United States Patent [19]

Hamilton

[11] **3,776,519**

[45] **Dec. 4, 1973**

[54] **CABLE HANDLING APPARATUS**

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[73] Assignee: **Fairey Winches Limited,** Devon, England

[22] Filed: **Jan. 11, 1972**

[21] Appl. No.: **217,021**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 17,066, March 6, 1970.

[52] **U.S. Cl.** ..... **254/175.5,** 242/83, 242/54 R

[51] **Int. Cl.** **B66d 1/76**

[58] **Field of Search** ..... 254/175.7, 175.5; 242/54 R, 83; 74/230.24

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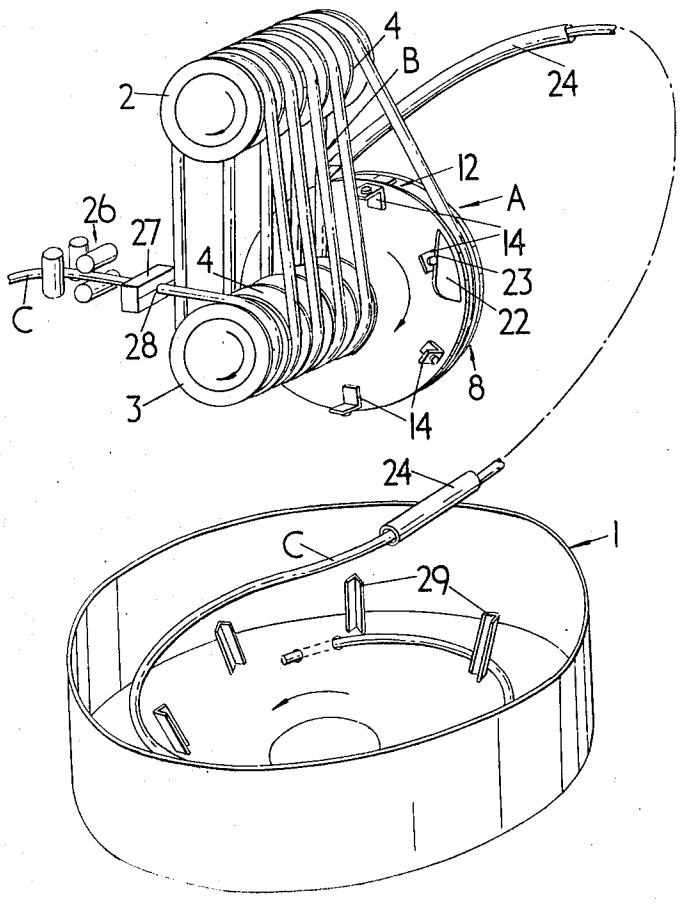
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Assistant Examiner—James L. Rowland
Attorney—Arthur E. Dowell, Jr. et al.

[57] **ABSTRACT**

The winch includes two spaced, parallel, circumferentially-grooved driven drums, a rotary cable-driving member defining an annular groove, and rollers, gripping elements or other means for retaining a cable in the groove. The drums and driving member are rotated from a source of rotary power. During drawing-in, the cable passes through a guide, around successive drums in successive grooves thereof, around part of the annular groove of the driving member, and then through a guide conduit into a storage space. The cable is under tension as it passes from the final drum groove to the annular groove defined by the driving member.

