the auxiliary brake side plates by a linkage system. The linkage system may be used to displace the auxiliary brake bottom shoe in a manner which permits it to engage or disengage the upper suspension cable resulting in variable frictional braking.

The linkage system may consist of at least one linkage connected at one end to the auxiliary brake bottom shoe 219 and at the other to the auxiliary brake side plates 220. Each linkage may consist of at least one auxiliary brake lower toggle 226 and at least one auxiliary brake upper toggle 227. The lower toggles may be pivotally attached to both side
plates by auxiliary brake main bushings 228. The lower toggles in turn may be attached to the upper toggles at the auxiliary brake lower toggle pivots 229. The upper toggles may be connected to the brake bottom shoe at the auxiliary brake upper toggle pivot point 230. According to the invention an actuation link may also be provided and may be connected to one or more of the linkages at the auxiliary brake lower toggle point.

According to a more preferred embodiment the linkage system consists of two linkages, fore 231a and aft 231b. Each linkage in turn may consist of a single "U-shaped" lower toggle 226 connected to the inner surface of both auxiliary brake side plates by the auxiliary plate main bushings 228. The lower toggle 226 is then connected to two independent upper toggles 227 at the auxiliary brake lower toggle pivot 229. Each upper toggle is then connected to a side of the bottom brake shoe at the auxiliary brake upper toggle pivot point 230. An actuation link 213 is then positioned and pivotally attached to the inner surface of each upper toggle at the lower toggle pivot 229.

For the purpose of initiating auxiliary braking operations displacement of the auxiliary brake bottom shoe 219 is accomplished by displacement of the auxiliary brake control handle 200 by the operator. The displacement of the auxiliary brake handle, translated to the to the auxiliary brake actuation cable through the auxiliary brake lever shaft 201 and in turn through the bell crank 203, results in a coaxial force, aligned with the longitudinal axis of both the brake actuator and the suspension cable, being applied to the auxiliary brake actuation link by means of the auxiliary brake actuation cable. The actuation cable runs longitudinally between the auxiliary brake cable bracket 233 and through the auxiliary brake cable stop bracket 218. As a result of the coaxial tensile force being applied to the auxiliary brake actuation cable, the auxiliary brake actuation link is displaced and translates in a direction parallel to the auxiliary brake actuator's longitudinal axis. Translation of the actuator link causes the angle created by the upper and lower toggles to increase resulting in a flexing or "straightening-out" of linkage system. This
straightening-out of the linkage system results in displacement of the auxiliary brake bottom shoe in a translational fashion parallel to the auxiliary brake actuator's vertical axis. The translational path followed by the bottom brake shoe is defined by the auxiliary brake bottom shoe guides 234 located on both sides of the bottom braking shoe.

It may be advantageous for a camera to follow the contour of the surface upon which the moving subject is traveling. This contouring may be accomplished according to the invention be causing the contouring winch 5 to spool the main support rope 1 in or out. If the drive cable 49 is coupled to a counterweight mechanism as described above, the drive cable tension will remain constant despite the contouring of the main support rope. Alternatively, contouring may be accomplished according to the invention by causing the support towers to alternately lean away from and towards from one another, thus raising and lowering the carriage and dolly. Accordingly, back stay cable sheaves 8 may be located near the top of the support structures 3a and 3b. Back stay cables 6 may pass from their anchored position up and over the back stay cable sheaves 8 and down to back stay cable tensioning mechanisms 101. According to the preferred embodiment back stay cable 6 may be attached to a triangular event 103 which may be mounted on two eight foot lead (lead) screws 104. The lead screws may extend between two end pieces 105 and 107. The lead screws may be driven by a four to ten horsepower dc motor 109 which may be mounted on one of the two end pieces. A cable 111 may attach to the bottom end piece and run down to the base of the tower where it may be attached to a cleat 113 or otherwise secured in place. Alternatively, cable 111 may run up from the cleat 113 and over the back stay cable sheave 8 to attach to the back stay cable tensioning mechanism 101 anywhere between the back stay cable sheave 8 and the point at which back stay cable 6 is anchored. Thus, according to this embodiment, the back stay cable 6 meets the back stay cable tensioning mechanism 101 without ever passing over the back stay cable sheave 8. Tension on the back stay cable 6 may be adjusted during operation by causing the electric
motor to drive the twin lead screws in one direction or the other. The triangular event to which the back stay cable is attached will be driven up or down depending upon the direction in which the lead screws are being driven. When the tension on the back stay cables is lessened, the towers will begin to lean towards one another and the carriage and dolly will be lowered. As the tension on the back stay cables is increased, the towers will lean away from one another and the carriage and dolly will be raised. The electric motor 109 may receive power from a battery or other power source via a power cable 115.

