

APPARATUS FOR PAYING OUT A FLEXIBLE LINE

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This invention relates to apparatus for paying out cable, rope or other flexible elongate element (all such flexible elongate elements hereinafter being referred to as a "flexible line") from a drum or reel suspended from
5 a helicopter or other aircraft, airship or balloon.

In the erection and installation of an overhead electric transmission line, it is the general practice to "string" the electric conductors to be suspended between the pylons or other support structures by paying out a light lead line between the pylons, using the lead
10 line to haul between the pylons a hawser cable of substantially greater diameter than the lead line, and then using the hawser cable to haul an overhead electric conductor or overhead electric conductors between the pylons. Where an overhead electric transmission line is
15 to be erected and installed over gorges, valleys, estuaries, rivers, forests, jungles and other sites where initial "stringing" of a light lead line is difficult because of the lack of accessibility, it has been proposed and is sometimes the practice to pay out
20 the lead line from pylon to pylon from a drum suspended from a helicopter, the leading end of the lead line initially being secured to a pylon or to the ground and the lead line being paid out from the suspended drum as the helicopter travels along the route of the
25 transmission line. Apparatus hitherto proposed and used

for paying out a lead line from a drum suspended from a helicopter has had the serious disadvantages that twisting or curling of the lead line is prone to occur as the lead line is paid out and that the tension in the lead line varies to an undesirable extent as the speed of the helicopter increases or decreases and the quantity of lead line on the drum falls. As a result, the paid out flexible line is liable either to foul the tops of trees or the ground profile when the tension falls or to place the helicopter in a hazardous situation when the tension rises to an undesirable extent.

It is an object of the present invention to provide improved apparatus for use in paying out a flexible line from a drum suspended from a helicopter by means of which the flexible line can be paid out smoothly at a substantially constant tension irrespective of the speed of the helicopter and the quantity of flexible line on the drum.

According to the invention the improved apparatus comprises a carrier which has means for suspending the carrier from a helicopter and which has means for so supporting a drum that, when the carrier is suspended from a helicopter, the drum is rotatable about a substantially horizontal axis; braking means which is mounted on the carrier, which is adapted to be rotatably

driven by the drum as a flexible line is paid out therefrom and which will impart to the drum a preset retarding force; control means which is mounted on the carrier and which will automatically decrease the
5 retarding force imparted to the drum by said braking means as the quantity of flexible line on the drum decreases; and, mounted on or carried by the carrier at a position spaced transversely from the axis of rotation of the drum, at least one guide for the flexible line to
10 be paid out from the drum, the arrangement being such that, when the free end of the flexible line is fixed and the helicopter is caused to travel along a desired route, the flexible line will be paid out from the drum smoothly at a substantially constant tension.

15 Preferably, the braking means comprises a circulatory hydraulic system comprising a hydraulic pump mounted on the carrier and adapted to be rotatably driven by the drum, a source of supply of hydraulic fluid connected to the hydraulic pump, and an adjustable
20 relief valve interconnected between said source of supply and the pump by means of which the pressure of the hydraulic fluid in the system can be preset to any desired value within a limited range. The hydraulic fluid is preferably oil. Any convenient means of rotatably driving the hydraulic pump by the drum can be
25 employed, but, preferably, the hydraulic pump is driven via an endless chain which engages a sprocket wheel which rotates with the drum.

The control means which will automatically decrease the retarding force imparted to the drum by the braking means as the quantity of flexible line on the drum decreases, preferably comprises a follower for
5 continuously determining the quantity of flexible line on the drum and a control valve interconnected between the source of supply of hydraulic fluid and the relief valve, the follower being operatively connected to the control valve to adjust the valve in such a way as to
10 decrease smoothly the pressure of the hydraulic fluid in the circulatory hydraulic system as the quantity of flexible line on the drum decreases. Preferably, the follower comprises a feeler which is pivoted about an axis substantially parallel to the axis of rotation of
15 the drum, rides on the outermost layer of flexible line on the drum, and controls a cam which is adapted to adjust continuously the control valve.

