Jan. 20, 1970 J. E. NICPON 3,490,715

REWIND CONTROL MECHANISM WITH SLOTTED CAM AND TOGGLE-ACTIVATED PAWL

Filed July 10, 1968 3 Sheets-Sheet 1

Fig. 1.

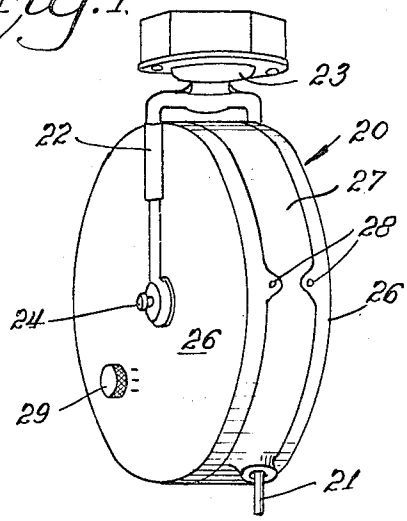
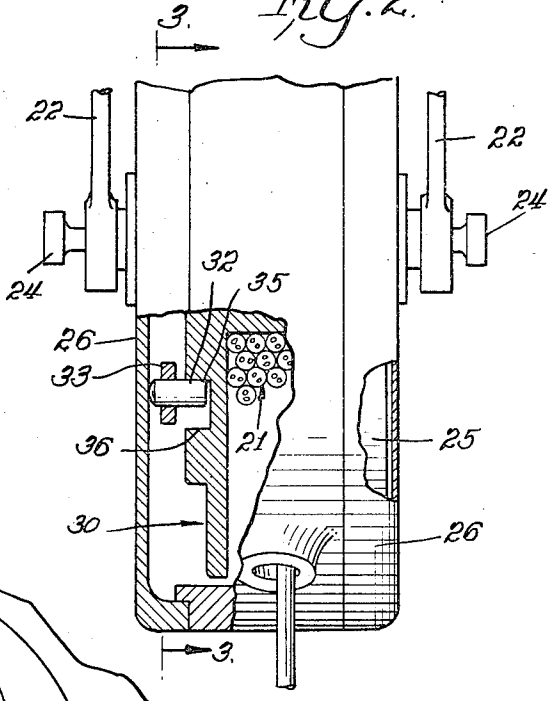


Fig. 2.



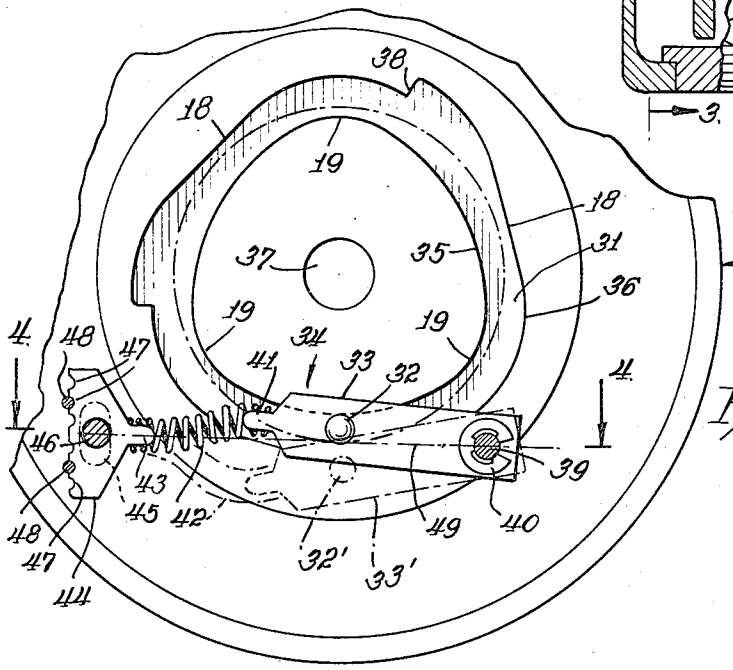
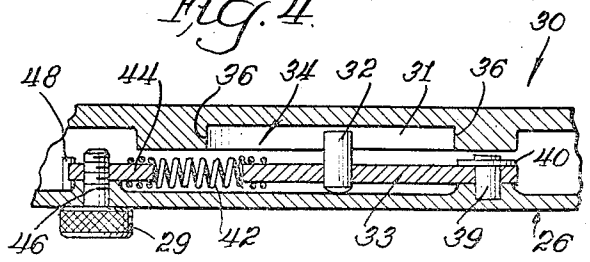


Fig. 3.

