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ACCUMULATOR DEVICE FOR A FLEXIBLE ELEMENT

Original Filed Jan. 17, 1955

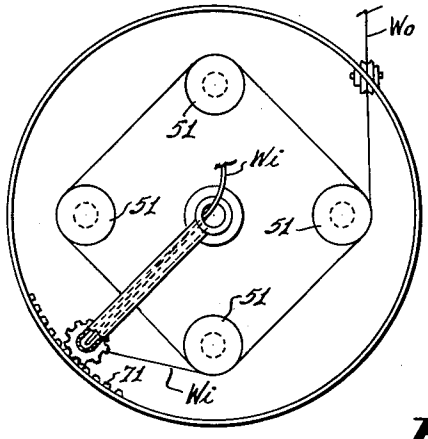


FIG. 1.

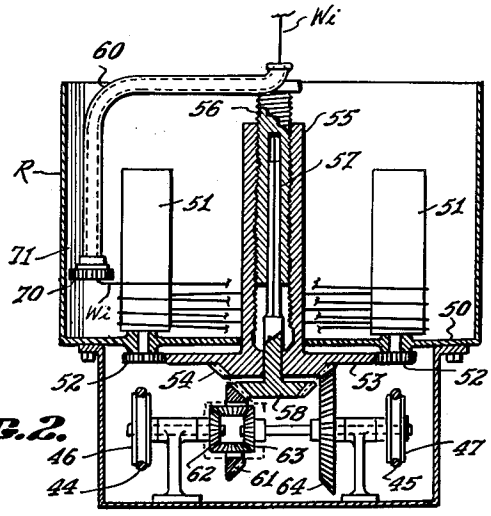


FIG. 2.

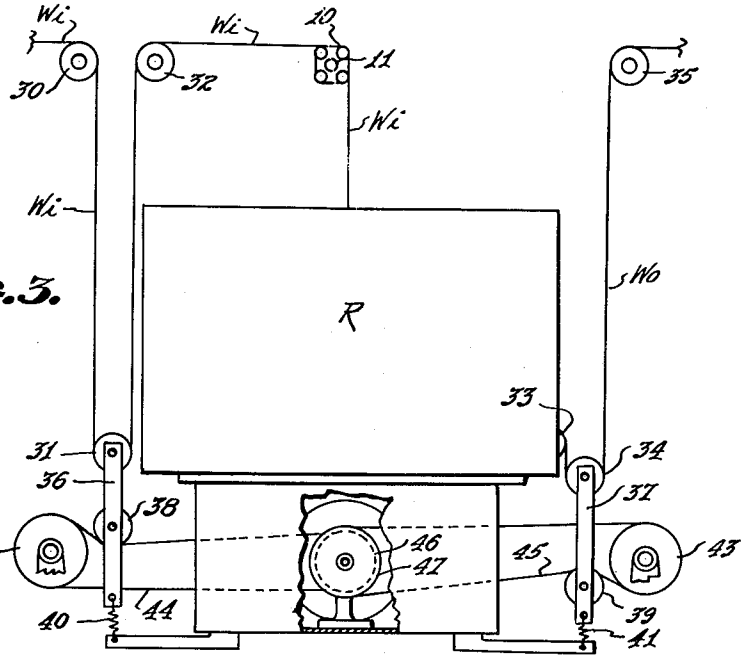


FIG. 3.

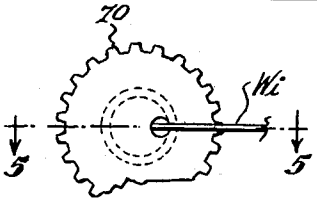


FIG. 4.

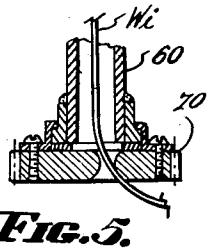


FIG. 5.

INVENTORS
KENNETH K. KNIGHT
AND WILLIAM J. WENZEL
BY

ATTORNEYS.

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ACCUMULATOR DEVICE FOR A FLEXIBLE ELEMENT

Kenneth K. Knight, 604 Forest Ave., and William J. Wenzel, 41 Meadowlark Drive, both of Great Falls, Mont.

Original application Jan. 17, 1955, Ser. No. 482,367, now Patent No. 2,824,616, dated Feb. 25, 1958. Divided and this application Dec. 6, 1957, Ser. No. 701,093
7 Claims. (Cl. 242—47.09)

This invention relates to an accumulator device for a flexible element and this application is a division of our copending application, Serial No. 482,367 filed January 17, 1955, now Patent No. 2,824,616.