A damping device is preferably operatively connected to the pivoted follower to prevent hunting of
20 the follower. If desired, means for manually adjusting the control valve and/or the relief valve may be provided for mounting in the helicopter for actuation by the pilot, thereby providing the pilot with the facility for changing the value of the substantially constant
25 tension of a flexible line as it is being paid out.

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The carrier is preferably in the form of a fabricated frame comprising a pair of side walls between which a drum can be rotatably supported and a transversely extending trailing portion which carries the guide or guides for the flexible line and on which may also be mounted stabilizing means for resisting spinning of the carrier when the carrier is being conveyed from one position to another by a helicopter without a flexible line being paid out from a drum mounted on the carrier.

By providing for a flexible line to be paid out from a drum supported in the apparatus at a substantially constant tension, the flexible line being paid out can be kept clear of the ground profile irrespective of the speed of the helicopter and of the quantity of flexible line on the drum. The flexible line can be paid out smoothly with substantially no snatch occurring throughout the period from helicopter hover - when its speed is zero - until the helicopter has reached the maximum speed at which the flexible line can be paid out and during any variation in speed between these limits. The smooth pay-off of the flexible line and the lack of snatch are also important safety factors insofar as the helicopter crew is concerned.

Although the description of the apparatus has been directed to its use in "stringing" the electric conductors to be suspended between the pylons or other support structures of an overhead electric transmission line, it is to be understood that the apparatus of the invention is not restricted to this use. Included in other uses to which the apparatus can be readily employed are the lowering of a flexible lead line to a ship or other vessel in distress and paying out the lead line to a tug or other vessel which is to take the distressed vessel in tow; laying of field telephone lines or, flexible pipes in distressed areas, e.g. such as areas affected by earthquakes, where normal telephone connections, water supply and other services have broken down; and laying field telephone cables for military operations where rapid installation of telephone connection between one position and another is required.

The invention will be further illustrated by a description, by way of example, of the preferred apparatus for use in paying out a flexible line from a drum suspended from a helicopter, with reference to the accompanying drawings, in which:-

Figure 1 is a diagrammatic perspective illustration of the preferred apparatus, and

Figure 2 is a diagram of the circulatory hydraulic system.

Referring to Figures 1 and 2, the apparatus comprises a carrier 1 in the form of a fabricated frame comprising two upstanding walls 2 between which a drum D is rotatably mounted. Interconnecting the walls 2 and positioned above the drum D is a cross member 3 and two upstanding members 13 supporting an eye 4 to which a cable suspended from a helicopter can engage. A trailing portion 5 of the carrier 1 has at a position remote from the drum D a guide 6 through which a flexible line L being paid out from the drum passes. Mounted above the guide 6 is a stabilizing device 7 which serves to restrict spinning of the carrier when it is being conveyed from one place to another suspended from a helicopter and no flexible line is being paid out from the drum D.

Mounted on one side wall 2 of the apparatus and constituting part of the circulatory hydraulic system is an oil pump 8 which is rotatably driven by the drum D as the flexible line L is paid out from the drum by means of an endless chain 9 engaging a sprocket wheel 10 which rotates with the drum. The oil pump 8 is connected to an oil reservoir 11 which is mounted on the cross member 3 and which is connected back to the oil pump via a known form of pilot-operated relief valve 12. A feeler 14 is

carried by an arm 15 extending from the wall 2 and free to pivot about an axis parallel to the axis of rotation of the drum D, the feeler riding on the outermost turn of flexible line L on the drum. Also mounted on the side wall 2 and constituting part of the control circuit is an automatic control valve 16 which is interconnected between the relief valve 12 and the oil reservoir 11. The control valve 16 is adjusted automatically to increase the oil pressure in the hydraulic system by a cam 17 carried by the pivoting arm 15. Hunting of the feeling 14 is prevented by a conventional damping device 18.