Fig. 4.



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Fig. 5

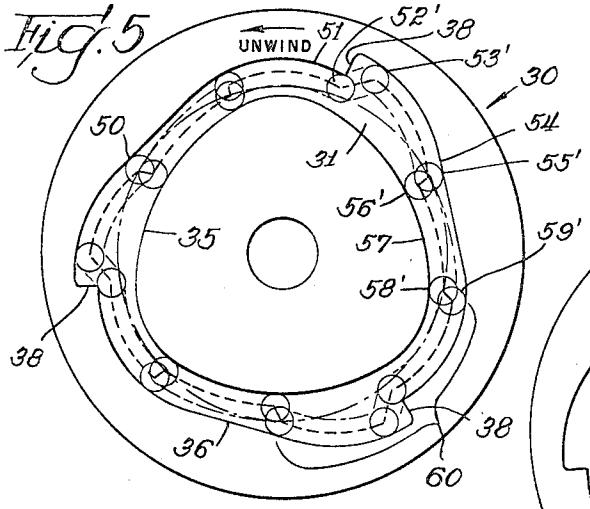


Fig. 6

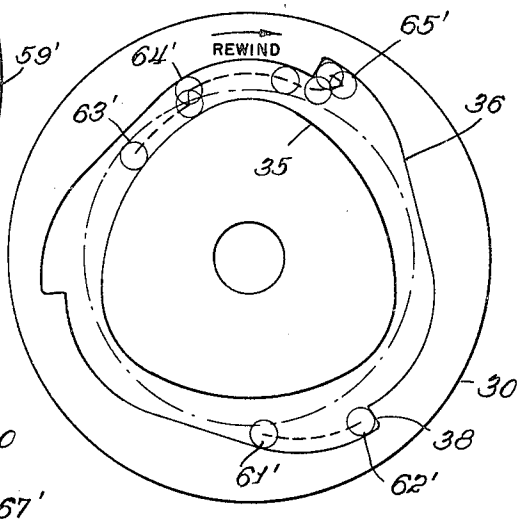


Fig. 7

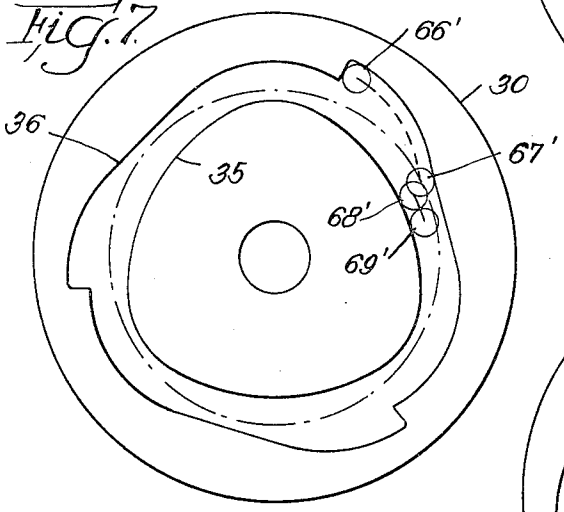
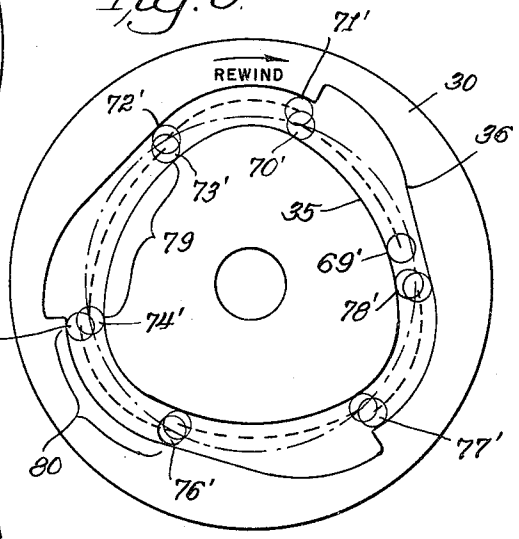


