Feb. 27, 1973 H. H. LYSONS ET AL 3,718,262

TWO CABLE TENSION-CONTROLLED CARRIAGE

Filed Feb. 24, 1971 3 Sheets-Sheet 1

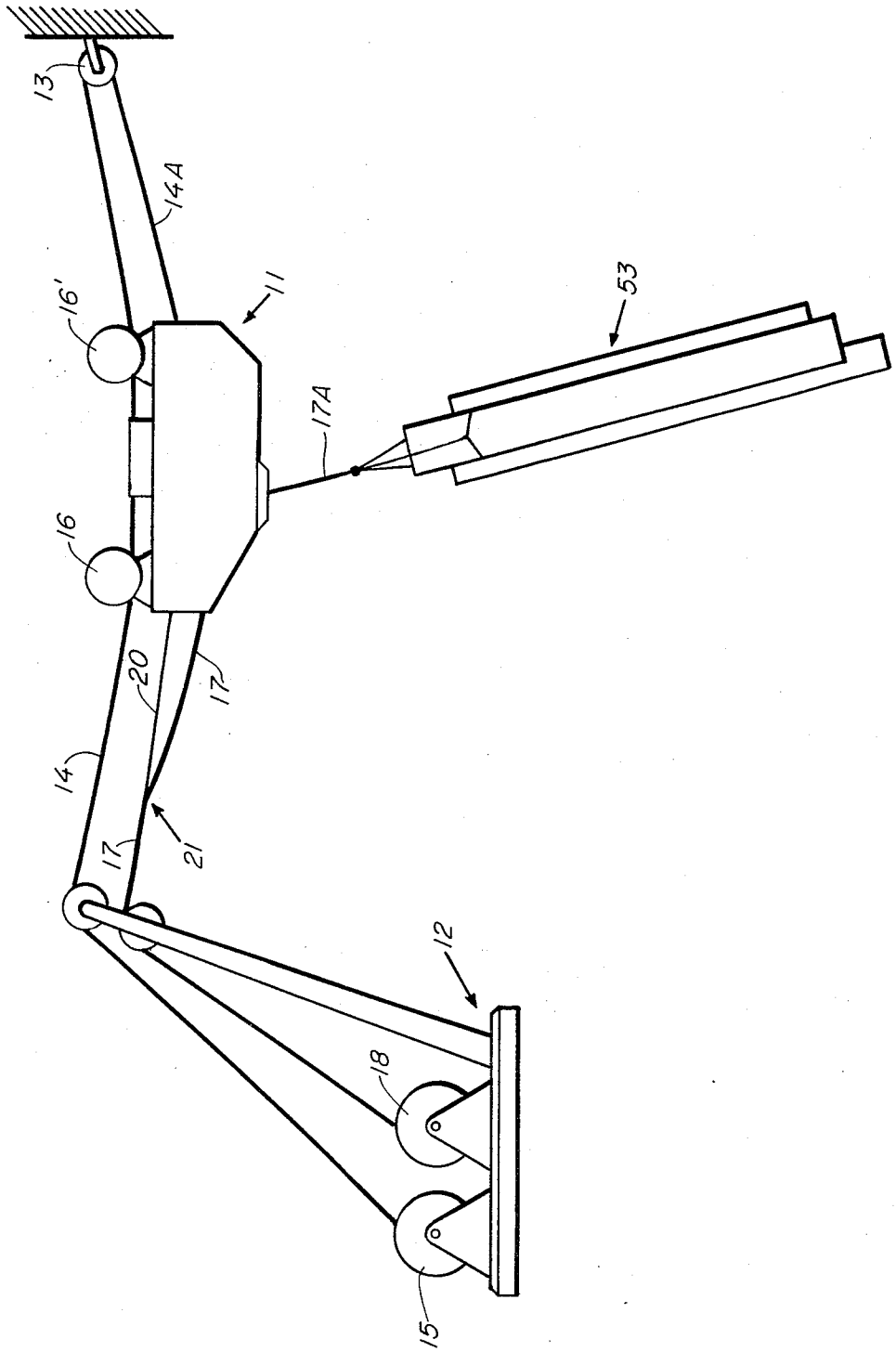


FIG. 1

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TWO CABLE TENSION-CONTROLLED CARRIAGE

