Feb. 23, 1954

R. T. HAIR

2,670,153

CABLE REELING MECHANISM

Filed Aug. 6, 1953

2 Sheets-Sheet 1

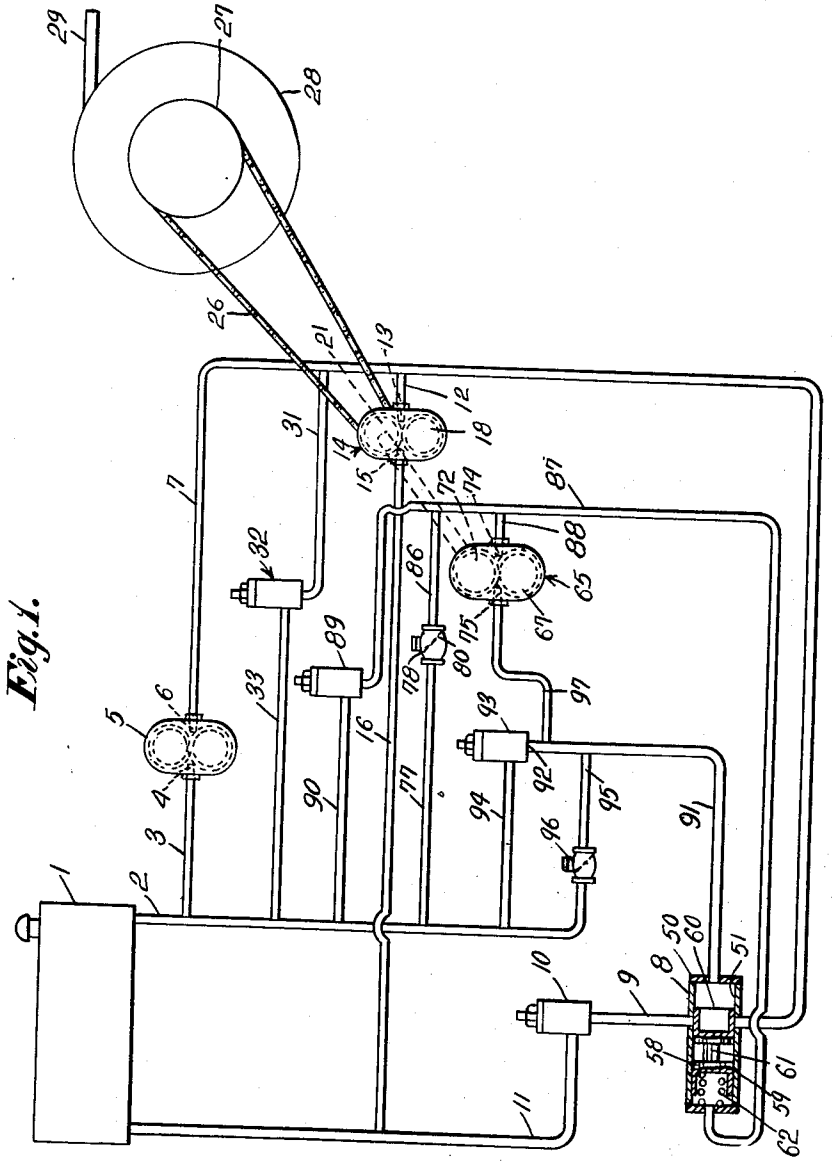

Fig. 1.

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2 Sheets-Sheet 2

Fig. 2.

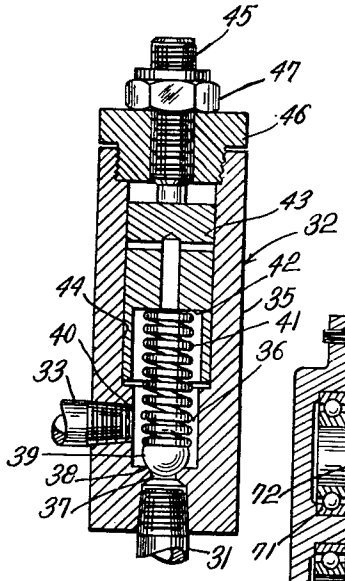


Fig. 6.

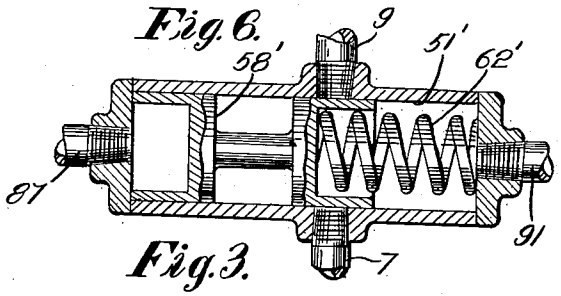


Fig. 3.

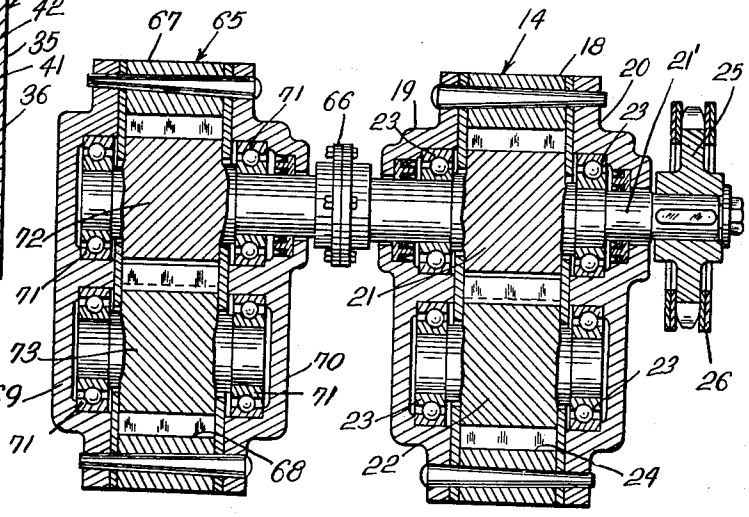


Fig. 4.