Fig. 8



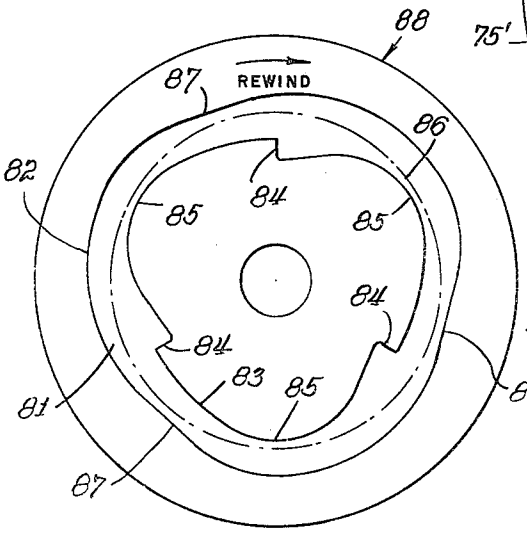


Fig. 9

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Fig. 10

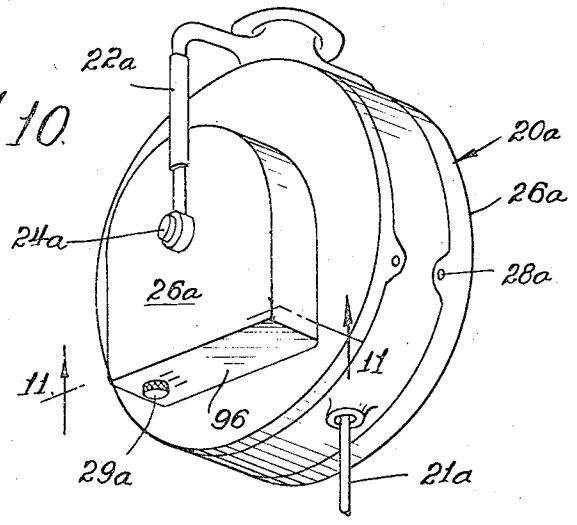


Fig. 11

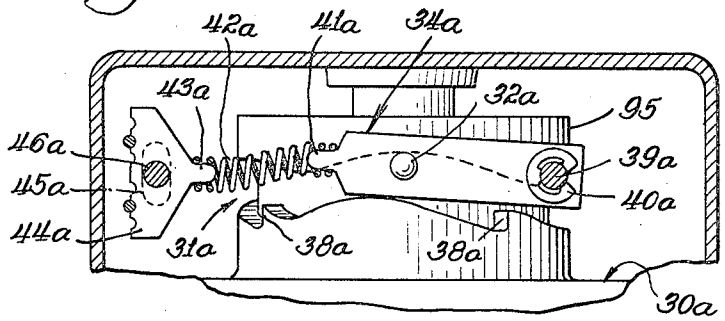
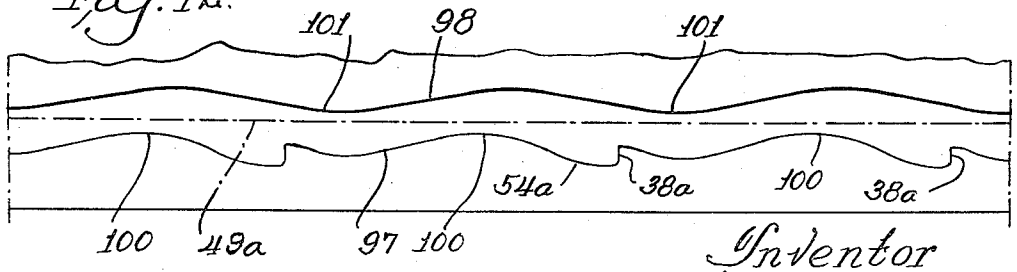