In the above mentioned copending application we disclosed an automatic self-steering vehicle which carried a length of flexible element such as a wire and which was arranged to lay this wire down as the vehicle proceeds. Means are provided to pick the wire up in front of the machine from a previously laid course so that once the machine is put in operation it moves along with it steering mechanism guided by sensing the position of the previously laid down wire which is being picked up, while at the same time the vehicle lays down additional wire in displaced relation. In this way the vehicle may be used to pull a mower, for example, and to mow an entire field starting at the periphery and ending at the center.

The accumulator device for the wire which is disclosed and claimed in said copending application constitutes the subject matter of the present application.

It is therefore the principal object of the present invention to provide an accumulator for a great length of flexible element such as wire, which may be paid out therefrom and taken up therein at variable and differing rates. It is thus another object of the invention to provide a differential accumulating reel from which a length of flexible element may be paid out and onto which a length of flexible element may be wound, wherein said flexible element may be paid out at a faster or slower rate than it is being taken up and wherein the rates of paying out and taking up may be constantly changed.

It is another object of the invention to provide a differential reel which will automatically and differentially take up and pay out flexible element while storing and accumulating any flexible element being taken up in excess of that being paid out.

These and other objects of the invention which will be described in more detail hereinafter or which will become apparent to one skilled in the art upon reading these specifications we accomplish by that certain construction and arrangement of parts of which we shall now describe an exemplary embodiment.

Reference is made to the drawings forming a part hereof and in which:

FIGURE 1 is a plan view of an accumulator reel according to the invention.

FIGURE 2 is a diametral cross-sectional view of the same.

FIGURE 3 is an elevational view of the same.

FIGURE 4 is a bottom view of the winding on element; and

FIGURE 5 is a fragmentary cross-sectional view of the same taken on the line 5—5 of FIGURE 4.

For the details of operation of the device with which the present invention may be used, reference is made to the copending application above referred to. It will of course be understood that the device is of utility in any situation where a flexible element must be taken up and paid out at varying rates, with a provision for the accumulation or storing of the flexible element. Referring first to FIGURE 3, the accumulating reel is indicated generally at R.

The wire which is being taken up passes over a series of pulleys **30**, **31** and **32** and thence about the induction device **10**, **11** (used in charging the wire according to the said copending application) and thence onto the reel. The wire being paid out passes over pulleys **33**, **34** and **35**. The pulleys **31** and **34** are mounted on arms **36** and **37** upon which are respectively also mounted pulleys **38** and **39**. The arms **36** and **37** are under tension of the springs **40** and **41**.

At **42** and **43** are shown pulleys which are continuously driven at a constant speed, as for example from a power take-off from the prime mover of the vehicle, and these pulleys by means of belts **44** and **45** drive the pulleys **46** and **47**.

In the case of the incoming wire W_i, it will be clear that as long as there is no resistance to the taking up of the wire, the spring **40** will urge the roller **38** against the belt **44** so as to maintain driving tension. If there is resistance to taking up of the wire W_i, the roller **38** will be pulled away from contact with the belt **44**, permitting the belt to slip so that the pulley **46** ceases to be driven.

In the case of the outgoing wire, the situation is reversed, in that the pulley **39** maintains driving tension on the belt **45** only so long as there is pull on the wire W_o. When there is no pull, the spring **41** pulls the roller **39** out of contact with the belt **45**, permitting it to slip and ceasing to drive the pulley **47**.

Turning now to FIGURE 2, we have shown the two pulleys **46** and **47** which are adapted to be driven by the belts **44** and **45** and it will be understood that the pulley **46** is turning when wire is being taken up, while the pulley **47** turns only when wire is being paid out, and it will be understood that that speed of the pulleys **46** and **47** is proportional to the rate at which the wire is being taken up and paid out, respectively.

On a platform **50** bearings are provided for four rollers **51** which are symmertically disposed. Each of the rollers **51** is provided with a small gear **52** by means of which it may be rotated. The four gears **52** are adapted to mesh with a large sun gear **53** having a beveled gear **54** integral therewith and having a central internally threaded sleeve **55**. Threaded into the sleeve **55** is an externally threaded element **56** which is connected by means of a spline **57** to a gear **58** coaxial with the gears **53** and **54**. Secured to the member **56** is a wire feeding arm **60** which extends radially outward and then downward and which is preferably tubular so that the incoming wire W_i may pass through it. The individual rollers **51** are provided with helical grooves to accept the wire as it is wound around them.