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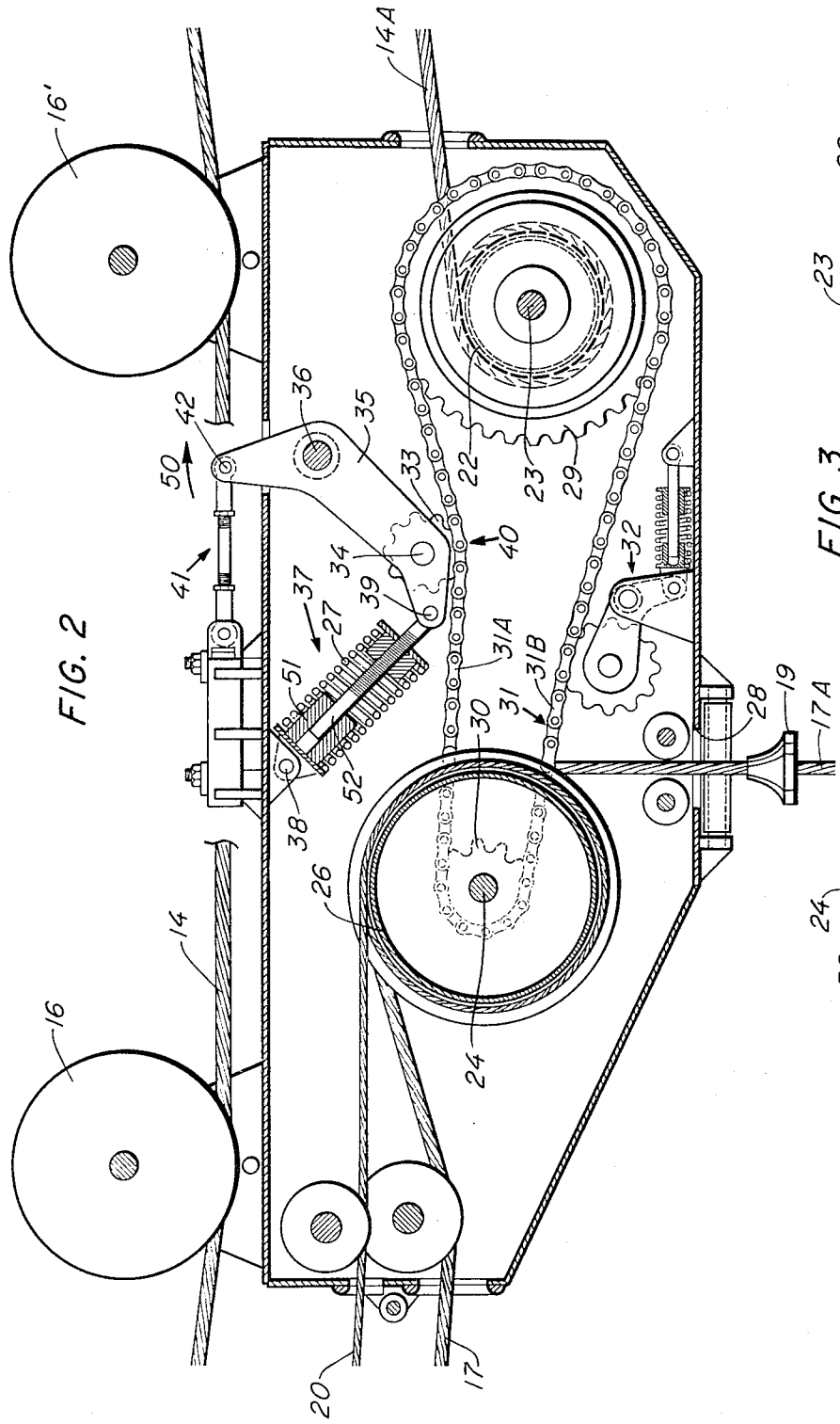