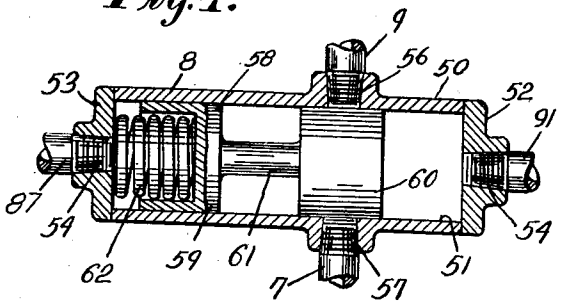


Fig. 5.

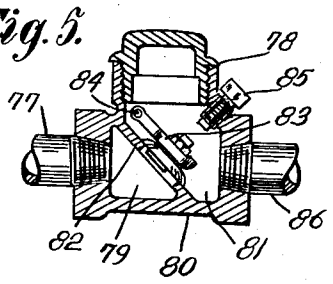
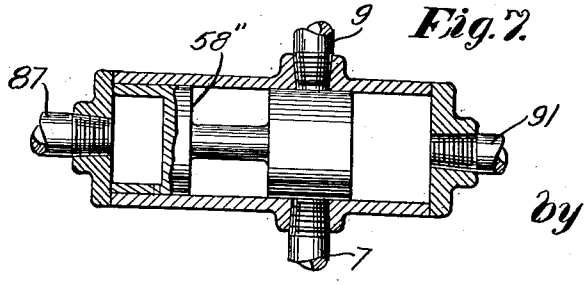


Fig. 7.



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Patented Feb. 23, 1954

2,670,153

UNITED STATES PATENT OFFICE

2,670,153

CABLE REELING MECHANISM

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Application August 6, 1953, Serial No. 372,728

26 Claims. (Cl. 242—90)

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My invention relates to reel driving and controlling mechanisms for vehicles which are propelled by motors to which operating medium is supplied through a flexible member wound upon a reel carried by the vehicle and connected at its free end to a source of operating medium relative to which the vehicle is movable when in use.

This application is a continuation-in-part of application Serial No. 731,124, filed February 26, 1947, and now forfeited.

It is desirable with vehicles of the character described that the reel driving motor be driven in such a manner as to exert a relatively high torque on the flexible member while the vehicle is moving in such a direction that the flexible member might be run over by the vehicle unless such member were kept as fully wound in as is possible. It is desirable, however, when the vehicle is so moving relative to the fixed point of supply mentioned that cable must be pulled off of the reel, that there be automatically effected a substantial reduction in the torque exerted by the reel driving motor, so that the flexible member can be pulled off of the reel under a substantially reduced tension.

An object of my invention is to provide an improved reel driving and controlling mechanism of the character described. Another object of my invention is to provide an improved reel driving and controlling mechanism of the type in which a pump supplies hydraulic fluid under pressure to a motor-pump device connected in driving relation with the reel, said improved mechanism including a plurality of relief valves having different settings, one predetermining the pressure during winding in of the flexible member and the other during paying out thereof, and means for selectively predetermining which one of said pressure relief valves is in control, including a shifter valve. Yet another object of my invention is to provide an improved reel driving and controlling mechanism of the type last mentioned in which there is associated with the shifter valve means for effecting its movements in opposite directions by unbalanced forces respectively existent when said reel is turning in opposite directions. Still another object of my invention is to provide an improved reel driving and controlling mechanism of the type last specified in which there is associated with the shifter valve means for effecting its movements in opposite directions by forces respectively created while said reel is turning in opposite directions. A still further object of my invention is to provide an improved reel driving and controlling mechanism of the type specified

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in the last preceding object of invention in which one of the forces mentioned is produced by reason of rotation of the reel under the tension of the cable. Still another object of my invention is to provide an improved reel driving and controlling mechanism of the type specified in the last preceding object of invention in which means is associated with the shifter valve for normally moving it to one extreme position when the reel is stationary. Yet another object of my invention is to provide an improved reel driving and controlling mechanism of the type mentioned in the second object of invention in which there is associated with the shifter valve means, preferably fluid operated, energized whenever the reel is driven for controlling the shifter valve. Yet another object of my invention is to provide an improved reel driving and controlling mechanism of the type specified in the second object of invention above set forth in which means is provided for subjecting one end of the shifter valve to a hydraulic pressure for moving it in one direction when the reel is to be driven in a winding direction and for subjecting the other end of said shifter valve to a hydraulic pressure for moving it in the other direction when the reel turns the motor-pump device backwardly with respect to its direction of rotation as a motor, when cable is drawn off of the reel. Still another object is to provide an improved reel driving and controlling mechanism of the type specified in the second object of invention above set forth, in which means is provided for automatically moving the shifter valve, if it does not already occupy such a position when the reel ceases to rotate, to a position in which the relief valve which predetermines the pressure during unwinding of the flexible member from the reel is shut off from communication with the motor-pump device. Other objects and advantages of the invention will hereinafter more fully appear.

In the accompanying drawings, in which three embodiments of my invention are shown for purposes of illustration,

Fig. 1 is a schematic diagram showing a reel driving and controlling mechanism in which my invention in one embodiment is incorporated.

Fig. 2 is a central longitudinal sectional view of a pressure relief valve of the type which may be used in the system of Fig. 1.