The gear **58** is arranged to be driven by the gear **61** which is secured to the cage of the differential. The differential has an input gear **62** driven by the pulley **46** and an input gear **63** driven by the pulley **47**, so that the gear **61** constitutes the output of the differential. The pulley **47** also drives a gear **64** which meshes with the gear **54** described above.

In describing the operation of this device, let it be assumed first that no wire is being paid out but that wire is being taken up. From what has gone before, it will be understood that under these conditions the pulley **46** will be rotating and the pulley **47** will be stationary. The pulley **46** drives the gear **62** and since the pulley **47** is not rotating, the gear **63** is not rotating. By the action of the differential, the entire input of the gear **62** is transmitted to the cage and the cage gear **61**, and from the gear **61** the drive is transmitted to the gear **58** which through the splined connection **57** causes the member **56** to rotate. As it rotates by virtue of its threaded connection with the member **55** which under these conditions is stationary, the member **56** is moving upwardly. As

the member **56** rotates and moves upwardly, the gear **70**, which will be described hereinafter, at the end of the arm **60** is caused to orbit around the four rollers **51** and move upwardly at the same time to describe a helical path. Thus, the wire W_i entering the arm **60** is by this action wound helically around the four rollers **51**. At this point it may be well to mention that because of the rotation of the arm **60**, a twist is imparted to the wire W_i. The function of the gear **70** is to remove the twist. The gear **70** has a bearing on the end of the arm **60**, as best seen in FIGURE 5, and it meshes with the partial internal gear **71** which extends the full height of the reel, and is fixed to the inside of the casing of the reel R. As the arm **60** rotates, the gear **70**, engaging the stationary gear **71** once in every revolution of the arm **60**, rotates in a reverse direction so as to take out of the wire the twist which was put into it by the rotating of the arm **60**.

Now let us assume that no wire is being taken up on the reel but that wire is being paid out. Under this hypothesis, the pulley **46** and the gear **62** are stationary while the pulley **47** is rotating and, therefore, the gear **64** and the gear **63** are rotating. Rotation of the gear **64** is transmitted through the gear **54** to the gear **53** and thence to the four small gears **52** so that each of the rollers **51** is caused to rotate about its own axis to feed the wire W_o off from the bottom.

It will be understood that because the wire lies in helical grooves on the rollers **51**, the locus at which the wire W_o came off would be continuously rising. This, however, is avoided because of the fact that the gear **63** is rotating and the entire input of the gear **63** is transmitted to the cage gear **61** which drives the gear **58** in the opposite direction. The opposite rotation of the gear **58** is transmitted through the splined connection **57** to the member **56** which is caused to rotate in the opposite direction so that the wire is being continuously unwrapped at the top from the rollers **51** as it is being fed off the bottom. Thus, the wire is always fed off the bottom and if no wire is being taken up, the rotating arm **60** simply lowers the level of the stored wire at the top.

If wire is being reeled in and paid out at equal rates, it will be clear that the gears **62** and **63** will be caused to rotate in opposite directions so that the cage gear **61** and the gear **58** and the member **56** will not rotate and the level of stored wire will remain stationary. It will be clear from what has gone before that the reel will always store or accumulate the difference between the amount of wire being taken in and the amount being paid out.

The operation of winding the wire onto the rollers **51** by rotation of the arm **60** induces a twist into the wire and this twist is taken out of the wire by means of the gear **70**, as best seen in FIGURES 4 and 5 and as described above.

It will be clear that numerous modifiications may be made in details of our invention and that the specific embodiment described is to be considered as being by way of example only. We do not intend to limit ourselves in any manner other than as set forth in the claims which follow.

Having now fully described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A differential reel for storing a great length of a flexible element which is adapted to be taken up on said reel and paid out therefrom at different and changing rates, comprising a frame, a plurality of rollers symmetrically disposed with their axes parallel and having bearings in said frame, each of said rollers having a helical groove for seating a portion of said flexible element, a gear secured to each of said rollers, a common gear meshing with each of said roller gears for concurrently rotating all of said rollers in the same direction, an internally threaded sleeve coaxially secured to said common gear, an externally threaded member in threaded

engagement with said internally threaded sleeve, a flexible element feeding arm secured to said externally threaded member and extending radially beyond the peripheries of said rollers, a splined shaft for rotating said externally threaded member, a gear secured to said splined shaft, a differential having one input controlled by the flexible element being taken up and a second input controlled by the flexible element being paid out, and an output in driving relation with said splined shaft gear, and a gear driven by said second input and in driving relation with said common gear.