FIG. 2

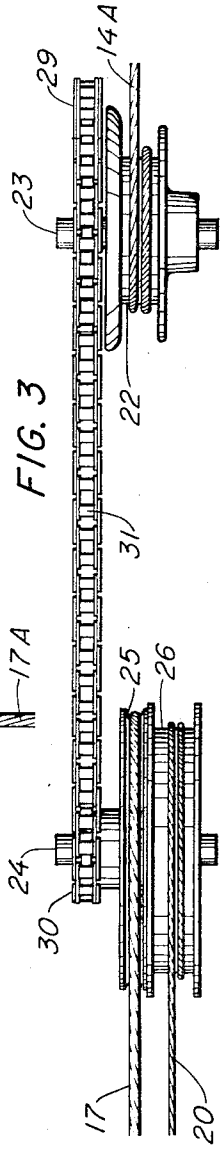


FIG. 3

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TWO CABLE TENSION-CONTROLLED CARRIAGE

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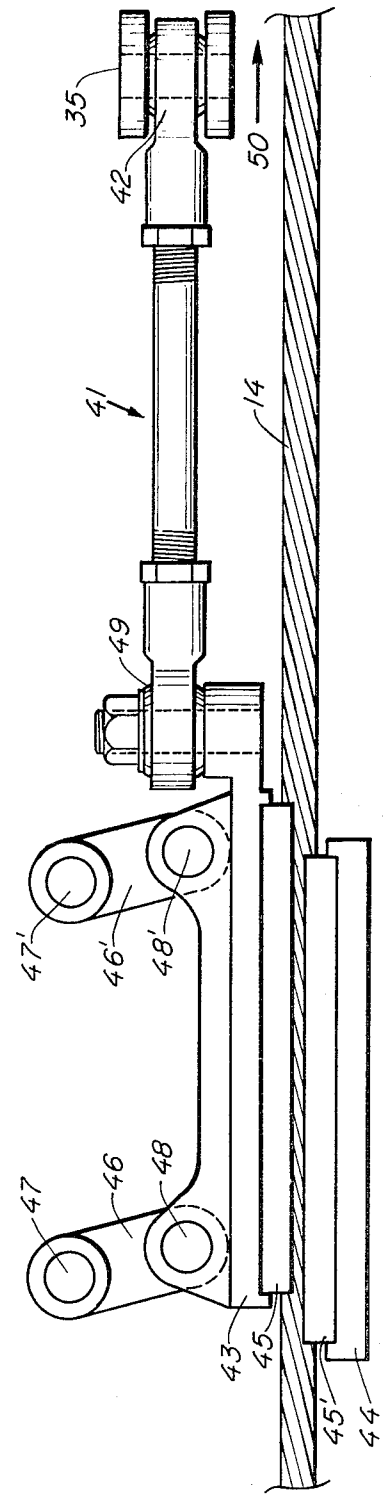


FIG. 4

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3,718,262

TWO CABLE TENSION-CONTROLLED CARRIAGE

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U.S. Cl. 212—110 3 Claims

ABSTRACT OF THE DISCLOSURE

A carriage for moving cable traversing hoist application with complete operation and control derived from the tension and movement of the two running cables without additional control lines or internal power sources. A tension-controlled clamp is engaged to hold the carriage in position on the cable from which it is suspended. With the carriage supported completely by the suspension cable, one running cable is freed for use as a hoist. A device in the carriage pulls a portion of this cable through the carriage, lowering it to allow attachment or removal of the load.

A nonexclusive, irrevocable, royalty-free license in the invention herein described, throughout the world for all purposes of the United States Government, with the power to grant sublicenses for such purposes, is hereby granted to the Government of the United States of America.

BACKGROUND OF THE INVENTION

(1) Field of the invention

This invention relates to a traversing hoist with particular reference to application with a running skyline logging system.