A potentiometer may be situated anywhere along the power cable between the electric motor and the power source. A tower based or ground based operator may control the tension on the back stay cables by manually turning the dial on the potentiometer, thus controlling the flow of power to the electric motor. Alternatively, the potentiometer may be controlled by a computer which may be programmed to increase and decrease tension on the back stay cables at selected times.

It may also be advantageous to raise and lower the camera dolly without a corresponding lowering of the cable system, for example when the system is set up above trees or other elements in which the cables could become entangled if they were lowered. Accordingly, the camera dolly may be equipped with two 3/4 inch, ten foot long lead screws 121 parallel to the central post. According to this embodiment, The central post 53 may extend down through the center of a central post extending sleeve 123. The inside diameter of the central post extending sleeve 123 may be just large enough to receive the outside diameter of the central post 53. The circular bearing 59, which ultimately supports the dolly operator’s platform 57 and the camera operator’s platform 67, may be attached to a central post extending sleeve 123. The lead screws 121 may be set, at one end, into ball/screw drives 125 which may be mounted to the underside of the carriage 33. At the other end, the lead screws may be threaded through a metal plate 127 mounted at the top of the central post extending sleeve 123. The lead screws may be driven by a battery
powered 4 hp electric motor 129. As the lead screws are driven in one direction, the central post extending sleeve, and attached dolly and camera operator's platforms, are drawn up over the central post. The extent to which the central post extending sleeve may be drawn up over the central post may be limited by the gyro actuator 99 which may be attached to the central post 53. As the lead screws are driven in the opposite direction, central post extending sleeve, along with the operators' stations, are forced away from the carriage.

According to another embodiment of the invention, a single lead screw 131 may be located parallel to the axis of the central post 53, and extend down through the center of the central post. The single lead screw may be set at one end into a ball/screw drive 133, which may be located inside the top portion of the central post 53. The lead screw may be driven by a battery powered 1.5 hp electric motor 135 which may be mounted on the outside of the central post 53. The single lead screw 131 may be threaded through a nut 137 which is connected to the top of a ten foot long hollow rod 139. The hollow rod 139 may have an interior diameter large enough to receive the single lead screw 131 and an exterior diameter small enough to be drawn up through the center of the central post 53. As the single lead screw 131 is driven in one direction, the hollow rod 139 may descend out from the center of the central post 53. As the single lead screw is driven in the opposite direction, the hollow rod 139 may be drawn up into the center of the central post 53. A remote camera mounting bracket 141 may be attached to the bottom of the hollow rod 139. A remote pan and tilt camera such as the type commercially available under the trade names Cam Remote and Power POD may be mounted on the remote camera bracket 141. The camera operator may operate the remote camera from the camera operator's station using a standard joystick remote control or any other remote control mechanism.

According to additional, unmanned, embodiments of the invention, the entire dolly operator's platform may be replaced with a remote camera assembly. According to one embodiment shown in FIG. 19a, a central post
177 of two to four feet may be used. At one end, the central post is
attached to the carriage chassis at a pivot point. At the other end of the
central post, a pan and tilt head 173 is mounted, to which a remote
camera 178 may be attached. Batteries 179 for the pan and tilt head may
be mounted on the central post. The action of the pan and tilt head is
controlled from the ground through a heavy duty remote control cable
174. The remote control cable passes from the pan and tilt head to the
carriage chassis, where it is tightly clamped or otherwise fixed in place.
It then passes across to a trailer dolly 175, suspended from a trailer dolly
cable 176, which stretches between two points which may be adjacent to
the end points of the camera carriage main support rope. The trailer
dolly may have a basic construction similar to the take-up sheave support
trolley 160, having two support trolley sheaves 150e and 150f connected
to vertical members 151e and 151f, respectively, and a transverse member
180. The remote control cable is tightly clamped or otherwise fixed to the
trailer dolly, then passes to a "pick point" 181 where it is again fixed in
place. Finally, from the pick point, the remote control cable passes to an
encoded tripod fluid head 182. As the carriage and remote camera dolly
travel up and down the main support cable, they pull along the trailer
dolly, suspended adjacent on the trailer dolly cable, using the remote
control cable as a tether. The length of remote control cable between the
pick point and the trailer dolly should be adjusted so that it will allow the
trailer dolly to travel the entire length of the cable run. When the trailer
dolly is at the point closest to the pick point, the extra length of cable will
hang, drape-like, between the pick point and the trailer dolly. When the
trailer dolly is at the most remote part of the cable run relative to the pick
point, the remote control cable should have very little slack. Alternatively, a festooning device, such as a recoiling spool may be located
either at the pick point or on the trailer dolly so that the remote control
cable is constantly being played in and out as the trailer dolly, being
pulled along by the carriage and camera dolly, travels up and down the
cable run.
Another unmanned embodiment, useful where the trailer dolly shown in FIG. 19a may be too obtrusive, is shown in FIG.s 19b and 19c. According to this embodiment, the carriage is assembled from hollow or U-shaped beams: left beam 184, center beam 185, and right beam 186. Center beam 185, is advantageously strengthened and stiffened using structural members 187. This longitudinal beam, consisting of left, center and right beams, is advantageously sized to carry a 135 pound camera/pan and tilt head payload, together with the necessary batteries and electronics. Central post 188, is attached to center beam 185. To the bottom of central post 188 is attached the pan and tilt head, consisting of pan axis 189, and camera bracket and tilt plate 190. Stays 191, may extend from the ends of left and right beams 184 and 186 to the pan and tilt head to help prevent swaying. Instructions, i.e., control signals, for the operation of the camera and the pan and tilt head are transmitted from the operator via microwave. Similarly, broadcast quality video is transmitted from the camera via microwave to a receiver at one end of the cable span. The electronics for the pan and tilt head are packaged in a unit 192 which is attached to the side of center beam 185. The electronics for the microwave video signal, and other optional dolly feedback functions, are packaged in a unit 193 which is mounted to the side of the center beam 185, opposite the pan and tilt head electronic unit 192. Power for the pan and tilt head and other onboard operations is provided from batteries 194 mounted in or on left and right beams 184 and 186. Batteries may be selected to last the length of an event being filmed. For especially long events, the batteries may be recharged using small electric generators 195, mounted on the left and right beams 184 and 186. According to one embodiment, the generators may be in rolling contact with either the support line 196 or the support sheaves 197 for generation of the power which it may then transmit to the batteries when needed. According to a preferred embodiment, the carriage may be equipped with an encoder 198, in rolling contact with the support line
196, which transmits to the operator a signal indicating the position of the carriage on the support line.