Fig. 3 is a section on a plane including the axes of rotation of a motor-pump device connected with a reel for driving the latter and adapted to be rotated by the reel when the latter is caused to turn in a reverse direction from that in which it is driven by said motor-pump device,

said view also including a section through a servo-pump rotating with the motor-pump device.

Fig. 4 is a central longitudinal section through a shifter valve shown in Fig. 1.

Fig. 5 is a central longitudinal sectional view through one form of check valve which may be used in the system of Fig. 1.

Fig. 6 is a central longitudinal sectional view through a shifter valve in which means for normally biasing it to a position corresponding to that of Figure 4 is provided.

Fig. 7 is a central longitudinal section through a shifter valve in which the positioning of the valve is determined entirely by the hydraulic pressures applied to its opposite ends.

Referring first to Fig. 1, it will be observed that a reservoir 1 contains oil or other suitable hydraulic medium (not shown) and is connected by communicating conduits 2, 3 with the intake 4 of a gear type fluid-pump 5 (the invention is, of course, not limited to this type of pump) whose discharge connection 6 communicates with a conduit 7. The conduit 7 extends to a shifter valve mechanism 8 from which a conduit 9 leads to a pressure relief valve 10, which is connected by a conduit 11 back to the reservoir 1. The conduit 2 is of substantial length and has a number of other conduits communicating with it in addition to the conduit 3, as will be later described. The conduit 7 also has branch conduits communicating with it.

One branch conduit 12, leading from the conduit 7, communicates with the supply connection 13 of a motor-pump device 14, shown as of the intermeshing gear type; and the discharge connection 15 of the motor-pump device 14 is connected by a conduit 16 with the conduit 11. Accordingly, fluid drawn from the reservoir 1 through a portion of the conduit 2 and the conduit 3 by the pump 5 (which may be driven in any suitable manner by any suitable means, not shown, and rotated continuously while the vehicle with which the system described is used is in use) may be discharged by the pump to the conduit 7 and passed through the conduit 12 to the motor-pump device 14 and, having caused rotation of the latter, may be discharged through the conduit 16 and a portion of the conduit 11 back to the reservoir. The motor-pump device 14 as shown in Fig. 3 includes a casing comprising a body portion 18 and end plates 19 and 20, and has gear type rotors 21 and 22 journaled by suitable bearings 23 in the end plates and supported for rotation in the usual rotor chamber 24 with which, at opposite sides of the mesh line of the rotors, the supply connection 13 and the discharge connection 15 communicate in a well known manner. The rotor 21 constitutes the primary driven member of the motor-pump device, and at one end thereof its shaft 21' carries a sprocket 25 which is connected by a drive chain 26 with a sprocket 27 on a suitable rotatably supported reel 28 which serves for the winding in and the paying out of a flexible power conducting member 29, which, in the case of an electrically powered vehicle, will be in the form of a conductor cable whose free end may be connected to dual trolley wires, in the case of trackless mining, or to a trolley wire and a rail in a mine provided with tracks.

Because it is necessary that some means be provided for preventing an excessive tension being imposed on the flexible member, but also necessary that a very substantial torque on the reel be maintained during cable winding to insure the effective winding in of the flexible member, it is necessary to provide some means for the return of the excess fluid pumped by the pump 5 but not capable of being passed through the motor-pump device 14, and accordingly there is provided a conduit 31 communicating with the conduit 7 and adapted to open through a relief valve mechanism 32 into communication with a conduit 33 which in turn opens into the conduit 2. Conduit 33 could of course equally well open into the conduit 11. A pressure on the order of several hundred pounds per square inch may perhaps be desirably imposed on the motor-pump device 14 while the flexible member 29 is being wound in. The actual pressure employed will depend on a number of factors including the size of the motor-pump device, the ratio of speed reduction between it and the reel, the size of the reel, the weight of the flexible member, etc. The relief valve 32 may assume many different forms, and one possible construction is shown in Fig. 2 where it will be noted that a casing 35 has a valve chamber 36 extending longitudinally thereof and adapted to communicate through an opening 37 surrounded by a valve seat 38 with the conduit 31. A suitable check valve 39 is adapted to cooperate with the valve seat and is arranged in the chamber 36. This chamber also communicates through a side opening 40 with the conduit 33. An adjustably loadable spring 41 cooperates with the ball check valve 39 and engages at its upper end a surface 42 on an abutment member 43 which is slidable in a chamber 44 which communicates with the valve chamber 36. The position of the abutment 43 may be adjusted by an adjusting screw 45 which may be held in different adjusted relations to an end closure member 46 for the chamber 44 by a lock nut 47.

When the flexible member 29 is to be pulled off of the reel 28, due, say, to motion of the vehicle away from the point at which the member 29 is connected, it is desirable to effect a marked reduction in the tension imposed on the flexible member, and this involves a reduction in the resistance to rotation of the reel. This is accomplished, according to my invention, by the provision of means for enabling the discharge of the fluid which will then be pumped by the motor-pump device from the reservoir 1 by way of a portion of the conduit 11 and the conduit 16, through the conduit 12 and into the line 7, and also the fluid pumped by the pump 5, past the relief valve 10, which has a much lower setting than the relief valve 32, into the conduit 11. The relief valve 10, whose structure is essentially the same as that of the relief valve 32, may, in order that it may permit discharge through it at a lower pressure, either have a lighter spring or, if the same spring is used, the loading of the spring may be reduced.