(2) Description of prior art

The most commonly used running skyline logging systems require three moving cables for operation of the traversing carriage. At the head of the skyline, the landing to which the logs are brought, a yarder containing three motor-driven control winches maintains the tensions and, by spooling in and letting out cables, controls the movement and operation of the carriage along the skyline.

The main cable runs from the yarder to the carriage, passes through the carriage, and attaches to a choker supporting the load below the carriage. The haulback cable runs from the yarder across the span of the skyline through a block at the outer limit of the area being logged and returns to the carriage. The carriage is suspended from the full span segment of the haulback cable in a running skyline. Tension in the main and haulback cables supports the skyline and winching in one cable while letting out the other pulls the carriage in either direction.

During pickup and landing the main cable is pulled through the carriage, lowering the choker for load attachment or removal. The main cable is pulled by a cable which runs from a third control winch at the yarder through the carriage, and back parallel to the main cable approximately one hundred and fifty feet to where the two cables are joined. As this third cable is spooled in at the yarder, the control winches maintain the required tension to support the skyline and hold the carriage in position as the main cable is pulled through the carriage.

A disadvantage of existing carriages is the requirement for running three cables and providing three control winches at the yarder. Carriages which have been devised for two-cable operation require internal power sources and either radio equipment or cyclic action to control operation. Some utilize motor-driven winches for raising and lowering the load which further increases the expense and weight of the carriage.

SUMMARY OF THE INVENTION

In general, the principal improvement of this invention resides in a carriage for moving cable traversing hoist application which requires only two running cables for complete operation and control.

A cable system suitable for operation of this invention is exemplified by a running skyline logging system using only the main and haulback cables. For clarity, cable system terminology normally associated with this application of the carriage will be used.

The haulback cable from which the carriage is suspended is routed between the jaws of a clamp on the carriage. The clamp is held in engagement with the cable by a spring or other distorted elastic material exerting a restoring force. This clamp, when so engaged, holds the carriage in position on the haulback cable which then supports the skyline—the main cable tension can be reduced and the skyline will not collapse.

Two interconnected cable drums in the carriage are used to pull slack in the main cable to and through the carriage. Approximately thirty feet of haulback cable is wrapped on one of these drums. As tension in the main cable is reduced, the tension in the haulback cable pulls the spooled end portion off the drum. The resulting rotation of this drum causes the second drum to rotate, spooling in a slack-pulling line. The opposite end of this line is connected to the main cable at a point between the carriage and the yarder so that as the slack-pulling line is wound into the carriage it pulls the main cable with it. The main cable passes over a sheave and exits the bottom of the carriage lowering the end of the cable to allow the load to be attached or removed.

The main cable and attached load are raised in the conventional manner by reeling in the cable at the yarder. As the main cable is pulled back through the carriage, the attached slack-pulling line is withdrawn from its drum. The rotation drives the interconnected haulback drum which spools in the haulback cable, resetting the slack-pulling drive means.

A release mechanism to disengage the clamp is controlled by the cable tensions. A mechanical stop holds the end of the main cable in place under the carriage so that increased tension in the main cable transmitted through the frame of the carriage increases the tension in the entire cable system. Tension is applied by the cables to the two cable drums so as to rotate them in opposite directions, thus tightening the chain connecting the drums. The taunt chain applies a force to a mechanical linkage in a direction opposing the elastic restoring force which holds the clamp engaged. As this opposing force increases with cable tension, the clamp opens and the carriage can be moved in the conventional manner by spooling in the haulback cable at the yarder for outhaul motion of the carriage away from the yarder or spooling in the main line for inhaul motion while maintaining tension in both cables. The cable tension, when the clamp is open, supports the skyline.

Accordingly, an object of this invention is to provide a traversing hoist carriage for moving cable operations which requires only two running cables for full control. More specifically, an object of the invention is to simplify and reduce the expense of running skyline logging operations by eliminating the third cable or other control devices which must be installed and maintained. A further object of this invention is to increase the length of the span which can be supported by a yarder of limited size by using larger interlocking drums for the haulback and main cables to utilize the space when the third drum now required is eliminated.