2. A device according to claim 1, wherein said feeding arm is tubular, said flexible element being taken up on said reel passing through said arm, said arm terminating in a rotatable throat, and means for rotating said throat to remove from said flexible element the twist imparted thereto by the rotation of said arm.

3. A device according to claim 2, wherein said throat is a bore in a gear rotatably mounted on the end of said arm, said gear meshing internally with a ring gear having an axial extent to accommodate said throat gear throughout the range of feeding movement of said arm.

4. An accumulating device for a long length of a flexible element which is adapted to be fed into and paid out from said device at rates which may differ and which may vary, comprising a reel for storing a portion of said flexible element in the form of helical convolutions, means for wrapping additional amounts of said flexible element onto said reel in helical convolutions, said wrapping means comprising an arm rotatable about and feedable along the axis of said reel, said arm being tubular and said flexible element, which is fed into said device, passing through said arm, said arm terminating in a rotatable throat, means for rotating said throat to remove from said flexible element the twist imparted thereto by the rotation of said arm, means for advancing said helical convolutions along said reel to pay out a portion of said stored flexible element from one end of said reel so as to maintain a substantially fixed locus from which said flexible element is being paid out, means for actuating said advancing means in proportion to the rate at which said flexible element is being paid out, and a differential gear drive means for actuating said wrapping means in proportion to the difference between the rates at which said flexible element is fed into and paid out from said device.

5. A device according to claim 4, wherein said throat is a bore in a gear rotatably mounted on the end of said arm, said gear meshing internally with a ring gear having an axial extent to accommodate said first named gear throughout the range of feeding movement of said arm.

6. An accumulating device for a long length of a flexible element which is adapted to be fed into and paid out from said device at rates which may differ and which may vary, comprising a reel for storing a portion of said flexible element in the form of helical convolutions, means for wrapping additional amounts of said flexible element onto said reel in helical convolutions, means for advancing said helical convolutions along said reel to pay out a portion of said stored flexible element from one end of said reel so as to maintain a substantially fixed focus from which said flexible element is being paid out, means for actuating said advancing means in proportion to the rate at which said flexible element is being paid out, and a differential gear drive means for actuating said wrapping means in proportion to the difference between the rates at which said flexible element is fed into and paid out from said device, said differential means having two inputs and wherein both inputs are driven through belt drives, said belt drives being driven by an independent power means and having for each belt an idler pulley and means for urging said idler pulley against its respective belt to produce power transmission, one of said idler pulleys being spring urged to operative position and

adapted to be pulled out of operative position by tension in said flexible element being taken up, the other of said idler pulleys being urged to operative position by tension in said flexible element being paid out, and spring urged to inoperative position where there is no tension on said flexible element beng paid out.

7. An accumulating device for a longth length of a flexible element which is adapted to be fed into and paid out from said device at rates which may differ and which may vary, comprising a reel for storing a portion of said flexible element in the form of helical convolutions, means for wrapping additional amounts of said flexible element onto said reel in helical convolutions, said wrapping means comprising an arm rotatable about and feedable along the axis of said reel, means for rotating said arm about said axis, means for feeding said arm along said axis, means for advancing said helical convolutions along said reel to pay out a portion of said stored flexible element from one end of said reel so as to maintain a substantially fixed locus from which said flexible element is being paid out, means for actuating said advancing means in proportion to the rate at which said flexible element is being paid out, a differential gear drive means for actuating said wrapping means in proportion

to the difference between the rates at which said flexible element is fed into and paid out from said device, said differential having two input elements and an output element, means for rotating one input of said differential at a rate of speed proportional to the rate at which said flexible element is being taken up, and means for rotating the other input of said differential at a rate of speed proportional to the rate at which said flexible element is being paid out, whereby the output of said differential is proportional to the difference between said rates, means for actuating said rotating and feeding means concurrently in a wrapping direction at a rate of speed proportional to the output of said differential, and means for actuating said feeding means only in a reverse direction in proportion to the rate of speed at which said flexible element is being paid out.

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