As it is necessary, in order to maintain necessary torque on the reel during cable winding, to prevent communication between the conduit 7 and the lower-pressure-seated relief valve 10 during the winding in of the flexible member, the shifter valve mechanism 8 previously referred to is provided. This shifter valve mechanism, as may be seen from Figs. 1 and 4, in the first embodiment thereof, includes a casing 50 having a bore 51 whose opposite ends are closed in any suitable manner by head elements 52, 53 each traversed by a threaded opening 54. The side walls of the casing 50 are also traversed by threaded openings 56, 57. Within the bore 51 a

piston valve 58, having spaced heads 59 and 60, is reciprocable, the heads connected by a reduced portion or stem 61. A spring 62 is provided to maintain the valve 58 in a position to connect the openings 56, 57 except when the valve is moved from such position by fluid pressure. The conduit 7 is connected in the opening 57, while the conduit 9 is connected in the opening 56.

With the arrangement of the piston valve and the connections 56, 57 as shown in Figs. 1 and 4 and so far described, the valve 58 would normally occupy a position opposite that shown in Figs. 1 and 4 if it were uninfluenced by any pressure except that exerted by the spring 62. In other words, it would occupy a position in which the relief valve 10 would be in communication with the conduit 7. That position corresponds to cable unwinding. To effect the movement of the valve 58 to the position shown in Figs. 1 and 4 at the desired time and its maintenance in that position for the desired periods, I have provided arrangements as follows:

Referring to Figs. 1 and 3, it will be observed that a reversible pump 65 which is shown as essentially a duplicate of the motor-pump device 14 but which may obviously be made smaller than the latter if desired, is connected in any suitable manner—shown in Fig. 3 as by a flange coupling 66—so that it is driven whenever the motor-pump device 14 is rotating. Its casing 67 contains a rotor chamber 68 and it has end heads 69, 70 in which by means of any suitable bearings 71, rotors 72, 73 are journaled. Connections 74 and 75 open into the casing adjacent to but at opposite sides of the mesh line of the rotors 72 and 73. The connections of this reversible pump to the shifter valve and the other portions of the mechanisms may now be noted. It is desired that the pump 65 shall be able to draw in fluid through either the connection 74 or the connection 75 and shall be able to discharge fluid from whichever one of these connections is not serving as an intake. It is desired that each of these connections, when serving as a discharge, shall be able to supply fluid to one end of the piston valve 58. Since the shifter valve, after being once moved from one end of its casing to the other, is capable of no further movement in that direction, it is desirable that the fluid pumped by the reversible pump 65 be discharged with as low a back pressure as is permitted by the necessity for maintaining the shifter valve in the positions to which it may move. With these objectives, a conduit 77 is extended from the conduit 2 to a check valve 78 which may be of any suitable form. A suitable construction for this valve is shown in Fig. 5, where it will be noted that the connection 77 leads into a chamber 79 in a valve casing 80. The chamber 79 is separated from another chamber 81 by a ported septum 82, and a hingedly supported valve 83 swingable about a pivot axis 84 in the casing is movable to permit flow of fluid from the chamber 79 to the chamber 81 but to prevent opposite flow. An adjustable stop 85 is provided for limiting the degree of opening of the check valve. A conduit 86 connects the chamber 81 with a conduit 87, one end of which is secured in one threaded opening 54 in the casing of the shifter valve mechanism 8. The conduit 87 is connected with the connection 74 of the reversible pump by a conduit 88. The other end of the conduit 87 opens into a pressure relief valve 89, and upon the unseating of

the valve element of the pressure relief valve 89, fluid may pass through a conduit 90 into the conduit 2. The construction of the relief valve 89 may be very similar to that of the relief valves 32 and 10, but the setting will be desirably lower than even that of the relief valve 10. Another conduit 91 is fixed at one end in the other opening 54 in the casing of the shifter valve 8, and at its other end opens at 92 into the end of a pressure relief valve 93 which, when its associated valve element (not shown) opens, is adapted to permit discharge through a conduit 94 into the conduit 2. A branch conduit 95 off the conduit 91 is adapted to have fluid supplied to it under circumstances later explained from the conduit 2 through a check valve 96 in all particulars similar to the check valve 78. The conduit 91 is connected by another conduit 97 with the connection 75 of the reversible pump 65. The setting of the relief valve 93 may be essentially the same as that of the relief valve 89. Conduits 90 and 94 might connect to conduit 11, instead of to conduit 2, if desired.

It will be observed that when the rotor 72 turns in the direction in which the rotor 21 rotates when the motor-pump device 14 is acting to effect driving of the reel 28 in a direction to wind in the flexible member 29, fluid will be drawn from the conduit 2 through the conduit 77, past the check valve device 78, through the conduit 86, through a portion of the conduit 87, through the conduit 88, into the casing of the reversible pump 65 through the connection 74, and be discharged through the connection 75 to the conduit 97, and pass in part through the conduit 91 into the right-hand end of the chamber 51 of the shifter valve, and move the valve element 58 to the position shown in Figs. 1 and 4, in which position communication between the conduits 7 and 9 is cut off, and the fluid forced by the reversible pump 65 through the conduit 97 will be maintained by the relief valve 93 under a pressure sufficient to hold the valve member 58 in the position desired, but will be delivered through the conduit 94 back into the line 2. Accordingly, since communication between the conduits 7 and 9 will be cut off, the motor-pump device 14 will be subjected to a pressure which will be determined by the high-set relief valve 32, and the motor-pump device 14 will exert on the reel 28 a torque suited to the certain drawing in of the cable in the desired manner.