BRIEF DESCRIPTION OF THE DRAWINGS

The inventive idea involved is capable of receiving a variety of mechanical expressions, one of which, for the purpose of illustrating the invention, is shown in the accompanying drawing wherein:

FIG. 1 is a pictorial view showing the carriage in operation on a two-cable running skyline.

FIG. 2 is a fragmentary side view of the carriage mechanisms.

FIG. 3 is a top view of the cable drum assembly.

FIG. 4 is a top plan view of the clamping device on the carriage.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, the following cables are used in conjunction with the carriage:

(1) Suspension cable.—A cable extending across the entire span of the cableway system. The carriage is suspended from and moves along this cable as it traverses the span. The suspension cable may either be a stationary cable, anchored at each end of the span, as exemplified by a "standing skyline" cable logging system or the suspension cable may be the full-span segment of the haulback cable as exemplified by a "running skyline" cable logging system and shown in FIG. 1.

(2) Haulback cable.—Haulback cable **14** runs from control winch **15** at the yarder, designated generally as **12**, across the span of the cableway, passes through tailblock **13**, and returns to the carriage, designated generally as **11**. The portion of haulback cable **14** between the tailblock and the carriage is designated **14A**. As the haulback cable is wound in by control winch **15**, the carriage, suspended from the cable by sheaves **16** and **16'**, is pulled toward tailblock **13**.

(3) Main cable.—Main cable **17** runs from control winch **18** at yarder **12** to the carriage. In the embodiment shown, the main cable passes through and extends below the carriage. The load, here shown as logs **53**, is attached to the segment, designated **17A**, of the main cable below the carriage. For loading and unloading operations segment **17A** is lowered by pulling slack in main cable **17** through the carriage.

From within the carriage, slack-pulling line **20** extends in the direction of the yarder to **21** where it is connected to the main cable.

Referring to FIGS. 2 and 3, two interconnected cable drums provide means for lowering the main cable to attach or remove the load.

Approximately thirty feet at the end of haulback cable segment **14A** are wrapped on haulback drum **22**. The drum is carried by shaft **23** which is suitably journaled to the frame of the carriage to allow rotation.

A second rotatable shaft **24** carries main cable sheave **25** and slack-pulling drum **26**. Slack-pulling line **20** is attached to drum **26** and extends approximately one hundred and fifty feet from the carriage to its connection point on main cable **17**. Main cable **17** is carried by sheave **25** as the cable passes through the carriage.

Sheave **25** and drum **26** desirably have the same diameters so that as they rotate with shaft **24**, the same quantities of main cable **17** and slack-pulling line **20** will be pulled to the carriage.

Sprocket gear wheels **29** and **30** are carried on shaft **23** and **24**, respectively. The gear wheels are connected by chain **31**.

Pulling haulback cable **14A** off drum **22** will cause shaft **23** to rotate clockwise as viewed in FIG. 2. Chain **31** transmits this rotation to shaft **24**. As slack-pulling line **20** is wrapped on drum **26**, it pulls attached main cable **17** over sheave **25** and through the carriage.

The mechanical advantage of this system is established by the relative diameters of drums **22** and **26** and sprocket gears **29** and **30** which are desirably so engineered that

unwrapping approximately thirty feet of haulback cable **14A** from drum **22** will cause approximately one hundred fifty feet of slack-pulling line **20** to be wrapped on drum **26** and equal length of main cable **17** to be pulled through the carriage.

As a result of this mechanical advantage whenever the tension in the haulback cable is greater than approximately five (5) times the tension in the main cable, haulback cable **14A** will be extended out of the carriage from drum **22**, main cable segment **17A** will extend below the carriage, and slack-pulling line **20** will be wrapped on drum **26**. Conversely, when the tension in the haulback cable is less than approximately five (5) times the main cable tension, the main cable and slack-pulling line will extend taut from the carriage toward the yarder and approximately thirty feet of haulback cable **14A** will be stored on drum **22**.

