A grapple assembly swivelly suspended from a skyline carriage is automatically opened and closed by mechanical means located within the carriage. The carriage is moved by in-haul and out-haul cables and through the skyline cable is lowered or raised for yarding logs. Sequential slackening and tensioning of the skyline cable controls the opening and closing of the grapple jaws.
AUTOMATIC LOG GRAPPLING MECHANISM

This invention relates to a system of yarding logs by means of a grapple assembly and more particularly to an automatic grappling mechanism for controlling the opening and closing of grapple jaws by mechanical means.

Logs are commonly transferred to a desired landing zone by a system of cables wound upon two or more cable winding drums. Such systems include a skyline cable from which a grapple assembly is suspended and in-haul and out-haul cable lines for moving the grapple assembly in opposite directions along the skyline cable. A control mechanism must be associated with the grapple assembly for opening and closing the grapple jaws in order to pickup and transfer a single log or a turn of logs to a landing zone. This yarding system to be successful must be readily adapted for uphill and downhill logging operations or logging on flat terrain with a minimum amount of deflection.

A troublesome problem with yarding systems of the aforementioned type, arises from twisting of the grapple assembly which often results in failure of the grapple jaws to open and makes closing of the grapple jaws difficult. Accordingly, it is necessary to untangle and change twisted cables with a resulting loss of production time. Further, particularly in conjunction with high lead logging, the untangling operation is very dangerous.

Also in connection with the aforementioned yarding systems, successful operation requires a reliable control mechanism for the grapple assembly which will not unintentionally drop logs when bumped or jarred and which will respond to the control operations of the operator.

It is therefore an important object of the present invention to provide in combination with a grapple assembly an automatic grappling control mechanism in a running haul back type of cable system capable of yarding logs with a minimum likelihood of cable twisting and without the use of radio-transmitting, receiving and other electronic equipment.

In accordance with the present invention, a grapple assembly of the type disclosed for example in my prior U.S. Pat. No. 3,245,712, is swivelly suspended about a vertical axis from a carriage adapted to be transported along a skyline cable by means of in-haul and out-haul lines connected thereto at opposite longitudinal ends. The grappling control mechanism for automatically opening and closing the grapple assembly, is located within the carriage and includes a cable control assembly which is movable between limit positions against the constant bias of springs by the weight of the grapple assembly connected thereto by an opening cable which extends into the carriage about a guide pulley. The grapple assembly is suspended by a swivel support so that it may be angularly displaced about the swivel axis without fouling the cable. The control assembly includes in opposite directions in response to slackening and tensioning of the skyline cable in order to control the opening and closing of the grapple assembly by retracting or extending the opening cable relative to the carriage from which it extends downwardly adjacent one longitudinal end through the swivel support along the swivel axis.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereininafter described and claimed, reference being had to the accompanying drawings forming part hereof, wherein like numerals refer to like parts throughout and in which:

FIG. 1 is a side elevational view with parts broken away illustrating a skyline carriage and grapple assembly embodying the grappiling control mechanism of the present invention.

FIG. 2 is an enlarged transverse sectional view taken substantially through a plane indicated by section line 2—2 in FIG. 1.

FIG. 3 is an enlarged transverse sectional view taken substantially through a plane indicated by section line 3—3 in FIG. 1.

FIG. 4 is an enlarged top sectional view taken substantially through a plane indicated by section line 4—4 in FIG. 1.

FIG. 5 is a front elevational view of the grapple assembly and swivel support shown in side elevation in FIG. 1.

FIG. 6 is an enlarged top sectional view taken substantially through a plane indicated by section line 6—6 in FIG. 5.

FIG. 7 is a schematic side elevational view of a typical log yarding system embodying the grappling control mechanism of the present invention shown in a grapple open condition.

FIG. 8 is a schematic side elevational view similar to FIG. 7 but showing the grapple assembly in a closed condition.

FIG. 9 is a side sectional view through the skyline carriage showing the grappiling control mechanism in a grapple closed condition corresponding to FIG. 8.

FIGS. 10–17 are diagrammatic illustrations of the grappling control mechanism in different operational phases.

FIG. 18 is an enlarged partial view of a portion of the grappling control mechanism with parts broken away and shown in section.

FIG. 19 is an enlarged partial sectional view taken substantially through a plane indicated by section line 19—19 in FIG. 18.

FIG. 20 is an enlarged partial sectional view taken substantially through a plane indicated by section line 20—20 in FIG. 3.