If now, through movement of the vehicle supporting the reel 28 and associated mechanism away from the point of connection of the free end of the flexible connection 29, the motor-pump device 14 is driven in a direction to cause it to perform its pumping function and to take fluid through the conduits 11 and 16 from the reservoir 1 and displace that fluid through the conduit 12 into the line 7 into which the pump 5 is also delivering, there will be a reversal in the rotation of the rotor 72, in this new direction of rotation of the rotor 21, and the rotors 72 and 73 will then cooperate to draw fluid from the line 2 past the check valve device 96, through the conduit 95, and through a portion of the conduit 91 and through the conduit 97 and into the casing 67 through the opening 75, and to discharge this fluid through the opening 74 and the conduit 88 into the conduit 87 where the pressure under which it is placed will be transmitted to act on the left-hand head 59 of the piston valve 58 and move the piston valve if the spring 62 has not already done this, to the opposite position from

that shown in Figs. 1 and 4, and thus establish communication between the conduits 7 and 9, excess pumped fluid in the conduit 87 being discharged past the relief valve 89 and through conduit 90 to conduit 2. As a result, the fluid pumped by the pump 5 and by the motor-pump device 14 will discharge from the conduit 7 through the space between the heads 59 and 60 of the piston valve 58, through the conduit 9, and through the relief valve 10—the low set relief valve—into the conduit 11 and back to the reservoir. As a result, the reel will be rotatable without the imposition of a high tension on the flexible member 29 and without the heating of the oil that would result with a higher pressure imposed on the volume of oil displaced, but yet under a resistance sufficient to prevent spinning or overrunning.

It will be evident that when the motor-pump device 14 is rotated in the direction in which it turns when cable is being pulled off the reel, the reversible pump 65 will create a suction in the conduit 97, and the resultant reduction in pressure in the bore 51 to the right of the head 60 would permit the spring 62, even without the supply of pressure through the conduit 87 to the left of the valve 58, to move the valve 58 to connect the conduits 7 and 9.

The shifter valve mechanism 8 may have the spring 62 disposed in either end thereof, depending upon whether it is desired to have the normal position of this valve such as to impose the high or low back pressure on the line 7 in the so-called normal position of the valve element 58, and it is even possible to omit the use of a spring in association with the valve 58.

One thing to be noted about the reversible pump 65 is that such devices have sufficient internal clearances so that different pressures existing at the opposite side of the mesh line of their teeth when they stop, rapidly equalize, and, accordingly, if, with the arrangement such as is shown in Figs. 1 to 5, rotation of the reel 28 ceases at the end of a period of rotation in a winding-in direction, during which period the reversible pump 65 has been delivering fluid to maintain the valve 58 in the position shown in Figs. 1 and 4, the spring 62 will be able very quickly to move the valve 58 to its right-hand position, interconnecting the conduits 7 and 9, and thus during a period when the vehicle is moving in neither direction the fluid still pumped by the pump 5 will discharge through the low-pressure-set relief valve 10 instead of having to be discharged past the high-pressure-set relief valve 32. The somewhat reduced heating of the hydraulic fluid which results from this arrangement is offset as an advantage by the facts that the torque exerted by the motor-pump device 14 on the reel 28, if the vehicle starts to move in a direction to make winding-in of the cable 29 necessary, will initially be low, and only as the motor-pump device commences to turn the reel in a winding-in direction will the reversible pump 65 build up a pressure in the conduit 91 that will throw the valve 58 to the position shown in Figs. 1 and 4 and thereby cause the torque exerted by the motor-pump device to be built up to the value which is desirable for cable winding.

By locating the spring 62' in the end of the chamber 51' opposite the one in which it is shown disposed in Figs. 1 and 4 the valve 58' will be caused, as shown in Fig. 6, normally to occupy the position in which its head 60 shuts off communication between conduits 7 and 9, and accordingly, with the arrangement of Fig. 6, in which the spring is located in the right-hand end of the chamber 51', the normal position of the valve when the reel is stationary for more than the briefest period will be such as to cause all the fluid displaced by the pump 5 to have to be discharged through the high-pressure-set relief valve 32, and so the cable 29 will always be maintained taut, under a substantial tension, whenever the vehicle is still, and the instant the vehicle begins to move in a direction to make possible the winding-in of cable, cable will be wound in under the higher tension produced by the motor-pump device when the latter is supplied with fluid at a pressure determined by the setting of the high-pressure-set relief valve 32. When cable must be unwound from the reel 28, the reversible pump 65 will be driven in such a direction as to supply fluid to the left end of the chamber 51' and the valve 58' will be moved, in opposition to the spring 62', to permit cable to be drawn off the reel under a tension determined by the setting of the low-pressure-set relief valve 10. The valve 58', if not previously moved to the left by the spring, would be moved to its extreme left-hand position by fluid displaced by the reversible pump 65 as soon as the vehicle began to move in a direction necessitating winding-in of the cable 29. However, if there were, between a period of paying off cable and a period of winding-in cable, the brief time necessary for equalization of pressures at the opposite sides of the reversible pump 65 the spring 62' would automatically move the valve 58' to the left and cause the motor-pump device to exert the desired higher winding-in torque on the reel. Under such circumstances all fluid displaced by the pump 5 while the vehicle is stationary would have to be discharged through the high-pressure-set relief valve 32, with a resultant somewhat undesirable increased heating of the hydraulic fluid, but this small disadvantage would be offset by the fact that the reel would commence instantly to wind in cable under the higher tension as soon as the vehicle commenced to move in a direction causing cable winding-in to be desirable.

It is entirely possible to dispense altogether with any spring in association with the shifter valve. Since the throwing pressures exerted on the shifter valve through the conduits 87 and 91 are determined wholly by the direction of rotation of the reversible pump 65 the valve 58'' in Fig. 7, in which there is no spring illustrated in association with the valve, will be thrown to one position or the other as soon as movement in one direction or the other of the vehicle determines in what direction the reversible pump 65 will turn.