14 Claims, 7 Drawing Figures



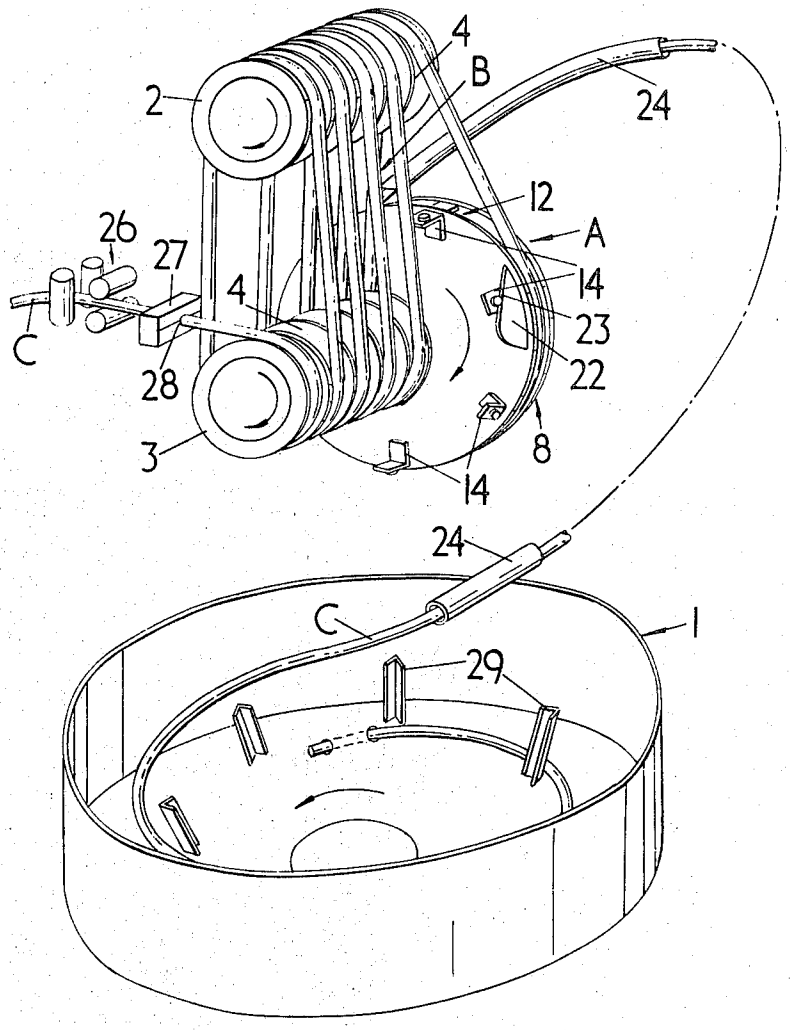


FIG. 1.

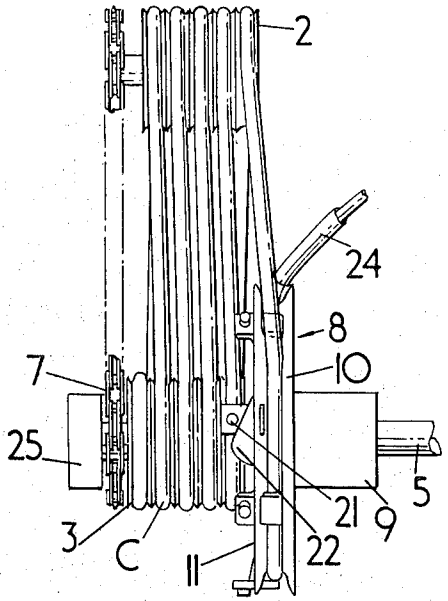


FIG. 2.

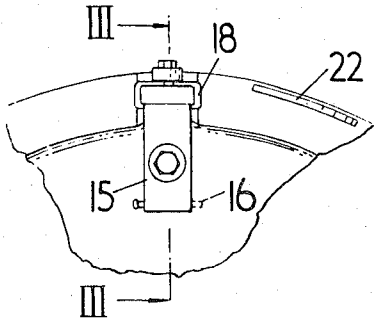


FIG. 4.

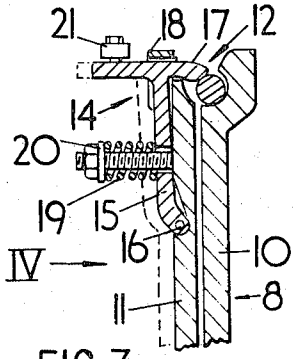


FIG. 3.

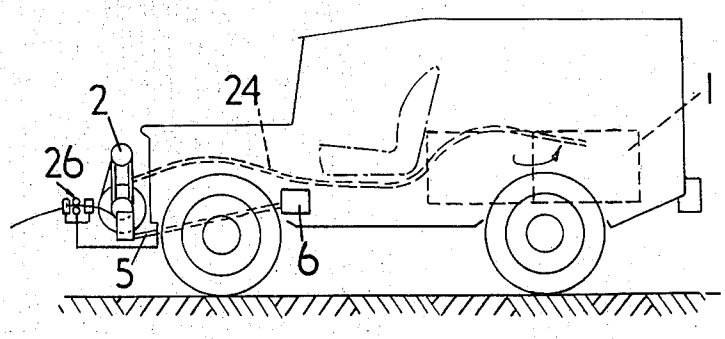


FIG. 5.