The remote camera assembly may be equipped with either of the drive assemblies shown in FIGs. 12 or 15, in which case the sheave brakes may be operated remotely. Alternatively, the remote camera dolly may be "spliced into" one leg of the drive cable as shown in FIG 19a. According to this embodiment, the drive cable may be attached to the dolly at two drive line attachments 183a and 183b. According to this embodiment, the direction and speed of the dolly may be controlled by, and corresponds directly to, the direction and speed of the bullwheel.
What is Claimed is:

1. An aerial cableway comprising:
   a first cable support and a second cable support located at opposing ends of a cableway;
   an endless cable extending in an elongated loop between said cable supports and defining first and second parallel segments;
   a cable drive connected to said endless cable;
   a carriage supported simultaneously on said first segment of said endless cable and on said second segment of said endless cable;
   exactly two drive sheaves connected to said carriage and contacting said endless cable;
   a first variable brake connected to said carriage and associated with said first segment of said endless cable;
   a second variable brake connected to said carriage and associated with said second segment of said endless cable.

2. An aerial cableway comprising:
   a first cable support and a second cable support located at opposing ends of a cableway;
   an endless cable extending in an elongated loop between said cable supports and defining first and second parallel segments;
   a cable drive connected to said endless cable;
   a carriage supported simultaneously on said first segment of said endless cable and on said second segment of said endless cable;
   a drive assembly connected to said endless drive cable, said drive assembly comprising:
   a first drive sheave connected to said carriage and contacting said first segment of said endless cable;
   a first variable brake connected to said first drive sheave and associated with said first segment of said endless cable;
   a second drive sheave connected to said carriage and contacting said second segment of said endless cable;
a second variable brake connected to said second drive sheave and associated with said second segment of said endless cable;

first and second forward idler sheaves connected to said carriage;

first and second rear idler sheaves connected to said carriage;

wherein said first leg of endless cable passes through the drive assembly by contacting said first forward idler sheave, passing around said first drive sheave for between 10 to 260 degrees, and contacting said first rear idler sheave, and

wherein said second leg of endless cable passes through the drive assembly by contacting said second forward idler sheave, passing around said second drive sheave for between 10 to 260 degrees, and contacting said second rear idler sheave.

3. An aerial cableway according to claim 2:

wherein said first leg of endless cable passes through the drive assembly by contacting said first forward idler sheave, passing around said first drive sheave for between 60 to 200 degrees, and contacting said first rear idler sheave, and

wherein said second leg of endless cable passes through the drive assembly by contacting said second forward idler sheave, passing around said second drive sheave for between 60 to 200 degrees, and contacting said rear idler sheave.

4. An aerial cableway comprising:

a first cable support and a second cable support located at opposing ends of a cableway;

a suspension cable extending between said cable supports;

an endless cable extending in an elongated loop between said cable supports and defining first and second parallel segments;

a cable drive assembly suspended from said suspension cable and engaging said endless cable;
a carriage supported simultaneously on said first segment of said endless cable and on said second segment of said endless cable;
a first variable brake connected to said carriage and associated with said first segment of said endless cable;
a second variable brake connected to said carriage and associated with said second segment of said endless cable.