Referring now to the drawings in detail and initially to FIGS. 7 and 8, a typical log yarding system is shown generally referred to by reference numeral 19 which comprises the running haulback line type utilized by logging riggers in high lead logging operations. This yarding system includes a power operated cable winding assembly 12 having at least two cable winding drums such as the haulback drum 16 and a main line drum 14. A skyline cable 18 is anchored to the drum 16 and extends from a tower mounted idler pulley to a pulley on an out-haul tail block 20 in order to suspend a skyline carriage 22. The skyline carriage is connected at one longitudinal end to an out-haul line 24 extending from the skyline cable 18 at the out-haul tail block. An in-haul cable line 26 is connected to the other longitudinal end of the carriage opposite to the end to which the out-haul line 24 is connected. The in-haul line extends from the carriage to the idler pulley on the yarding tower and is anchored to the drum 14 upon which it is adapted to be wound. It will therefore be apparent, that by appropriately winding and unwinding the drums 14 and 16, in controlled relation to each other, the carriage 22 may be moved in opposite directions along the skyline cable 18 and the cables slackened or tensioned to lower or raise the grapple assembly 28 suspended from the carriage by a swivel support 30. A grappling control mechanism which is operated by sequential slackening and tensioning of the skyline cable 18, is effective to open the grapple assembly 28 as shown in FIG. 7 so that the grapple assembly may be lowered engagement with a log 32 for example and then closed on the log. When closed on the log, the grapple assembly may be raised in a closed condition as shown in FIG. 8 and transported to a desired landing zone.

In FIGS. 1 and 4, the grappling control mechanism generally referred to by reference numeral 34, is shown in an open grapple condition corresponding to that of FIG. 7. The grappling control mechanism is located within the housing 36 of the carriage having removable access panels 38 on the top wall thereof. Opposite longitudinal ends of the housing are provided with mounting ears 40 carrying upper support pins 42 and intermediate hauling pins 44. A pair of support pulley assemblies 46 ride on top of the skyline cable 18 and are connected by means of the suspension links 48 to the carriage housing 36 through the support pins 42. Rigging links 50 are engaged with the hauling pins 44 and are connected through rigging swivels 52 to the out-haul and in-haul lines 24 and 26.

The grapple assembly 28 is suspended from the carriage housing adjacent one longitudinal end by means of the swivel support 30. As more clearly seen in FIGS. 1, 5 and 20, the swivel support includes a cable guide member 54 rotatably mounted by the carriage housing about a substantially vertical swivel axis which extends through a guide bore 56 in the guide member 54. A pair of mounting ears 58 depend from the guide
member 54 and support a pair of guide rollers 60 between which an opening cable 62 extends downwardly from the carriage housing. Suspended from each of the mounting ears 58, is a link 64 supporting a pair of support lines 64 by means of rigging elements 66 at the upper ends. Rigging elements 68 at the lower ends of the support lines, are connected by links 70 to a grapple spreader element 72 associated with the grapple assembly 28. The support lines 64 are maintained in spaced apart relation intermediate the upper and lower ends thereof by a line separator link 74 held in position between separator link ferrules 76 as more clearly seen in FIG. 5. The grapple opening cable 62 extends through the separator link 74 and then downwardly through an opening cable guide 78 mounted to the grapple spreader element 72.

A stop element 80 is secured to the end of the opening cable 62 for engagement with the cable guide 78 thereby anchoring the end of the cable 62 spaced above a cable pulley rotatably mounted on a center pivot 82 about which the cable is entrained. The center pivot interconnects grapple tongs 84 associated with the grapple assembly. The grapple tongs include jaw portions 86 adapted to engage a log or turn of logs and one of the jaws is provided with a jaw stop 88 for limiting closing movement. The upper ends of the grapple tongs are pivotally connected to leverage links 90 which are pivotally connected at their upper ends to the spreader element 72. It will be apparent that when the grapple assembly 28 is full supported by the support cable 30 so that the support lines 64 are under tension, a portion of the opening cable 62 into the carriage housing causing tensioning thereof will elevate the center pivot 82 and through the leverage links 90 open the grapple jaws as shown in FIG. 5. When the opening cable 62 is slackened and the center pivot 82 is permitted to be lowered relative to the swivel support 30, the jaws will close under gravitational bias.

Referring now to FIGS. 1, 4 and 9 in connection with the grappling control mechanism 34, the carriage housing 36 slidably mounts a cable control carriage assembly 92 which is movable between limit positions within the housing 36. As more clearly seen in FIG. 2, the upper and lower walls of the housing 36 fixedly mount parallel guide tracks 94 engaged with guide rollers 96 mounted on the control carriage 92 for guiding its movement. A cable pulley 98 is rotatably mounted by the control carriage and the opening cable 62 entrained thereabout and anchored at one end thereof to a limit stop member 102 by the element 100. The stop 102 extends transversely across the housing 36 between the side walls thereof for abutment with the control carriage 92 as shown in FIG. 9 corresponding to a closed condition of the grapple assembly.