When the vehicle is moving in a direction to permit cable to be wound in, the reversible pump 65 will cause fluid pressure to maintain the valve 58'' in the position shown in Fig. 7 thereby causing the motor-pump device to exert its higher torque on the reel. If the vehicle moves in a direction to necessitate the paying off of cable the reversible pump 65 will supply fluid to the conduit 87 and move the valve 58'' to effect interconnection of the conduits 7 and 9 and the development by the motor-pump device 14 of a torque suitable to the drawing off of cable from the reel. As the valve 58'' is a balanced valve, there will be no tendency, in the absence of a spring, for it to shift from either position it oc-

cupies under a pressure imposed on one of its ends, to its opposite position, when said pressure is simply dissipated. Accordingly if the vehicle stops at the end of a period of winding-in of the cable, the valve 58'' will remain in its left hand position, and if the vehicle then moves in a direction to call for further winding-in of cable the cable will be wound in under the proper higher tension. If the vehicle starts to move, after stopping with the valve 58'' in left-hand position, in a direction to make pulling off of cable necessary the valve 58'' will be shifted to the right, and permit the low-pressure-set relief valve 10 to become effective, just as soon as the reversible pump 65 creates the necessary throwing pressure for the valve. If the vehicle stops after a period of cable unwinding, the valve 58'' will remain in right-hand position, and, accordingly, if the vehicle starts to move in a direction making the winding-in of cable necessary, the initial torque applied to the reel will not be the maximum torque, but as soon as the reversible pump 65 commences to rotate, as it will immediately, the valve 58'' will be shifted to the left and the torque exerted by the motor-pump device will immediately increase to the desired value determined by the high-pressure-set relief valve 32, as soon as the low-pressure-set relief valve 10 is shut off from communication with the conduit 7 by the shifting of the valve 58'' to the left.

It will be noted from what has been said that the use of a spring at either end of the shifter valve or the complete omission of spring in association with the shifter valve are all possible within the scope of my invention from its broader aspects.

From the foregoing description, it will be evident that I have provided simple and highly effective arrangements for insuring a reduction in the torque imposed by the motor-pump device 14 on the reel 28 whenever cable must be drawn off of the reel, arrangements in which there is no necessity for the use of electrical devices or slip friction mechanisms, and ones in which the positive and reliable characteristics of hydraulic devices are made applicable to all phases of the operation.

While there are in this application specifically described three forms which the invention may assume in practice, it will be understood that these forms of the invention have been shown for purposes of illustration, and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In combination, a winding reel adapted to have a power conductor wound thereon and to wind in the conductor or to have the conductor drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure, and means for precluding release at said relatively lower pressure while the motor-pump device is operating as a motor including a valve and another pump rotated with said motor-pump device for controlling the positioning of said valve.

2. In combination, a winding reel adapted to have a power conductor wound thereon and to wind in the conductor or to have the conductor drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure, and means for precluding release at said relatively lower pressure while the motor-pump device is operating as a motor and for permitting such release when the motor-pump device is rotated by said reel, including a shifter valve and means for supplying fluid to move said shifter valve in opposite directions including a further pump rotatable with said reel.

3. In combination, a winding reel adapted to have a power conductor wound thereon and to wind in the conductor or to have the conductor drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure, and means for precluding release at said relatively lower pressure while the motor-pump device is operating as a motor and for permitting such release when the motor-pump device is rotated by said reel, including a shifter valve and means, including a further pump rotatable with said reel, for exerting substantial pressures on said valve in one direction or in an opposite one depending on the direction of motor-pump device rotation.

4. In combination, a winding reel adapted to have a power conductor wound thereon and to wind in the conductor or to have the conductor drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure, and means for determining whether release shall occur at said relatively high pressure or at said relatively lower pressure including a reversible pump operatively connected to said reel for rotation therewith and valve means controlled by the fluid discharged by said reversible pump.

5. In combination, a winding reel adapted to

have a power conductor wound thereon and to wind in the conductor or to have the conductor drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure, and means for determining whether release shall occur at said relatively high pressure or at said relatively lower pressure including a reversible pump operatively connected to said reel for rotation therewith and valve means connected with said reversible pump to receive at spaced points the fluid pumped by such pump as it is reversed.

6. In combination, a winding reel adapted to have a power conductor wound thereon and to wind in the conductor or to have the conductor drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure, a further pump rotatable with said reel, and fluid actuated valve means operated by fluid pumped by said further pump while said reel is winding in cable for precluding release at said relatively lower pressure while the motor-pump device is operating as a motor.

7. In combination, a winding reel adapted to have a power conductor wound thereon and to wind in the conductor or to have the conductor drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure, and means for precluding release at said relatively lower pressure while the motor-pump device is operating as a motor including a valve shiftable to predetermine the minimum pressure at which release occurs and common means for generating and for exerting on said valve oppositely directed fluid pressures during opposite directions of reel rotation.

8. In combination, a winding reel adapted to have a cable wound thereon and to wind in the cable or to have the cable drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir at a relatively high pressure and at a relatively lower pressure, and means for precluding release at the relatively lower pressure while the motor-pump device is operating as a motor including a control element and means for moving the same including a pump rotated with said reel.

9. In combination, a winding reel adapted to have a cable wound thereon and to wind in the cable or to have the cable drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure each including a yieldably loaded relief valve individual thereto and having its own relief line, and means for precluding release through the second mentioned fluid releasing means while the motor-pump device is operating as a motor including a valve in the relief line associated with said second mentioned fluid releasing means and operating means therefor including a pump rotated with the reel.

10. In combination, a cable winding reel, a motor for driving said reel to wind in cable and driven backwards by said reel when cable is pulled off of the latter, power supply means for said motor, and means for increasing the torque exerted by said motor when driving said reel in a winding direction and for reducing the torque exerted by said motor when it is driven backwards including an element movable to different positions to effect such changes in torque and fluid operated means for said element having a fluid supply source comprising a pump connected to turn with said motor.