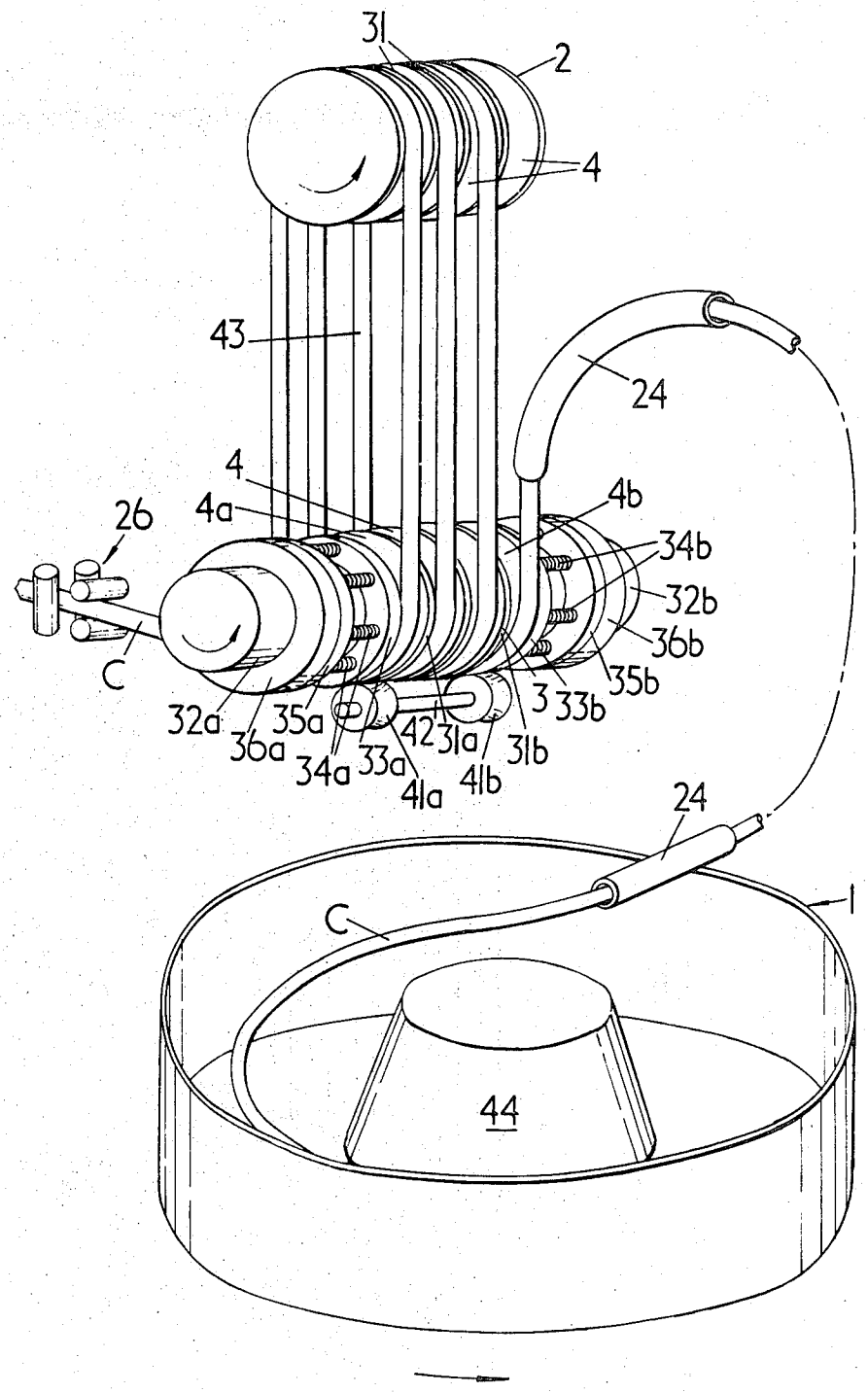

31
2
4
43
24
4
4a
4b
26
34b
32b
36b
35b
C
3
33b
32a
35a
42
31a
31b
36a
34a
33a
41a
41b
24
C
1
44

FIG.6.