The opening cable extends from the anchor stop 100 at the control carriage pulley 98 to an end sheave 104 rotatably mounted by a sheave support 106 secured to the longitudinal end wall of the housing 36. From the end sheave 104 the cable extends downwardly through the cable guide 54 along the vertical swivel axis about which the grapple assembly and swivel support 30 are angularly displaceable without twisting of the skylines, in-haul and out-haul cable lines. In the position of the control carriage 92 as shown in FIG. 9, the opening cable 62 will be fully extended from the housing 36 and continuously biased from this limit position by means of four springs 108 which are mounted on parallel spaced guide rods 110 that extend longitudinally between opposite end walls of the housing. The springs 108 are mounted on the guide rods axially reacting between the rod mounting elements 112 at one longitudinal end of the housing and guide rings 114 laterally projecting from the control carriage 92 through which the guide rods 110 extend.

A pair of mounting ears 116 project forwardly from the control carriage 92 for supporting a pivot pin 118 on which a control arm 120 is pivotally mounted as more clearly seen in FIGS. 18 and 19. The control arm is pivotally displaceable from an upper position engaging a limit stop 122 as shown in FIG. 18 to two other operative positions including an intermediate position and a lower position. The control arm is yeldably held in each of its three operative positions by any suitable detent mechanism 124 as more clearly seen in FIG. 19. The control arm is displaceable between its operative positions through a control pin 126 which extends laterally from both sides of the control arm as more clearly seen in FIG. 16. The control pin is adapted to ride on the top of stroke guides 128 mounted on the side walls of the housing 36, thereby holding the control arm 120 in its upper operative position. The control pin 128 is being displaced to or from its limit position engaging the limit stop 122.

The side walls of the housing 36 also mount mid-cycle stop elements 130 and end cycle camming elements 132 as more clearly seen in FIGS. 4 and 9 for engagement by the control pin 126 on the control arm 120. The stroke guide 128 includes an inclined ramp portion 134 forming a guide path 136 for the control pin below the mid-cycle stop elements 130.

FIG. 9 shows the control carriage assembly 92 in a position corresponding to a closed condition of the grapple assembly as shown in FIG. 8. The control carriage 92 is held in this position against the limit stop 102 by the gravitational load on the grapple assembly full tensoning the opening cable 62 with a force exceeding the bias of the springs 108 which tend to move the control carriage away from this limit position. The mid-cycle stop 130 and the end-cycle stop 132 may be moved in this condition by means of the in-haul or out-haul cable lines. To open the grapple assembly, the skylines 122 are slackened considerably in order to slacken the grapple support lines of the swivel support resulting in a reduction in the tensioning of the opening cable 62 permitting the opening cable 62 to move the control carriage 92 in a left-hand direction as viewed in FIG. 9 to open the grapple assembly. When the control carriage approaches the left-hand limit position, the control pin 126 engages the upper receiving formations 138 on the end camming elements 132 as shown in FIG. 10 thereby downwardly displacing the control arm 120 from its upper operative position. When the control pin 126 is fully seated in the upper formations 138, as shown in FIG. 11, the control carriage 92 retracts the control pin 126 from the upper formation 138 into engagement with the upper portion of the mid-cycle stop elements 130 as shown in FIG. 12. The control pin 126 then becomes fully seated in the receiving notch of the mid-cycle stop elements as shown in FIG. 13, to stop further right-hand movement of the control carriage 92. Thus, the opening cable 62 remains substantially retracted and thereby holds the grapple assembly in an open condition. In this condition of the grappling control mechanism, the control arm 120 is yieldably held in its intermediate position by the detent mechanism 124.

With the skylines in a tensioned condition, the skylines 122 may move again by the in-haul or out-haul cable lines to any desired position about the log or the ground. The grapple assembly will then be in an open condition as shown in FIG. 7. The skylines may then be slackened to lower the grapple assembly and also thereby relieve the cable tension opposing the spring 108 so that the control carriage moves in a left-hand direction as shown in FIG. 14 withdrawing the control pin 126 from the mid-cycle stop elements 130 into engagement with the lower formations 140 of the end camming elements 132. When the control carriage reaches the end of its left-hand movement once again, the control pin 126 is fully seated and the control arm downwardly displaced from its intermediate operative position as shown in FIG. 15. This corresponds to engagement of the grapple assembly with the log or the ground. The skylines may then be tensioned to cause right-hand movement of the control carriage 92 withdrawing the control pin 126 from the lower formations 140 and into engagement with the lower portion of the mid-cycle stop elements 130 as shown in FIG. 16. Continued movement of the control carriage 92 in a right-hand direction causes the control arm 120 to be cammed downwardly to its lower operative position into engagement with the ramp portion 134 of the stroke guide as shown in FIG. 17. This permits closing of the grapple assembly under the weight of the grapple jaws as the control carriage continues its
movement in a right-hand direction toward its limit position abutting the limit stop 102. During the latter movement of the control carriage, the control arm 120 is angularly restored to its upper operative position as the control pin 126 rides up the ramp portion 134 and along the stroke guide 128.