Fig. 12



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3,490,715

REWIND CONTROL MECHANISM WITH SLOTTED CAM AND TOGGLE-ACTIVATED PAWL

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Int. Cl. B65h 75/48; B65 75/38
U.S. Cl. 242—107.7 6 Claims

ABSTRACT OF THE DISCLOSURE

Mechanism to permit stop-go control of rewinding rotation of a spring-driven reel. The mechanism includes a cam-slotted ratchet wheel and an over-the-center mounted pawl. A first wall of the cam slot has alternating tooth and throw portions, the throw portion moving the pawl across an unstable center position whereby the pawl is thrown to the other wall of the cam slot. The other wall of the cam slot has throw portions positioned to reverse the movement of the pawl across center and to the first wall between the tooth and throw portions on the first wall during rewinding rotation.

BACKGROUND OF THE INVENTION

Working storage reels for electric cable, water hose, air hose, static discharge grounding wire and other elongated articles are in wide used. Very commonly these reels provide for the retrieval or rewinding action by the use of a spring motor which is tightened during the unwinding of the article off the reel. Sufficient energy is thereby stored in the spring to drive the spool in the rewind direction. A type of working storage reel which is particularly useful is the type which permits dispensing of the elongated article by pulling on the article, temporary locking of the storage reel to prevent retrieval of the elongated article by the reel while the elongated article is in use, and selective rewinding all or part of the article onto the spool after the use of the article is completed. This invention provides a rewind control mechanism for temporarily locking the reel during use of the withdrawn elongated article, and for providing stop and go control of the rewinding motion of the reel.

This invention provides a rewind control mechanism which need not be gravity responsive, provides completely free-wheeling rotation of the reel in one direction, provides free-wheeling rotation of the reel in the other direction and stop and go control over rotation in that other direction.

SUMMARY OF THE INVENTION

In accordance with a preferred embodiment of this invention a slotted cam is used in conjunction with a pawl mounted for over-the-center movement. The walls of a slot in a cam define the limits of movement of the pawl. The pawl is adapted to have a point of unstable equilibrium and means for driving the pawl in both directions from its point of unstable equilibrium. One wall of the slot has alternating tooth and throw portions. A throw portion is a cam surface which brings the pawl beyond its point of unstable equilibrium thereby causing the pawl to be thrown against the opposing wall of the cam slot. The other wall of the cam slot has throw portions positioned to throw the pawl against the first wall at a point between the tooth and throw portions of the first wall when the cam is rotating in the rewind direction. In a preferred embodiment the pawl is a pivotable lever having a pin for engaging the slot. The lever is subjected to the action of a compression spring affixed to its free end. The other end of the spring is attached at an adjustable mounting point. In this embodiment the point of unstable equilibrium of the pawl pin is that point in its rotation which falls on the straight line between the pivot permitting rotation of the pawl lever and the mounting point of the compression spring. In accordance with this invention the mounting point of the compression spring is adjusted so that the pawl pin movable within the cam slot is thrown back and forth against the opposite walls of the slot by the throw portions of the slot walls.

The pawl pin contacts one set of surfaces on both walls during the advance of the cam, and a different set of surfaces on both walls during the rewind motion. Consequently, wear on the cam surfaces is thereby reduced. This is especially true in the use of this invention in the rewinding type reels referred to above insofar as the amount of rotation in the unwind direction is substantially equal to the amount of rotation in the rewind direction. Additionally, the mechanism which is provided by this invention requires relatively little space, thereby adding little to the width of the overall reel mechanism. Also, the slotted cam which is used in accordance with this invention may be incorporated into a side wall or a circumferential surface of the reel mechanism when that mechanism is fabricated, e.g. by casting.

DESIGNATION OF THE DRAWINGS

FIGURE 1 is a perspective view illustrating the type of rewinding working storage reel in which the rewinding control mechanism of this invention is advantageously employed.

FIGURE 2 is a cutaway front view showing a portion of the rewind mechanism in cross section.

FIGURE 3 is an enlarged fragmentary cross-sectional view taken approximately along the line 3—3 of FIGURE 2.