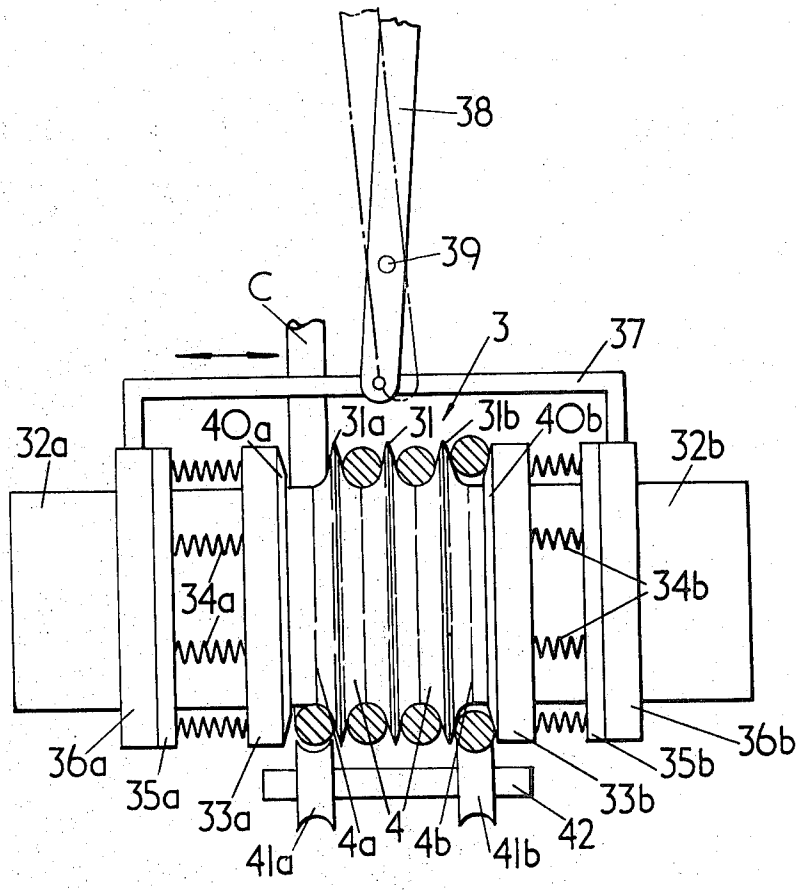

38
39
C
3
37
40a
31a
31
31b
40b
32a
32b
34a
34b
36a
35a
33a
41a
4a
4
4b
41b
42
33b
35b
36b

FIG.7.

CABLE HANDLING APPARATUS

This application is a continuation-in-part of application Ser. No. 17066 "Cable Handling Apparatus" of William Roy Hamilton, filed Mar. 6th, 1970. The benefit of the filing date of the parent application is hereby claimed.

This invention relates to cable winches. Such cable winches may be used for hauling in cable, rope, strand, or like flexible elongate members.

The invention is more particularly, but not exclusively, applicable to portable cable winch installations and cable winches adapted to be mounted on motor vehicles.

In some known cable winches, particularly vehicle mounted winches, a rotary drum is driven from the vehicle engine, usually through the gearbox of the vehicle, and acts as a storage drum for the winch cable. The size of the winch drum and, therefore, the amount of cable that can be stored thereon, is in practice limited by the torque which is available to drive the drum, the torque required increasing progressively as the cable is wound on the drum. Moreover, space in the usual mounting position of a winch drum on a vehicle (that is, at the front of the vehicle) is usually restricted.

One of the objects of the present invention is to provide a cable winch in which cable can be stored in a separate space remote from the paying-out and drawing-in apparatus without the necessity of a powered storage drum in the storage space.

The present invention provides a cable winch comprising: (a) cable guide means; (b) two spaced, parallel, circumferentially grooved driven drums; (c) a rotary cable driving member defining an annular groove; (d) means for retaining the cable in said groove over a part of its circumference; (e) a cable storage space; (f) a cable guide conduit extending from said driving member to said cable storage space for conducting cable to and from said space when the winch is drawing-in and paying-out cable respectively; (g) a source of rotary power; and (h) means for rotating said drums and said driving member from said source so that, upon drawing-in of the cable, the cable will pass through said cable guide means, around successive drums in successive grooves thereof, around said part of the groove defined by the driving member, the cable being under tension as it passes from the final drum groove to the groove defined by the driving member, and then through said guide conduit into said storage space.

Since the cable driving member grips the cable positively on drawing-in the cable it can push the cable through the cable guide conduit to the storage space. The cable guide conduit can have any convenient shape, provided sharp curvature is avoided, and accordingly the cable storage space can be located at a suitable position, for example in the main body of a vehicle, providing for storage of a large length of cable. Moreover, since the cable is fed into and withdrawn from the storage space by the driving member, it is not necessary to provide a positively driven storage drum or reel in the storage space: a freely rotatable cable storage container is guite suitable for this purpose.

It is preferable for the drums to be mechanically linked to rotate in synchronism, for instance by a chain; alternatively, worms mounted on a common, driven shaft may engage with respective worm wheels rigid with the respective drums.

The means for retaining the cable in the groove of the driving member may comprise movable cable gripping elements on the said member, means on the said member normally urging the gripping elements into operative positions wherein the cable is tightly gripped in the groove, and means for releasing the gripping elements as they pass two stationary stations upon rotation of the driving member to permit feeding of the cable onto and withdrawl of the cable from the driving member at these stations.

Means are preferably provided for rendering the gripping elements of the rotary driving member ineffective to grip the cable when the latter is paying-out around the groove. Said means for rendering the gripping elements ineffective preferably comprise an actuator coupled to a peripheral portion of the driving member which is movable, upon operation of the actuator, away from the remainder of the driving member to render it impossible for the gripping elements to grip the cable.

Each of the gripping elements on the driving member may be spring-biased into its operative position and may carry a cam follower roller which engages suitably shaped cams provided at the two positions at which release of the gripping elements is required.