It will therefore be apparent from the foregoing, that by sequential toning and slackening of the skyline cable, the grapple assembly may be automatically opened and closed in order to pickup, transport and drop logs at a desired unloading zone.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed is new is as follows:

1. In a system for yarding logs having a movable cable suspended carriage, a grapple assembly, support means swivelly suspending the grapple assembly from the carriage about a substantially vertical swivel axis, and tension responsive means mounted within the carriage and connected to the grapple assembly for automatically opening and closing the same, said grapple assembly including a pair of jaws, pivot means interconnecting the jaws, links suspending the jaws from the support means and an opening cable engageable with the pivot means and connected to the tension responsive means and the support means, said cable tension responsive means comprising, a control assembly movably mounted by the carriage and connected to the cable, cable guide means directing the cable from the carriage substantially along said swivel axis urging movement of the control assembly in one direction under the gravitational bias of the grapple assembly, spring means continuously biasing the control assembly for movement in the other direction to a limit position opening the grapple assembly, said stop means including an end camming element mounted on the carriage having spaced formations thereon, a control arm movably mounted on the control assembly and engageable with said formations at the limit position of the control assembly, a stop element mounted on the carriage and engageable by the control arm in close spaced adjacency to the limit position, means yieldably holding the control arm in operative positions between which the control arm is displaced in response to successive engagement with the end camming and stop elements, and guide means fixed to the carriage for engagement with the control arm during movement of the control assembly in said one direction restoring the control arm to one of said operative positions.

2. The combination of claim 1 wherein said stop means includes an end camming element mounted on the carriage having spaced formations thereon, a control arm movably mounted on the control assembly and engageable with said formations at the limit position of the control assembly, a stop element mounted on the carriage and engageable by the control arm in close spaced adjacency to the limit position, means yieldably holding the control arm in operative positions between which the control arm is displaced in response to successive engagement with the end camming and stop elements, and guide means fixed to the carriage for engagement with the control arm during movement of the control assembly in said one direction restoring the control arm to one of said operative positions.

3. The combination of claim 2 wherein said support means includes a spreader element to which the links are pivotally connected, a swivel guide assembly mounted on the carriage through which the cable extends along said swivel axis and support lines interconnecting the swivel guide assembly and the spreader element, said cable being anchored at one end to the spreader element and extending upwardly from the pivot means through the spreader element.

4. In a system for yarding logs having a movable cable suspended carriage, a grapple assembly, support means swivelly suspending the grapple assembly from the carriage about a substantially vertical swivel axis, and tension responsive means mounted within the carriage and connected to the grapple assembly for opening and closing the same, said cable tension responsive means comprising, a grapple cable, a control assembly movably mounted by the carriage and connected to the cable, cable guide means directing the cable from the carriage substantially along said swivel axis urging movement of the control assembly in one direction connected under the gravitational bias of the grapple assembly, spring means continuously biasing the control assembly for movement in the other direction to a limit position opening the grapple assembly, and tension releasable stop means mounted by the carriage and the control assembly for holding the control assembly adjacent said limit position to maintain the grapple assembly open, said stop means including an end camming element mounted on the carriage having spaced formations thereon, a control arm movably mounted on the control assembly and engageable with said formations at the limit position of the control assembly, a stop element mounted on the carriage and engageable by the control arm in close spaced adjacency to the limit position, means yieldably holding the control arm in operative positions between which the control arm is displaced in response to successive engagement with the end camming and stop elements, and guide means fixed to the carriage for engagement with the control arm during movement of the control assembly in said one direction restoring the control arm to one of said operative positions.

5. In a system for yarding logs having a movable cable suspended carriage, a grapple assembly, support means suspending the grapple assembly from the carriage, and mechanical means mounted with the carriage and connected to the grapple assembly for opening and closing the same, said grapple assembly including a pair of jaws, pivot means interconnecting the jaws, links suspending the jaws from the support means and an opening cable engageable with the pivot means and connected to the mechanical means, said mechanical means including spring means operative to automatically retract the opening cable when tension is reduced therein, and means retaining said opening cable retracted when tension is subsequently increased therein thereby automatically opening the jaws, said last named means subsequently automatically releasing the opening cable for gravity closing of the jaws in response to tension cycles in the opening cable.

6. The combination of claim 5 wherein said support means includes a spreader element to which the links are pivotally connected, a swivel guide assembly mounted on the carriage through which the cable extends along a swivel axis and support lines interconnecting the swivel guide assembly and the spreader element, said cable being anchored at one end to the spreader element and extending upwardly from the pivot means through the spreader element.