Referring now to FIG. 2, a second feature of the invention is a tension sensing means for deriving control of a carriage clamping function from the tension in the two running cables.

Chain **31** connecting sprockets **29** and **30** is run with enough slack to allow approximately ten inches of vertical play at its midpoint. On lower segment **31B** of the chain, slack is taken up by an idler assembly, here shown as an idler pulley on a spring-loaded pivot arm and designated generally as **32**.

Actuation of a cable clamp on the carriage is derived from the tautness of upper chain segment **31A**. Pivot arm **35** rotates on axle **36** which is suitably journaled to the carriage frame. At its lower end, pivot arm **35** carries idler pulley **33** rotatably mounted to the arm by axle **34**. Idler pulley **33** engaged chain segment **31A** and is held in such engagement by a spring assembly, designated generally as **37**, which is installed between the carriage frame and pivot arm **35**. Spring assembly **37** consists of two flanged telescoping shafts **51** and **52** with compressed spring **27** wrapped around them between the flanges such that the restoring force of the spring acts to lengthen the assembly. The outer end of shaft **51** is rotatably connected by axle **38** to the carriage frame and the outer end of shaft **52** is rotatably connected by axle **39** to pivot arm **35**. The force generated by spring assembly **37** acts to rotate pivot arm **35** counterclockwise on axle **36**. The distance the arm can pivot is limited by the engagement of idler pulley **33** in upper chain segment **31A**.

The angular position of pivot arm **35** is established by the tautness of chain segment **31A**. Tension in main cable **17** acts to rotate sheave **25** and connected axle **24** and sprocket gear **30** counterclockwise as viewed in FIG. 2. Tension in haulback cable **14** is exerted at the carriage by segment **14A** which acts to rotate drum **22**, axle **23**, and sprocket gear **29** in the opposite, clockwise direction. Thus when tension in either or both cables is low, one or both axles **24** and **23** are free to rotate to allow slack in chain segment **31A**. Spring assembly **37** forces pivot arm **35** clockwise around axle **36** so attached idler pulley **33** moves chain segment **31A** downward to take up this slack. When tension in both main cable **17** and haulback cable segment **14A** is increased, the cable sheave and drum associated with each of these cables rotate or attempt to rotate in opposite directions. Connected sprocket gears **30** and **29** turn to transfer slack from segment **31A** to **31B** such that upper segment **31A** becomes taut. The chain exerts a force in the direction of refrence arrow **40** against idler pulley **33**. This causes arm **35** to pivot clockwise around axle **36**, motion which is resisted by the force generated in spring assembly **37** as the spring **27** is compressed so that it generates a larger restoring force. Pivot arm **35** will arrive at an equilibrium position where this increased restoring force generated by spring **27** balances the opposing force caused by the upward displacement of chain segment **31A** as it becomes taut. This balanced situation is upset by changing the tension in the two running cables—as cable tension is increased,

chain segment 31A is pulled more taut displacing pivot arm 35 clockwise by the amount necessary to increase the compression of spring assembly 37 enough to again balance the forces. The angular position of pivot arm 35 is thus controlled by the tensions in the main and haulback cables.

Referring now to FIG. 4, another feature of the invention is a clamping device controlled by the running cable tension.

The haulback cable 14 from which the carriage is suspended is routed between the jaws 43 and 44 of a clamp. Jaw 44 is rigidly attached to the carriage frame, while jaw 43 is movable. Jaw 43 can be swung toward or away from jaw 44 to engage or release the clamp through the motion of positioning arms 46 and 46' which are rotatably mounted between jaw 43 and the carriage frame by axles 48 and 48' and 47 and 47', respectively.

Pads 45 and 45' line the faces of jaws 43 and 44, respectively. The pads desirably are capable of generating friction when held against the cable and are desirably grooved to optimize the surface area in contact with the cable.

Jaw 43, shown in contact with haulback cable 14 so that the clamp is engaged in FIG. 4, is connected to pivot arm 35 by linkage arm 41.