In a preferred embodiment the driving member comprises a pair of elements mounted at one end of one drum so as to rotate with this drum, the elements defining an annular groove substantially coaxial with this drum to receive the last turn of cable, the groove widening outwardly, and means for biasing the two members towards one another so as to force the last turn of cable radially outwardly, the means for retaining the cable in the groove over part of its circumference being arranged so as to retain the cable in the groove at a radius such that the cable entering the annular groove from the other drum is under tension.

when the cable passes through the winch in the reverse direction (paying out) there may be some tendency for the cable to be loose as it passes onto the drums, and it is therefore preferable to provide means for rendering the biasing means inoperative.

It is convenient for one element to be axially fixed with respect to the drum (preferably by being integral or solid with the drum) while the other element is axially movable. In this case it is preferable for the biasing means to act on the axially movable member to bias it towards the axially fixed one. The biasing means may conveniently act between the axially movable member and a stop; means may be provided for moving the stop with respect to the axially movable member to render the biasing means inoperative.

In some circumstances it will be impracticable to pay out cable through the winch by hand, especially if a large length of cable is provided. In this case it will be expedient to provide a second driving member at the end of one of the drums opposite to the first-mentioned member. The biasing means of one arrangement will be operative while the biasing means of the other are inoperative. It is convenient for the two driving arrangements to be at opposite ends of the same drum.

The invention will now be described further, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic perspective view of a cable winch according to one embodiment of the invention;

FIG. 2 is a rear elevation of the winch;

FIG. 3 is a diagrammatic cross-sectional view on an enlarged scale of part of the rotary cable driving member of the winch, taken on the line III—III of FIG. 4;

FIG. 4 is an elevational view in the direction of arrow IV of FIG. 3 of the said part of the cable driving member;

FIG. 5 illustrates diagrammatically a typical installation of the winch in a motor vehicle;

FIG. 6 is a fragmentary isometric view of a preferred embodiment of cable winch, with certain parts omitted for clarity; and

FIG. 7 is a plan view of part of the winch, being a horizontal section through the turns of cable.

The cable winch shown in FIGS. 1 to 4 is designed to draw in and pay out a cable C in the form of a wire hawser, and cable C being stored in a rotary storage container 1 of any desired capacity. The container 1 which, as illustrated in FIG. 5, may be mounted on the floor of a vehicle storage compartment, is freely rotatable about a central vertical axis on a suitable bearing and is provided with means (not shown) for anchoring the free end of the cable C to the floor of the container 1, preferably externally thereof.

The winch itself includes two circumferentially grooved drums 2,3 mounted with their axes parallel and spaced apart vertically. Each drum 2,3 has an equal number of identical circumferential annular grooves 4, typically five in number.

Each of the drums 2,3 is positively driven. In the vehicle mounted example illustrated, one of the drums, 3, has a drive connection, indicated diagrammatically at 5 in FIG. 5, to an external drive shaft on the gearbox 6 of the vehicle. Alternatively, drive may be taken direct from the crankshaft of the vehicle engine, or may comprise a hydraulic transmission through a power take-off, or an independent winch drive unit may be provided. The other drum 2 is drivingly connected to the drum 3 by means of a chain and sprocket drive 7 (FIG. 2), omitted from FIG. 1 for clarity.

A rotary driving member 8 is mounted coaxially with the drum 3 and is driven from the drive connection 5 by way of a slipping clutch 9. As an alternative to the slipping clutch 9 a suitable gear transmission may be provided between the drum 3 and rotary member 8 so as to ensure that the peripheral speeds of the drum 3 and member 8 are equal.

The rotary driving member 8 is formed by an axially fixed rotary disc 10 and an axially displaceable rotary disc 11, the two discs 10,11 together defining a peripheral cable receiving groove 12. A number of cable gripping elements 14 are mounted at equal angular intervals around the periphery of the axially movable disc 11.

The construction and arrangement of one of the cable gripping elements 14 is illustrated in FIGS. 3 and 4. Each cable gripping element 14 comprises a radially extending arm 15 which is attached to the disc 11 by way of a circumferentially extending hinge pin 16. At its radially outer end the arm 15 is formed integrally with an axially extending tongue 17 which passes through a slot 18 in the periphery of the disc 11 and protrudes into the peripheral groove 12. The arm 15 is urged resiliently towards the outer face of the disc 11 by means of a helical spring 19 compressed between the outer face of the arm 15 and a a stop 20 carried by a bolt secured to the disc 11 and passing through a bore in the arm 15. The cable gripping element 14 is therefore spring-biased into an operative position in which the tongue 17 protrudes into the groove 12 and can engage a cable C lying in the groove, gripping the cable tightly to the rotary driving member 8.