FIGURE 4 is an enlarged cross-sectional view of the elements involved in the rewind mechanism this view being taken approximately along the line 4—4 of FIGURE 3.

FIGURES 5, 6, 7 and 8 are front views of a slotted cam wheel which is in accordance with this invention, the slotted cam in each figure being substantially identical. The purpose of these figures is to illustrate the manner in which the slotted cam works in cooperation with a toggled pawl.

FIGURE 9 illustrates an alternative slotted cam design embodying the principles disclosed herein in which the ratchet teeth are located in the more central wall of the cam slot.

FIGURE 10 is a perspective view illustrating an alternative embodiment of a rewinding working storage wheel in which the rewinding control mechanism of this invention is advantageously employed.

FIGURE 11 is an enlarged cross-sectional view taken approximately along the line 11—11 in FIGURE 10.

FIGURE 12 is a developed view of the cam slot utilized in the embodiments illustrated in FIGURES 10 and 11.

DESCRIPTION OF PREFERRED EMBODIMENTS

The reel mechanism 20 illustrated in FIGURE 1 is of the general type in widespread use. This reel stores, dispenses and retrieves the wire 21. The reel is supported by hollow arms 22 which are mounted in swivel 23 to permit rotation of the entire reel mechanism in the horizontal plane. The reel mechanism is also rotatable in the vertical plane around axle mounting 24. Reel side wall covers 26 are secured to circumferential cover 27 by means of screws 28. Pawl adjusting knob 29 is added in accordance with this invention, and will be discussed in greater detail hereinafter. Very commonly, electrical connection for wire 21 is provided through the interior of arms 22 and axle mounting 24. Spool 30 is driven in rewind direction by spring 25. However insofar as the details of such electri-

cal connections and spring motor connections do not constitute part of the invention they will not be discussed in detail herein.

In accordance with a preferred embodiment, a spool **30** which stores cable **21** has in its side wall a slot **31** in which a pawl pin **32** resides. Slot **31** is substantially wider than pin **32**. Pawl pin **32** is carried on a lever arm **33**. The slot **31** has a central wall **35**, and an outer wall **36**. Slot **31** provides a continuous path around the center **37** of the cam structure. Outer wall **36** of slot **31** includes stop-tooth configurations **38**. Both walls of the slot also provide throw or cam surfaces **18**, **19** herein referred to as "throw portions" for moving pawl pin **32** towards and past a center point as will be explained more fully hereinafter. Throw portions **18** in outer wall **36** are approximately midway between tooth configurations **38**. Throw portions **19** of inner wall **39** are positioned to throw cam **32** to the opposite wall between the tooth and the outer wall throw portion during rewind rotation. In one of the illustrated embodiments, the entire pawl mechanism, generally **34**, is mounted to housing **26**. Pawl lever arm **33** is pivotally mounted on stud **39** and secured thereto by C washer **40**. The free end of lever arm **33** provides finger **41** for holding spring **42**. Spring **42** is under compression as a result of its attachment to mounting finger **43** on adjustable mounting **44**. The dotted line **45** appearing in FIGURE 3 above mounting **44** represents the extent of an opening in side cover **26** through which screw **46** passes. Screw **46** terminates exteriorly in knurled knob **29** as best illustrated in FIGURE 1. Thus, upon loosening of screw **46** the position of the spring mounting **44** can be moved in either up or down direction as viewed in FIGURE 3. Mounting **44** may be adjusted to any one of three positions corresponding to the positions in which notches **47** are pressed against pins **48**.

OPERATION

Thus, the combination of the rotatable pawl arm **33** and compression spring **42** as hereinbefore described provides an over-the-center mounting for driving pin **32** in either direction from a line between the post **39** and spring mounting finger **43**. When pawl pin **32** is moved to a point directly under that line it is said to be at its point of unstable center. The slightest move in either direction from this center point causes spring **42** to drive pin **32** away from the center. Thus, in the illustration of FIGURE 3, as spool **30** rotates in either direction, pawl **33** moves downwardly to line **49**, even though the spring is forcing the pawl pin **32** upwardly away from the dotted line **49**, i.e. against central wall **35**. However as soon as the center of pawl pin **32** passes through dotted line **49** the spring forces the pawl away from the dotted line, but now in a downward direction, to the position shown by the dotted outline of the pawl lever **33'**, pawl pin **32'** and compression spring **42'**. Thus pawl pin at the position indicated at **32** in FIGURE 3 is being forced against the central wall of the cam slot, while the pawl pin at the position indicated at **32'** is being forced against the outer wall **36** of the cam slot.