As previously described, increasing tension in the main and haulback cables causes pivot arm 35 to rotate clockwise as viewed in FIG. 2. This motion, in the direction shown by reference arrow 50 in FIGS. 2 and 4, is used to open the clamp. As pivot arm 35 moves in the direction shown by reference arrow 50, linkage arm 41 pulls jaw 43 away from jaw 44. Ball and socket joints 42 and 49 which connect linkage arm 41 to pivot arm 35 and jaw 43, respectively, allow the linkage arm to maintain angular alignment during this motion.

SEQUENCE OF OPERATION

(1) Inhaul or outhaul of the carriage.—The carriage traverses the span as the two interlocked control winches at the yarder spool in either the main or haulback cable while letting out an equal length of the other. An interlock tension must be maintained in the two cables to support the skyline. The tension sensing means in the invention is so engineered that when the main and haulback cables are at this interlock tension, the clamping device on the carriage will be held open to allow carriage movement.

(2) Positioning the carriage.—The control winches at the yarder are braked when the carriage reaches the desired location along the span. The interlock tension in the main and haulback cables is reduced, preferably by gradually letting out slack in the main cable.

The tension sensing means is desirably so engineered that when the cable tension is reduced to approximately fifty percent of the original running interlock tension, the clamping device will be fully engaged. The carriage is thus held in place so that as the main cable tension is further reduced at the yarder, the cable onto which the carriage is clamped increasingly supports the skyline alone.

(3) Lowering the main cable.—When the tension in the main cable is further reduced at the yarder to approximately one fifth the tension in the haulback cable, the weight of the carriage causes the stored haulback cable to be pulled off its cable drum in the carriage. This rotates the second cable drum to wind in the slack-pulling line which in turn pulls the main cable over the rotating sheave and through the carriage.

(4) Raising the main cable.—As main cable is wound onto the control winch at the yarder (with the haulback winch braked) the cable is pulled through the carriage raising the load. This also unwinds the slack-pulling line from its drum in the carriage simultaneously causing the haulback drum to reel in haulback cable. Mechanical stop 19 on main cable segment 17A engages the carriage frame at 28 to prevent further cable motion when the load has been raised. As tension in the main cable is further increased, it exerts a force pulling the carriage toward the yarder which is opposed by the clamped haulback cable. As this tension approaches full running interlock tension, the tension sensing means in the carriage pulls the clamp open to allow the carriage to move.

The tension controlled clamping function of the carriage may be accomplished by several alternative embodiments. The means of providing force to hold the clamp engaged, here shown as the compression of spring assembly 37, can include any force exerting device incorporating an elastic material which generates a sufficient restoring force. This could alternatively include a spring in tension, an axially connected rod or spring generating a torquing force, or a compressed gas generating an expansion force. The tension sensing means used to open the clamp, here shown as the displacement of chain segment 31A caused by opposing rotation of interconnected cable drums, can be replaced with alternative mechanical arrangements. Haulback cable 14A could be attached directly to the linkage connected to the moveable jaw of the clamp, tension in the cable would provide a horizontal force in the direction of reference arrow 50 to pull the clamp open. This opening force could also be derived directly from the tension in the main cable. Passing the main cable over a sheave at the lower end of an actuating pivot arm would similarly allow increased cable tension to overcome the force holding the clamp engaged.

The hoist means is also capable of a variety of mechanical expressions. The haulback cable drum used to provide the energy for lowering the main cable can be replaced with an axially connected spring or other drive device operating the slack-pulling line drum by providing a rotation force which opposes the tension in the main cable such that a reduction in that tension allows the device to rotate the slack-pulling drum, lowering the cable. The hoist means need not be a slack-pulling device. The drive means could be connected to two cabled drums, one to winch main cable into the carriage and a second to lower a separate hoist cable. Finally, while the preferred embodiment uses two axles, the various cable drums and/or sheaves comprising the hoist means could be carried on a single axle or be separated and carried on a plurality of interconnected axles.