Outwardly of the slot 18 each tongue 17 carries a cam follower roller 21 which is rotatable about an axis extending radially with respect to the axis of rotation of the driving member 8. Respective fixed cams 22, one only of which is shown in FIG. 2, are provided at two angularly spaced-apart stationary positions. Each of the cams 22 has a shaped cam surface 23 which is positioned so as to be engaged by each cam follower roller 21 in turn as the rotary driving member 8 rotates in the direction indicated by the arrow, corresponding to drawing in of the cable C. Upon such engagement, the cam follower roller 21 rides up over the cam surface 23, causing the arm 15 of the respective cable gripping element 14 to rock outwardly about its hinge pin 16, withdrawing the tongue 17 from the peripheral groove 12 and thereby momentarily releasing the cable C. The two positions at which the cams 22 are provided correspond to the positions at which the cable C is fed onto and withdrawn from the rotary drive member 8 when drawing-in the cable, these positions being indicated at A and B respectively in FIG. 1. The position B may be spaced 180° from position A.

A rigid metal cable guide conduit 24 extends from a position close to the position B, at which cable is withdrawn from the member 8 upon drawing-in of the cable by the winch, to a position above and close to the internal surface of the rotary storage container 1. The guide conduit 24 is shaped to extend over any suitable path as required, as indicated in broken outline in FIG. 5, sharp curvature in the conduit 24 being avoided. The guide conduit 24 may in practice be flexible.

The axially movable disc 11 of the rotary cable driving member 8 is spring-biased into its closed position, illustrated in FIG. 2. A mechanical or hydraulic operating actuator, indicated diagrammatically at 25, is provided for displacing the disc 11 axially away from the disc 10, to the position shown in broken outline in FIG. 3. In this position, which is adopted when the winch is paying-out the cable C, the cable runs in that part of the peripheral groove 12 which is carried by the disc 10, and is not gripped by the cable gripping elements 14. The spacing of the fixed cams 22 from the disc 11 is obviously such as to permit this movement of the disc 11.

A dog-clutch (not shown) is provided for disengaging the drive connection 5 from the winch, for example when paying-out the cable C by hand.

Fixed cable guide means 26 are provided at the front of the winch and in the vehicle installation (FIG. 5) are mounted on the front bumper of the vehicle. The cable guide means 26 comprise, in a conventional manner, two pairs of parallel rollers mounted one behind the other, the front pair being rotatable about vertical axes and the rear pair about horizontal axes. The spacing of the rollers of the two pairs is such that the cable C can be fed between them successively. A fixed friction block 27 is mounted behind the guide means 26 and has a bore 28 through which the cable C passes with light friction. The purpose of the friction block 27 is to ensure that at all times there is a tension loading on the cable C passing through the winch, irrespective of the presence or absence of external load on the cable C.

In operation of the winch the cable C after passing through the guide means **26** and the friction block **27** is fed into a groove **4** at one end of the lower drum **3**, thence to the groove **4** at the same end of the other drum **2** and thence to the next successive groove **4** of the lower drum **3**, and so on until cable has passed around all the grooves **4** of the two drums **2,3**. The cable C then passes from the final groove **4** of the drum **2** to the groove **12** of the rotary cable driving member **8**, entering the groove **12** at the position A where the gripping elements **14** are held open momentarily by means of one of the cams **22**.

As the cable C passes around the driving member **8** it is positively driven by virtue of the fact that the cable is gripped tightly to the member **8** by the gripping elements **14**, the clutch **9** slipping to ensure that the peripheral speed of the member **8** is matched to the feeding speed of the cable C from the drum **2**. The cable C leaves the groove **12** of the driving member **8** at the position B an is fed through the guide conduit **24** into the storage container **1**, the latter rotating freely in the direction indicated to permit self-coiling of the cable in the container **1** about a circular array of spaced-apart upstanding posts **29** in the container **1**. For this purpose the conduit **24** terminates at the container **1** in a generally tangential direction, as shown in FIG. **1**. Positive drive of the container **1** is not necessary, since the cable is pushed through the guide conduit **14** by the driving member **8**.

When payint-out cable from the winch the actuator **25** is operated to move the disc **11** away from the disc **10** of the driving member **8**. The cable gripping elements **14** are then ineffective to grip the cable passing around the driving member **8** and the cable C is paid out by rotation of the drums **2,3** in the opposite direction to that shown.

The arrangement using gripping elements, described above, is somewhat complicated to manufacture. The winch illustrated in FIGS. **6** and **7** avoids the use of such gripping elements.