FIGURES 5, 6, 7 and 8 illustrate the relative motion and path of pawl pin **32** in slot **31** during the course of winding, unwinding and locking of the reel mechanism.

In these figures small circles **50** illustrate positions of the pawl pin **32** at various points in time during the operation of the reel. During the operation of the illustrated embodiment, the pawl mechanism is fixed with respect to the reel mechanism housing and the spool **30** is the element which actually rotates. However, for the purpose of illustration in FIGURES 5, 6, 7 and 8 the spool **30** is shown in one position and the circles **50** are provided to show the relative position of the pawl pin **32** with respect to the spool wall **30** during the rotation of spool wall **30**. The various positions assumed by the pin will be designated hereinafter by numbers **55** through **79** in primed numbers.

In FIGURE 5 spool **30** is illustrated rotating in the "unwind" direction indicated by the arrow at the top of the spool. Hence the successive relative positions of pin **32**, as slot **31** moves past it, would appear to follow a path moving in the opposite direction. Consequently, during the unwinding rotation of spool **30** pawl pin moving along the portion **51** of the outer wall of the slot reaches position **52'** and thereafter drops over the tooth configuration **38** to position **53'** and proceeds against outer wall portion **54**. The outer wall, in portion **54**, curves inwardly to move the pawl across its point of unstable center. At position **55'** the center of the pawl pin mechanism crosses center and is then thrown to position **56'** against the portion **57** of the inner wall of the slot. As the pawl pin moves from position **56'** to position **58'** along the portion **57** of the inner wall it is again being moved towards its point of unstable center. Shortly after it passes position **58'**, it is thrown to position **59'** and again rides against the outer wall of the slot through the entire region marked **60** in FIGURE 5. Thus during the unwinding rotation of the working storage reel **30** the pawl is simply thrown from wall to wall, repeating the motions described immediately above as it passes the alternating throw portions and tooth portions in the cam slot. Hence during the unwinding rotation of the reel spool **30** the spool is free-wheeling.

When the pawl is being forced against the outside wall at the bottom of a tooth, e.g. at position **61'** in FIGURE 6, the spool can be temporarily locked against rotation in the rewind direction by simply allowing the spool to rotate in the rewind direction thus moving the cam so that the pawl engages the tooth configuration **38** at position **62'**. However if the pawl is riding against the inside wall, e.g. at position **63'** in FIGURE 6, during the free-wheeling rewind rotation of the spool, or during the advance, i.e. unwinding of the spool, the spool can be temporarily locked against rewinding rotation by advancing the spool until the pawl clicks (moves across center). During the advance, the pawl is moved towards it point of unstable equilibrium and is thrown against the outside wall, e.g. at **64'**, and further advance moves the pawl over the next tooth configuration, e.g. to position **65'**, thus causing a "click." Hence, when the pawl is approximately in the position **65'**, which is of course equivalent to position **61'**, permitting the spool to rotate in the rewind direction again causes a tooth in the outside wall to engage the pawl thus temporarily locking the spool against further rewind rotation.

A temporarily locked spool is released for rotation in the rewind direction by advancing the spool as illustrated in FIGURE 7 and FIGURE 8. The position of the pawl indicated at **66'** is of course the position for locking the spool against rewind rotation. However the spool is free to rotate in the advance direction. Thus a locked spool is unlocked for rewinding by simply advancing the reel slightly thus moving the pawl to relative position **67'** which is approximately at the point of unstable center at which point it is thrown against the opposite wall of the cam slot to position **68'** and **69'**. At this moment the pawl is being forced against the inside wall **35**. If the unlocking advance rotation is stopped when the pawl pin is at position **69'** and the spool is then permitted to rotate in the rewind direction, the pawl will bypass the tooth configurations as it slides along the central wall **35** of the slot, as illustrated in FIGURE 8, thus permitting free rotation in the rewind direction.