11. In a cable reeling mechanism adapted to supply power to a moving vehicle, a winding drum adapted to have a cable wound thereon, a fluid motor for driving said drum in a direction to wind cable thereon, a fluid pump, a pressure line connecting said pump to said motor and having relief means associated therewith for relieving pressure therefrom to preclude excessive tension on the cable during winding in, said motor being driven by said winding drum as a pump during the unwinding operation and exerting a torque to maintain tension on said cable during unwinding, and means for relieving pressure from said motor when driven as a pump, but permitting said pump to maintain a back pressure on said motor sufficient to maintain tension on said cable during the unwinding operation and to initiate resumption of winding when cable tension is reduced by vehicle movement, including relief means for relieving pressure at a substantially lower value than is requisite to operate said first mentioned relief means, and means for preventing relief by said second mentioned relief means during cable winding including a device for blocking relief thereby and a control for said device comprising a reversible pump driven with the drum.

12. In a cable reeling mechanism adapted to supply power to a moving vehicle, a winding drum adapted to have a cable wound thereon, a fluid motor for driving said drum in a direction to

wind cable thereon, a fluid pump, a pressure line connecting said pump to said motor and having relief means associated therewith for relieving pressure therefrom to preclude excessive tension on the cable during winding in, said motor being driven by said winding drum as a pump during the unwinding operation and exerting a torque to maintain tension on said cable during unwinding, and means for relieving pressure from said motor when driven as a pump, but permitting said pump to maintain a back pressure on said motor sufficient to maintain tension on said cable during the unwinding operation and to initiate resumption of winding when cable tension is reduced by vehicle movement, including relief means for relieving pressure at a substantially lower value than is requisite to operate said first mentioned relief means, and means for preventing relief by said second mentioned relief means during cable winding including a device for blocking relief thereby and a control for said device comprising means for biasing said device in one direction and a pump driven with the drum for alternatively subjecting said device in the other direction to a pump produced pressure exceeding the force exerted by said biasing means and withdrawing such pressure.

13. In a cable reeling mechanism adapted to supply power to a moving vehicle, a winding drum adapted to have a cable wound thereon, a fluid motor for driving said drum in a direction to wind cable thereon, a fluid pump, a pressure line connecting said pump to said motor and having relief means associated therewith for relieving pressure therefrom to preclude excessive tension on the cable during winding in, said motor being driven by said winding drum as a pump during the unwinding operation and exerting a torque to maintain tension on said cable during unwinding and when unwinding ceases, and means for relieving pressure from said motor when driven as a pump, but permitting said pump to maintain a back pressure on said motor sufficient to maintain tension on said cable during the unwinding operation, including relief means for relieving pressure at a substantially lower value than is requisite to operate said first mentioned relief means and means for rendering said second mentioned relief means ineffective during winding in of the cable including a shifter valve and means for subjecting it to throwing pressures including a reversible pump driven when the drum is turning, lines from said reversible pump leading to said valve, check valve controlled supply connections communicating with said lines and relief valve controlled surplus fluid release lines also communicating with said lines.

14. In a cable reeling mechanism adapted to supply power to a moving vehicle, a winding drum adapted to have a cable wound thereon, a fluid motor for driving said drum in a direction to wind cable thereon, a fluid pump, a pressure line connecting said pump to said motor and having relief means associated therewith for relieving pressure therefrom to preclude excessive tension on the cable during winding in, said motor being driven by said winding drum as a pump during the unwinding operation and exerting a torque to maintain tension on said cable during unwinding and when unwinding ceases, and means for relieving pressure from said motor when driven as a pump, but permitting said pump to maintain a back pressure on said motor sufficient to maintain tension on said cable during the unwinding operation, including relief means for relieving pressure at a substantially lower value than is requisite to operate said first mentioned relief means and means for rendering said second mentioned relief means ineffective during winding in of the cable including a shifter valve and means for subjecting it to throwing pressures to control its position including a pump driven when the drum is turning, means for constantly biasing said valve in one direction and a line from said pump for delivering fluid to said valve to overcome said biasing means.

15. In a cable reeling mechanism adapted to supply power to a moving vehicle, a winding drum adapted to have a cable wound thereon, a fluid motor for driving said drum in a direction to wind cable thereon, a fluid pump, a pressure line connecting said pump to said motor and having relief means associated therewith for relieving pressure therefrom to preclude excessive tension on the cable during winding in, said motor being driven by said winding drum as a pump during the unwinding operation and exerting a torque to maintain tension on said cable during unwinding and when unwinding ceases, and means for relieving pressure from said motor when driven as a pump, but permitting said pump to maintain a back pressure on said motor sufficient to maintain tension on said cable during the unwinding operation including relief means for relieving pressure at a substantially lower value than is requisite to operate said first mentioned relief means and means for rendering said second mentioned relief means ineffective during winding in of the cable including a shifter valve and means for subjecting it to oppositely acting pressures to control its position including means for constantly biasing said valve in one direction and a pump driven when said drum is turning in a direction to wind in cable, a line from said pump leading to said valve, a check valve controlled supply connection leading to said pump and a relief valve controlled surplus fluid release line communicating with said first mentioned line.

16. In a cable reeling mechanism adapted to supply power to a moving vehicle, a winding reel adapted to have a cable wound upon it, a motor-pump device operable as a motor to drive said reel in a direction to wind cable thereon, a fluid pump, a pressure line connecting said pump to said motor-pump device, said motor-pump device being rotatable by said winding reel to cause the same to operate as a pump when cable is pulled off of the reel, and means for imposing on said motor-pump device a predetermined supply pressure when it is operating as a motor and a lower back pressure when it is being driven by the reel and acting as a pump, including a valve element movable to different positions to effect said changes in pressure and means for pumping fluid to throw the same when cable is being drawn off of the reel.