In the cable winch of FIGS. **6** and **7**, the cable C passes through cable guide rollers **26**, round two driven drums **2,3** and through a tubular guide conduit **24** which leads into a freely rotatable storage container **1** where the cable is stored.

The upper drum **2** has four annular circumferential grooves **4**, three of which are used in this particular example. The lower drum **3** (best seen in FIG. **7**) has two grooves **4** which are identical to those of the upper drum. The grooves **4** are defined between annular ridges **31** which have tapering side-walls; the bases of the grooves **4** are radiused to join smoothly with the ridges **31** and to conform to the circular cross-section of the cable.

Both ends of the drum **3** are extended to form respective cyclindrical shafts **32*a***, **32*b***, which carry respective clamping rings **33*a***, **33*b***. These rings are mounted so as to be freely movable along the shafts **32*a***, **32*b***, and so as to rotate with the shafts, for instance by means of splines (not shown). Helical compression springs **34*a***, **34*b***, which are equally spaced around the shafts, connect the clamping rings **33*a***, **33*b*** to respective stop plates **35*a***, **35*b***, which are mounted on the shafts in a similar manner to the clamping rings. In the drawings the left-hand springs **34*a*** are at their natural length, while the right-hand springs **35*b*** are under compression. The stop plates **35*a***, **35*b*** rest slidably against respective collars **36*a***, **36*b***, which are slidable along the shafts **32*a***, **32*b*** but do not rotate with the shaft.

The collars **36*a***, **36*b*** are rigidly linked by a connecting bar **37**, so that when one of the collars is bearing against the corresponding collar to put the corresponding springs under compression, the other collar is drawn back to release the other springs from compression. The collars **36*a***, **36*b*** are actuated by a lever **38**, which is articulated to the connecting bar **37** and turns about a fixed pivot **39**.

The right-hand end of the drum **3** (FIG. **7**) will now be considered in detail, but the description applies equally to the left-hand end.

The collar **36*b*** bears slidingly against the stop plate **35*b***, which through the intermediary of the compression springs **34*b*** biases the clamping ring **33*b*** towards the annular ridge **31*b*** at the right-hand end of the drum **3**. The axially inwardly directed face **40*b*** of the ring **33*b*** is bevelled, and together with the tapering outer face of the ridge **31*b*** defines a groove **4*b*** which widens radially outwardly; this groove receives the last turn of the cable C.

Because the ring **35*b*** is biased towards the ridge **31*b***, the cable is clamped in the groove **4*b*** and is forced outwards away from the axis of rotation. The cable is retained in the groove **4*b*** by idle rollers **41*b*** (see also FIG. **6**) mounted on spindle **42**. The position of the rollers **41*b*** determines the radius at which the cable lies in the groove **4*b*** and therefore the tension which is applied to the length of cable **43** (FIG. **6**) extending from the last operative groove of the upper drum **2** to the groove **4*b***. SInce the cable in the groove **4*b*** lies at a greater radius than the turns of cable in all the other grooves **4**, the length of cable **43** will always be under tension during drawing in, so that the turns of cable will tighten round the drums **2,3**.

It is to be noted that the tuen of cable in the left-hand groove **4*a***, defined between the ridge **31*a*** and the bevelled face **40*a*** of the ring **33*a***, rests on the cylindrical surface of the shaft **32*a*** at the same radius as the other turns of cable in the drum grooves **4**, while the winch is drawing the cable in.

Thus, during drawing in, the cable C is drawn through the guide rollers **26**, around part of the left-hand groove **4*a***, tightly around successive grooves **4** of the driven drums **2,3**, and around part of the groove **4*b***, in which the cable is retained by the rollers **41*b***. Due to the driving action of the clamping groove **4*b***, the cable is pushed along the guide conduit **24**, which leads approximately tangentially into the storage container **1**. The cable is thus pushed into the container **1**, which rotates freely. The cable coils naturally about the central projection **44** in the container **1**.

To pay out cable from the container **1** through the winch, the lever **38** is moved to the position shown in chain line (FIG. **7**) so that the left-hand clamping ring **33*a*** is biased towards the ridge **31*a***, while the right-hand ring **33*b*** is freed from compression. The drums **2,3** are then rotated in the reverse direction to that indicated in FIG. **6**, so that cable is drawn from the container **1**, through the guide conduit **24**, and tightly around the groove **4*b*** and **4** at the same radius. The left-hand clamping groove **4*a*** pulls the cable under tension from the upper drum **2** and drives it through the cable guide rollers **26**.