When the apparatus is to be used in paying out the flexible line L along the route of an overhead electric transmission line, the pilot-operated relief valve 12 is preset to the desired oil pressure - and hence the tension at which the flexible line L is to be paid out from the drum is selected - by setting the valve for this oil pressure when the drum is empty. The helicopter from which the apparatus is suspended takes off and the leading end of the flexible line L is lowered and fixed to a pylon or the ground. As the helicopter travels above the route of the transmission line, the flexible line L is paid out from the drum D through the guide 6 at a substantially constant tension, the tension remaining substantially constant as the speed of the helicopter rises from zero to the maximum

value at which the flexible line can be paid out. As the quantity of flexible line L carried by the drum D decreases, the cam 17 carried by the pivoting arm 15 and activated by the feeler 14 automatically adjusts the
5 control valve 16 to decrease the oil pressure in the circulatory hydraulic system and thereby maintain the tension in the flexible line substantially constant even though the quantity of flexible line on the drum is decreasing.



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CLAIMS:

1. For use in paying out a flexible line from a drum suspended from a helicopter, apparatus comprising a carrier which has means for suspending the carrier from a helicopter and which has means for so supporting a drum that, when the carrier is suspended from a helicopter, the drum is rotatable about a substantially horizontal axis; braking means which is mounted on the carrier, which is adapted to be rotatably driven by the drum as a flexible line is paid out therefrom and which will impart to the drum a preset retarding force; control means which is mounted on the carrier and which will automatically decrease the retarding force imparted to the drum by said braking means as the quantity of flexible line on the drum decreases; and, mounted on or carried by the carrier at a position spaced transversely from the axis of rotation of the drum, at least one guide for the flexible line to be paid out from the drum, the arrangement being such that, when the free end of the flexible line is fixed and the helicopter is caused to travel along a desired route, the flexible line will be paid out from the drum smoothly at a substantially constant tension.

2. Apparatus as claimed in Claim 1, wherein the braking means comprises a circulatory hydraulic system comprising a hydraulic pump mounted on the carrier and adapted to be rotatably driven by the drum, a source



of supply of hydraulic fluid connected to the hydraulic pump, and an adjustable relief valve interconnected between said source of supply and the pump by means of which the pressure of the hydraulic fluid in the system can be preset to any desired value within a limited range.

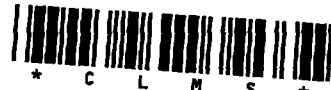
3. Apparatus as claimed in Claim 2, wherein the hydraulic pump is driven via an endless chain which engages a sprocket wheel which rotates with the drum.

10 4. Apparatus as claimed in Claim 2 or 3, wherein the hydraulic fluid is oil.

5. Apparatus as claimed in any one of Claims 2 to 4, wherein the control means comprises a follower for continuously determining the quantity of flexible line on the drum and a control valve interconnected between the source of supply of hydraulic fluid and the relief valve, the follower being operatively connected to the control valve to adjust the valve in such a way as to decrease smoothly the pressure of the hydraulic fluid in the circulatory hydraulic system as the quantity of flexible line on the drum decreases.



6. Apparatus as claimed in Claim 5, wherein the follower comprises a feeler which is pivoted about an axis substantially parallel to the axis of rotation of the drum, rides on the outermost layer of flexible line on the drum, and controls a cam which is adapted to adjust continuously the control valve.
7. Apparatus as claimed in Claim 6, wherein a damping device is operatively connected to the pivoted follower to prevent hunting of the follower.
8. Apparatus as claimed in any one of Claims 2 to 7, wherein means for manually adjusting the control valve and/or the relief valve is provided, which means is suitable for mounting in a helicopter.
9. Apparatus as claimed in any one of the preceding Claims, wherein the carrier is in the form of a fabricated frame comprising a pair of side walls between which a drum can be rotatably supported and a transversely extending trailing portion which carries the guide or guides for the flexible line.



10. Apparatus as claimed in Claim 9, wherein the transversely extending trailing portion carries stabling means for resisting spinning of the carrier when the carrier is being conveyed from one position
5 to another by a helicopter without a flexible line being paid out from a drum mounted on the carrier.
11. For use in paying out a flexible line from a drum suspended from a helicopter, apparatus substantially as hereinbefore described with reference
10 to and as shown in the accompanying drawings.)

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