Having thus disclosed our invention we claim:

1. A transport system comprising:

(a) a support member extending between two distant points;

(b) a carriage suspended from and adapted to travel along said support member;

(c) a pair of running cables extending from the carriage to a control point;

(d) a pair of rotatable shafts journaled in said carriage having a roll mounted on each of said shafts, a first of said running cables being secured to a first roll whereby tension in said first cable exerts a force on the carriage, the second cable passing over the second roll and through the carriage to serve as a load-carrying means;

(e) flexible drive means connecting said shafts whereby rotation of either shaft causes the other shaft to rotate in the same direction thereby causing a segment of the drive means to become slack, while tension in both of the cables, when acting to rotate each shaft in opposite directions, causes said segment to become taut;

(f) engageable clamping means attached to the carriage and so positioned as to grip the support member when an activating force is applied to said clamping means; and

(g) tension sensing means between said segment and clamping means comprising:

(1) a lever arm having a first end thereof connected to said clamping means and being pivoted to the carriage at a point intermediate said first end and a second end,

(2) contact means connected to the lever arm at a point between the pivot and the second end of said lever arm, said means being in moving contact with the aforementioned segment of the flexible drive means whereby lateral movement of said segment due to variations in tautness are transmitted to said lever arm; and

(3) pressure applying means connected between the carriage and the second end of said lever arm for maintaining continuous contact between said contact means and the segment of the flexible drive means, said pressure applying means acting through the lever arm to maintain the clamping means in locked engagement with the support member when the segment of the flexible drive means is slack, thereby maintaining the carriage stationary, said segment, acting in a direction opposite to the force exerted by the pressure applying means at a predetermined tautness, to overcome said force, thereby releasing the engagement of the clamping means from the support member to permit travel of the carriage.

2. The system of claim **1** wherein the pressure applying means comprising a compressed elastic material exerting a restoring force.

3. A traversing hoist carriage suspended from a supporting cable for operation with a cable transport system employing at least two running cables comprising:

(a) an engageable cable clamp mounted on the carriage frame positioned to grip the supporting cable;

(b) a first rotatable axle suitably journaled to the carriage frame carrying:

(1) a first cable drum and

(2) a first sprocket gear, a first running cable attached to, and having a length of said cable wrapped around the first cable drum;

(c) a second rotatable axle suitably journaled to the carriage frame carrying:

(1) a cable sheave,

(2) a second sprocket gear, and

(3) a second cable drum having a diameter substantially equal to that of the cable sheave, the diameters of the first and second cable drums and first and second sprocket gears being such that upon rotation the ratio of angular displacement of the first axle to the second axle is at least two to one (2:1);

(d) a second running cable carried by said cable sheave and passing through the carriage so that an end of said cable extends below the carriage;

(e) load attachment means on the second running cable below the carriage;

(f) a slack-pulling line attached to the second cable drum, extending from the carriage substantially parallel to the supporting cable, and attached to the second running cable;

(g) a flexible drive chain engaged in and interconnecting the first and second sprocket gears such that rotation of either axle caused by unspooling cable or line from the attached cable drum is transmitted by the chain to cause rotation of the other axle as to spool line or cable onto the attached cable drum, said drive chain being of sufficient length to provide slack therein;

(h) a pivot arm suitably journaled to the carriage frame to allow angular movement;

(i) an idler pulley rotatably mounted on the pivot arm positioned to engage the segment of the drive chain which becomes taut when tension is applied to both running cables;

(j) a distorted elastic material moveably connected between the carriage frame and the pivot arm such that the restoring force generated by said elastic material acts to move the pivot arm to hold the idler pulley as to take up any available slack in the drive chain; and

(k) a linkage arm connecting the pivot arm to the engageable cable clamp such that when said pivot arm is held in position to take up slack in the drive chain, the linkage arm positions the cable clamp to grip the supporting cable, thereby preventing carriage movement, and as increasing running cable tensions cause the drive chain to become more taut, the chain forces the pivot arm to rotate against the opposing restoring force of the distorted elastic material and the attached linkage arm moves the clamp in a direction to release the supporting cable.

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