As described above with reference to FIG. **5**, the winch may be mounted in a vehicle and driven by a

drive from the crankshaft of the vehicle engine, a hydraulic transmission through a power take-off, or an independent drive unit. The drums **2,3** are rotated in synchronism, and for this purpose they may be connected by a chain and sprockets. Alternatively, the drums **2,3** may be driven by worm gears from a common worm shaft. In this case, each drum **2,3** is mounted on an axle carrying a worm wheel; a worm shaft bears worms which engage with the respective wheels. If the shaft passes between the two wheels, the two worms will be of opposite hand.

Various modification may be made within the scope of the invention. For example, the two clamping grooves **4***a*, **4***b* need not be provided on the same drum, e.g. the left-hand groove **4***a* could be arranged at the left-hand end of the upper drum **2.** Although only two rollers **41***b* (and **41***a*) have been illustrated, three or more may be provided; in certain cases, one might be sufficient. The lever **38** and connecting bar **37** could be dispensed with and replaced by other mechanisms for actuat1ng the biasing springs, such as by making the collars axially fixed and provided by projections selectively engageable with depressions in the stop plates by relative rotation; alternatively a mechanism inside or outside the shaft **32***a*, **32***b* may act directly on the rings **33***a*, **33***b* to press them selectively away from the ridges **31***a*, **31***b;* yet another alternative is to actuate the collars hydraulically. The sets of springs **34***a*, **34***b* could be replaced by a single helical sprung surrounding the shaft **32***a*, **32***b*.

I claim:

1. A cable winch comprising:

a. cable guide means;

b. two spaced, parallel, circumferentially grooved driven drums;

c. a rotary cable driving member at one end of one drum defining an annular groove coaxial with said one drum, the member being mounted to rotate with said one drum;

d. means for retaining the cable in said groove over a part of its circumference;

e. a cable storage space;

f. a cable guide conduit extending from said driving member to said cable storage space for conducting cable to and from said space when the winch is drawing-in and paying-out cable respectively;

g. a source of rotary power;

h. means for rotating said drums together with said driving member from said source so that, upon drawing-in of the cable, the cable will pass through said cable guide means, around successive drums in successive grooves thereof, around said part of the groove defined by the driving member, the cable being under tension as it passes from the final drum groove to the groove defined by the driving member, and then through said guide conduit into said storage space; and

i. said driving member comprising a shaft extending rigidly from said one end of said drum, an axially movable element mounted to rotate with the shaft, a further element mounted to rotate with the shaft, and means for preventing relative axial movement of the two elements away from one another, said axially movable element having an annular surface cooperating with a further annular surface on said further element to define said annular groove which is coaxial with said one drum.

2. A cable winch as claimed in claim **1,** wherein said means for retaining the cable in said groove of said driving member comprise movable cable gripping elements on said member, means on said member normally urging said gripping elements into operative positions wherein the cable is tightly gripped in said groove, and means for releasing the gripping elements as said elements pass two stationary stations upon rotation of the driving member to permit feeding of the cable onto and withdrawal of the cable from the driving member at said stations.

3. A cable winch as claimed in claim **2,** wherein each end of the cable gripping element is spring-biased into its operative cable-gripping position, further comprising a cam-follower roller on each gripping element, and suitably shaped cams provided at the two said stations at which release of the gripping elements is required, said cams being adapted to engage said rollers and to move successive gripping elements from their operating positions as the driving member rotates.

4. A cable winch as claimed in claim **1,** further comprising a freely rotatable storage container, said guide conduit being directed into said storage container.

5. A cable winch as claimed in claim **4,** wherein said storage container is freely rotatable about a substantially vertical axis.

6. A cable winch as claimed in claim **4,** wherein said guide conduit leads into said storage space in a substantially tangential direction.

7. A cable winch as claimed in claim **1,** wherein said annular groove widens radially outwardly, and said driving member further comprises spring means for biasing said two elements towards one another so as to force said last turn of cable radially outwardly, the means for retaining the cable in said groove over part of its circumference being arranged so as to retain the cable in said groove at a radius such that the cable entering said groove from the other drum is under tension.

8. A cable winch as claimed in claim **7,** further comprising means for rendering said biasing means inoperative.

9. A cable winch as claimed in claim **7,** wherein said retaining means comprise at least one roller adjacent the circumference of the groove.

10. A cable winch as claimed in claim **4,** wherein said annular groove has a cylindrical base whose diameter is substantially equal to that of the drum grooves.

11. A cable winch as claimed in claim **7,** further comprising a second driving member at the end of one of the drums opposite to the first-mentioned driving member, and means for rendering the biasing means of one driving member inoperative while the biasing means of the other driving member are operative.

12. A cable winch as claimed in claim **1,** wherein said members are at opposite ends of the same drum.

13. A cable winch as claimed in claim **7,** wherein said further element is axially fixed with respect to said drum.

14. A cable winch as claimed in claim **13,** wherein the biasing means act between said axially movable member and a stop.

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