17. In a cable reeling mechanism adapted to supply power to a moving vehicle, a winding reel adapted to have a cable wound upon it, a motor-pump device operable as a motor to drive said reel in a direction to wind cable thereon, a fluid pump, a pressure line connecting said pump to said motor-pump device, said motor-pump device being rotatable by said winding reel to cause the same to operate as a pump when cable is pulled off of the reel, and means for imposing on said motor-pump device a predetermined supply pressure when it is operating as a motor and a lower back pressure when it is being driven by the reel and acting as a pump, including a valve element movable to different positions to effect said

changes in pressure and means for pumping fluid to throw the same when cable is being wound on the reel.

18. In combination, a winding reel having a cable thereon adapted to be wound in or unwound, a motor connected to said reel to drive the latter to wind in the cable when supplied with operating medium and to be driven backwards by the reel when cable is pulled off of the reel, means for supplying operating medium to said motor to drive the same to effect winding in of said cable, said operating medium supply means including a device movable to reduce the force required to drive the motor backwards as compared with the force exerted by the motor when driving the reel, and means for subjecting a surface on said device to an operating pressure when the reel is rotated by the tension of the cable including fluid pumping means turning with said motor and said reel at such time.

19. In combination, a winding reel having a cable thereon adapted to be wound in or unwound, a motor connected to said reel to drive the latter to wind in the cable when supplied with operating medium and to be driven backwards by the reel when cable is pulled off the reel, means for supplying operating medium to said motor to drive the same to effect winding in of said cable, said operating medium supply means including a device movable to reduce the force required to drive the motor backwards as compared with the force exerted by the motor when driving the reel and to increase the force exerted by the motor on the reel, when the reel is being driven by the motor, as compared with the force exerted by the motor when the reel is driving the motor backwards, and means for effecting movement of said device to opposite positions including fluid pumping means turning with the motor and reel and resilient means, said resilient means and the fluid pumped by said motor acting on said device to control the position of said device.

20. In combination, a winding reel adapted to have a cable wound thereon and to wind in the cable or to have the cable drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure each including a yieldably loaded relief valve individual to it and responsive, as regards opening, to the pressure it relieves, and means including a fluid placed under pressure at both of said times for precluding release through the second mentioned fluid releasing means while the motor-pump device is operating as a motor and for rendering said second mentioned fluid releasing means operative when said motor-pump device is operated as a pump.

21. In a cable reeling mechanism, a cable reel, a fluid motor for driving said reel in winding direction only, said motor when said reel is rotating in unwinding direction running backwards and acting as a pump to retard such reel rotation, and means including a pump driven by the reel as the latter rotates in unwinding direction for effecting a reduction in pressure on the discharge side of said motor when the latter is operating as a pump to lower the resistance to reel rotation.

22. In a cable reeling mechanism, a cable reel, a fluid motor for driving said reel in winding direction only, said reel as it rotates in unwinding direction effecting drive of said motor in a reverse direction whereby said motor acts as a pump to retard such reel rotation, and means including a pump driven as said reel rotates in unwinding direction for creating a pressure to effect a reduction of the pressure at the discharge side of said motor when the latter is acting as a pump to lower the resistance to reel rotation.

23. In a cable reeling mechanism, a cable reel, a fluid motor for driving said reel only in winding direction, said reel as it rotates in unwinding direction effecting drive of said motor backwards to cause the latter to act as a pump to retard reel rotation, a fluid actuated valve normally held closed during reel rotation in winding direction and movable to open position to reduce the back pressure on said motor as the latter acts as a pump, and a pressure generator driven by said reel as the latter rotates in unwinding direction for subjecting said valve to a throwing pressure to effect valve movement to open position, said pressure generator as said reel is rotated in winding direction subjecting said valve to a pressure for holding said valve closed.

24. In a cable reeling mechanism, a cable reel, a fluid motor for driving said reel only in winding direction, said reel as it rotates in unwinding direction effecting drive of said motor in a reverse direction whereby said motor acts as a pump to retard such reel rotation, fluid actuated valve means ineffective during reel rotation in winding direction and effective when said reel rotates in unwinding direction to reduce the back pressure on said motor when the latter is acting as a pump, a controlling valve movable to determine when said valve means shall be effective, and pressure generating means other than said fluid motor and driven when said reel is rotated in unwinding direction for subjecting said valve to a throwing pressure to move the same to render said valve means effective as aforesaid.

25. In combination, a winding reel adapted to have a power conductor wound thereon and to wind in the conductor or to have the conductor drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure, and means for precluding release at said relatively lower pressure while the motor-pump device is operating as a motor and for permitting such release when the motor-pump device is rotated by said reel, including a shifter valve and controlling means for the position of the latter providing forces for moving it in opposite directions including a pump connected to turn with the reel and discharging fluid to act on said shifter valve.

26. In combination, a winding reel adapted to

have a power conductor wound thereon and to wind in the conductor or to have the conductor drawn off therefrom, a reservoir for a hydraulic fluid, a pump having driving means, a motor-pump device, a driving connection between the motor-pump device and the reel, a connection between the reservoir and the pump, a connection between the pump and the motor-pump device, a connection between the motor-pump device and the reservoir, means for releasing fluid from the connection between the pump and the motor-pump device to the reservoir including means for releasing fluid at a relatively high pressure and means for releasing fluid at a relatively lower pressure, and means for precluding release at said relatively

lower pressure while the motor-pump device is operating as a motor and for permitting such release when the motor-pump device is rotated by said reel, including a shifter valve and controlling means for the position of the latter providing forces for moving it in opposite directions including a pump connected to turn with the reel and resilient means biasing said shifter valve in one direction.

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