Thus, position **69'** in FIGURE 7 is again shown as position **69'** in FIGURE 8. Rotation of the spool in the rewind direction, i.e. the direction indicated by the arrow at the top of the spool in FIGURE 8, thus brings the pawl along the inner wall **35** of the cam slot which moves the pawl towards the point of instability so that at position **70'** the pawl is thown against the outside wall at position **71'**. Continued rotation of the cam slot with

the rewind rotation of the spool brings the pawl to the position 72' at which time the pawl is again moved across center and against the central wall 35 approximately at position 73'. Continued rotation of the spool carries the slot (and tooth 38) past the pawl until the pawl reaches relative position 74' at which moment it is again thrown to the opposite wall to position 75'. Thus the movements described immediately hereinabove are repeated so that the pawl pin is thrown against the inside wall before reaching a tooth 38 (approximately at position 76'), against the outside wall after passing the tooth (approximately at position 77') and again against the inside wall before reaching the next tooth (at the position marked 78'). Thus, free rotation in the rewind direction is permitted by the combinantion in accordance with this invention.

The pawl therefore moves against the central wall 35 of the cam slot in regions corresponding to the region indicated as 79 in FIGURE 8 and moves against the outside wall in the regions indicated as 80 in FIGURE 8, during the rewind rotation of the spool. Thus the pawl slides along the slot wall opposite a throw portion during both rewind and unwind rotation. However, it is apparent that the surfaces which the thrown pawl strikes during rewind rotation are not the same surfaces which the pawl strikes when thrown during the rotation of the spool in the unwind direction. Since different surfaces of the walls of the cam slot are struck by the thrown pawl during the winding and rewinding rotation, and insofar as the amount of unwinding, i.e. advance rotation of the spool, is substantially equal to the amount of rotation in the rewind direction during normal use of these spools, wear of the cam surfaces will be lessened due to the even distribution of the striking of the pawl between different areas of both walls of the slot.

ALTERNATIVE CONSTRUCTIONS

Thus, from the above description it will be appreciated that the slot employed in applicant's invention has two side walls, one wall containing alternating tooth and throw portions, the second wall providing a throw portion which moves the pawl to the first wall at a point between the tooth and throw portion when the cam is rotating in a rewind direction. Therefore, applicant's invention is not to be limited to the specific embodiment illustrated in the aforementioned drawings, but includes all embodiments which utilize the principles disclosed herein. As illustrated in FIGURE 9 the cam slot 81 may be bounded by outer wall 82 and central wall 83, and the teeth configurations 84 may be located in inner wall 83. The inner wall 83 carries alternating tooth portions 84 and throw portions 85. The relative path of the points of unstable equilibrium is indicated by line 86. Thus it is not necessary that the wall of the throw portion 85 actually pass under the center line of the pawl mechanism. It is only necessary that throw portion 85 move the pawl to such a position that the center of the pawl passes the point of unstable equilibrium. It is also apparent that outer wall 82 provides throw portions 87 which throw the pawl against a point on the central wall between the tooth portion 84 and throw portion 85 when the spool 88 is rotating in the rewind direction indicated by the arrow at the top of the spool. The slotted cam configuration illustrated in FIGURE 9 utilizes the principles disclosed in conjunction with the preceding figures, and the operation of a reel 20 which utilizes the configuration illustrated in FIGURE 9 is identical to the operation described in connection with the reels utilizing configurations described in FIGURES 5, 6, 7 and 8 above.