5. An aerial cableway comprising:
a first cable support and a second cable support located at opposing ends of a cableway;
a suspension cable extending between said cable supports;
an endless cable extending in an elongated loop between said cable supports and defining first and second parallel segments;
a cable drive connected to said endless cable;
a cable take-up assembly suspended from said suspension cable and engaging said endless cable;
a carriage supported simultaneously on said first segment of said endless cable and on said second segment of said endless cable;
a first variable brake connected to said carriage and associated with said first segment of said endless cable;
a second variable brake connected to said carriage and associated with said second segment of said endless cable.

6. An aerial cableway comprising:
a first cable support and a second cable support located at opposing ends of a cableway;
a suspension cable extending between said cable supports;
an endless cable extending in an elongated loop between said cable supports and defining first and second parallel segments;
a cable drive connected to said endless cable;
a carriage supported simultaneously on said first segment of said endless cable and on said second segment of said endless cable;
wherein said carriage is also in contact with said suspension cable;

a first variable brake connected to said carriage and associated with said first segment of said endless cable;

a second variable brake connected to said carriage and associated with said second segment of said endless cable; and

an auxiliary brake connected to said carriage and associated with said suspension cable, said auxiliary brake comprising:

a first side plate connected to a first side of said carriage;

a second side plate connected to a second side of said carriage;

a top brake shoe disposed between and attached to said first and second side plates;

an auxiliary brake linkage disposed between said first and second side plates and attached at a first end to said first side plate;

a bottom brake shoe disposed between said first and second side plates and connected to a second end of said auxiliary brake linkage;

an actuation cable connected at a first end to said auxiliary brake linkage;

an auxiliary brake actuation assembly connected at a second end of said actuation cable.

7. An aerial cableway comprising:

a first cable support and a second cable support located at opposing ends of a cableway;

a third cable support and a fourth cable support located at opposing ends of said cableway;

a first suspension cable extending between said cable supports;

a drive cable extending in an elongated loop between said cable supports and defining first and second parallel segments;

a cable drive connected to said drive cable;
a carriage suspended from said suspension cable and connected to a first end of said drive cable and to a second end of said drive cable;
a pan and tilt head connected to said carriage;
a second suspension cable extending between said third and fourth cable supports and substantially adjacent to said suspension cable;
a trailer dolly suspended from said second suspension cable;
a remote control cable attached at a first end to said pan and tilt head and attached at a second end to a tripod fluid head and attached at a point between said first and second ends to said trailer dolly.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : Please See Extra Sheet.
US CL : Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)


Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, &amp;</td>
<td>US, A, 5,224,426 (Rodnunsky et al) 06 July 1993, see whole document</td>
<td>1-7</td>
</tr>
<tr>
<td>A</td>
<td>US, A, 3,390,640 (Couttet et al) 02 July 1968, see figures 5 &amp; 8.</td>
<td>1-3</td>
</tr>
<tr>
<td>A</td>
<td>US, A, 3,839,967 (Wyssen) 08 October 1974, lines 33-35, column 3.</td>
<td>2-3</td>
</tr>
<tr>
<td>A</td>
<td>US, A, 5,113,768 (Brown) 19 May 1992, see whole document.</td>
<td>4-7</td>
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<tr>
<td>A</td>
<td>DE, A, 3730115 (Rexroth) 08 September 1987, see figure 1.</td>
<td>5</td>
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</table>

Further documents are listed in the continuation of Box C. See patent family annex.

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* Special categories of cited documents:
  *A* document defining the general state of the art which is not considered to be of particular relevance
  *E* earlier document published on or after the international filing date
  *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  *O* document referring to an oral disclosure, use, exhibition or other means
  *P* document published prior to the international filing date but later than the priority date claimed
  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "*" document member of the same patent family

Date of the actual completion of the international search: 27 MARCH 1995
Date of mailing of the international search report: 24 APR 1995

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A. CLASSIFICATION OF SUBJECT MATTER:
IPC (6):
B61B 07/02

A. CLASSIFICATION OF SUBJECT MATTER:
US CL:
104/112, 95, 173.1, 178, 197, 202, 229, 234; 188/188, 65.1

B. FIELDS SEARCHED
Minimum documentation searched
Classification System: U.S.
104/112, 95, 173.1, 178, 197, 202, 229, 234, 117.1, 173.2, 180, 192, 196, 204, 230, 235, 236, 238, 239; 188/188, 65.1, 65.2, 65.3; 254/391; 105/155; 182/5, 6, 7, 12, 13, 14; 212/76, 77, 97, 99, 110, 111, 112, 117, 119