Another alternative construction of the invention is illustrated in FIGURES 10 to 12. The parts numbered in FIGURES 10 to 12 have the same number as corresponding elements appearing in FIGURES 1 through 9 except that the numbers are shown with the suffix *a*. In this alternative embodiment cam slot 31*a* is situated on the external circumference of drum 95 and the pawl mechanism 34*a* is mounted on a flat bottom portion 96 of reel housing 26*a*. Drum 95 is fixed to spool 30*a*. Thus as spool 30*a* rotates drum 95 rotates also, and cam slot 31*a* moves pawl pin 32*a* back and forth across the center line 49*a*. One wall 97 of the slot has alternating tooth portions 38*a* and throw portions 100. The other wall 98 of the slot has throw portions 101 which throw pawl pin 32*a* against the opposite wall 97 at a point between the tooth portion 38*a* and the throw portion 100 on that wall 97. Comparison of cam slot 31 of FIGURE 12 with the illustrations of FIGURES 5 through 9 will reveal that the mode of operation of the alternative embodiment is the same as the mode of operation of the previously described embodiments.

Therefore I claim:

1. In an apparatus for holding an elongated article such as an electric cable, a hose or the like in which the apparatus comprises a frame member, a reel member for holding the article and mounted for rotation about an axis on the frame member for movement with respect to the frame in an article unwinding direction and in a rewinding direction, a motor interconnecting the frame member and the reel member to urge the reel member toward rotation in the rewinding direction, and a rewinding control mechanism to releasably lock the reel against movement in the rewinding direction at a given position of rotation, the improvement wherein such mechanism comprises: a slotted cam and a pawl with the pawl moving in the slotted cam at a given direction when the reel is moving in the rewind direction, said slotted cam extending 360° around said axis, said slotted cam having a slot having edges which are opposed first and second cam surfaces between which the pawl is movably confined; means for driving the pawl in either direction from a point of unstable center; said first cam surface including stop means for engaging the pawl and stopping relative movement of the cam and pawl when the motion of the spool is in the rewinding direction, said first cam surface including a first throw portion for moving the pawl past its point of unstable center, whereby the pawl is thrown against the opposing second cam surface, said second cam surface including a second throw portion for moving a pawl riding on the second cam surface past the point of unstable center, whereby the pawl is thrown against the first cam surface, the second throw portion being positioned to throw the pawl against the first cam surface at a point between the stop means and the first throw portion when the motion of the spool is in the rewind direction.

2. The rewind control mechanism of claim 1 in which said slotted cam is a wheel, the slot being in the side thereof, and the pawl is a pin on a toggle lever.

3. A rewind control mechanism of claim 1 in which the slotted cam is a drum, the slot being on the circumference thereof.

4. The rewind control mechanism of claim 1 which includes means for shifting the point of unstable equilibrium of the pawl, whereby the pawl is limited in its motion to contacting one of said cam surfaces.

5. The rewind control mechanism of claim 1 in which the slotted cam is cast as part of the spool and the pawl is a toggle lever on support means which are fixed with respect to the frame.

6. In an apparatus for holding an elongated article such as an electric cable, a hose or the like in which the apparatus comprises a frame member, a reel member for holding the article and mounted for rotation about an axis on the frame member for movement with respect to the frame in an article unwinding direction and in a rewinding direction, a motor inter-connecting the frame member and the reel member to urge the reel member toward rotation in the rewinding direction, and a rewinding control mechanism to releasably lock the reel against movement in the rewinding direction at a given position of rotation, the improvement wherein such mechanism

comprises: a device defining a continuous cam track having two opposed cam faces, a pawl positioned in said track and an over-the-center mounting means connected to said pawl to resiliently urge against one or the other of said faces from an unstable center position, said device being affixed to one member and said mounting means being affixed to the other member, whereby said pawl moving relative to the device in one direction when the reel member is moving in the rewind direction and moving relative to the device in the opposite direction when the reel member is moving in the unwind direction, said mechanism positioning said pawl so that the unstable center position defines a line along said track generally between said faces, one of said faces having a stop positioned to face said pawl as the relative movement of the pawl is in said one direction, said one face having a throw portion preceding said stop in said opposite direction from said stop, the other of the faces having a throw portion following said stop in said one direction from said stop, said one face being sufficiently spaced from said line except at said throw portion thereof to permit the

pawl to remain against said one face under the urging of the mounting means without the pawl moving across center, said other face being sufficiently spaced from said line except at said throw portion thereof to permit the pawl to remain against said other face under the urging of said mounting means without the pawl moving across center.

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U.S. Cl. X.R.

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