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Hagen

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[54] **METHOD AND APPARATUS FOR WINDING WIRE**

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[52] **U.S. Cl.** ..... **242/25 R**

[51] **Int. Cl.** **B65h 54/00**

[58] **Field of Search** ..... 242/25 R, 25 A, 18 PW

[56] **References Cited**

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2,341,369	2/1944	Fornwald, Jr.	242/25 R
3,011,730	12/1961	Martino	242/25 R
3,596,844	8/1971	Engmann	242/25 A
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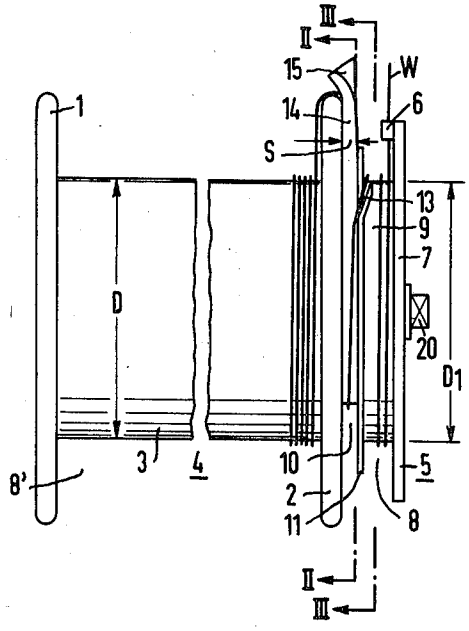
[57] **ABSTRACT**

Method and apparatus for winding wire material. The material is wound about a main spool by providing an auxiliary spool coaxial therewith and by winding a predetermined length of the material such as the wire about the auxiliary spool. Subsequently the wire is fed linearly or end-wise over a loop forming device having a smaller periphery than the core of the auxiliary or main spool and thereafter continuously over an annular flange of the main spool to be wound on the core of the main spool.

11 Claims, 2 Drawing Figures



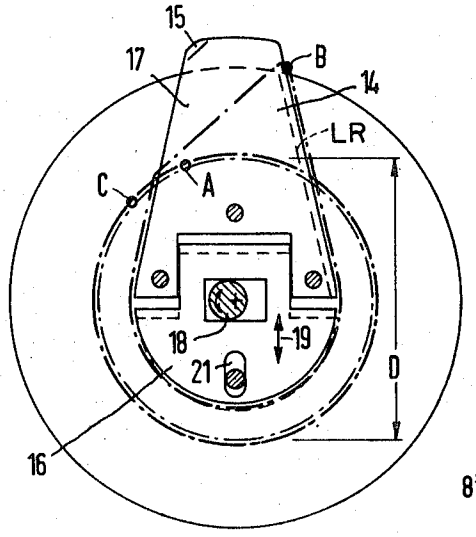


Fig. 2

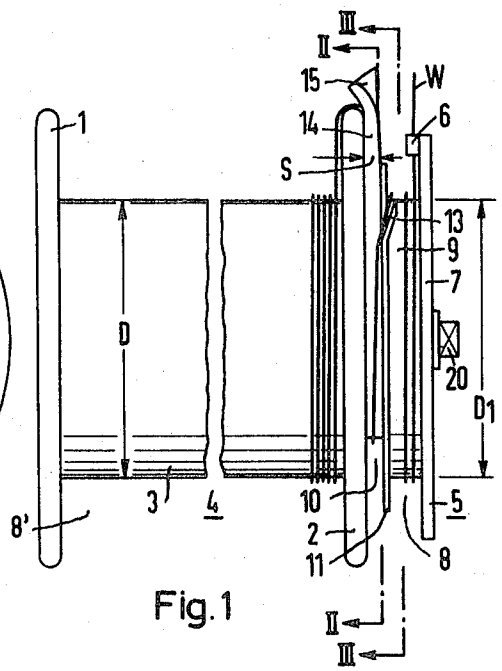


Fig. 1

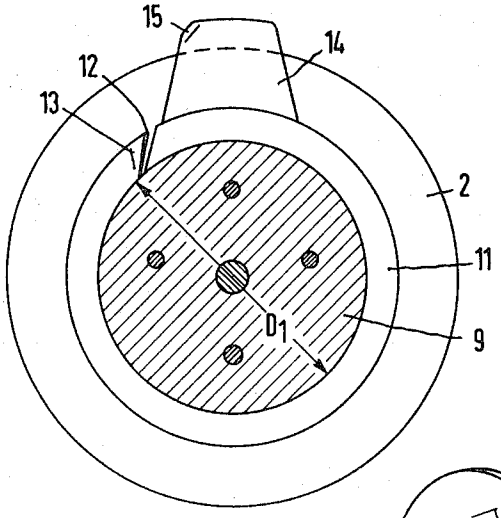


Fig. 3

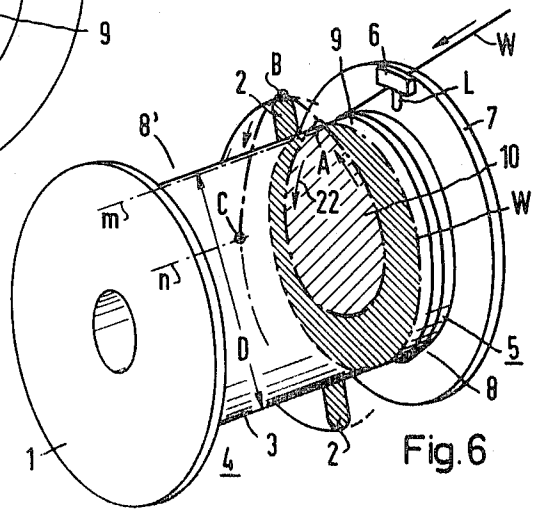


Fig. 6

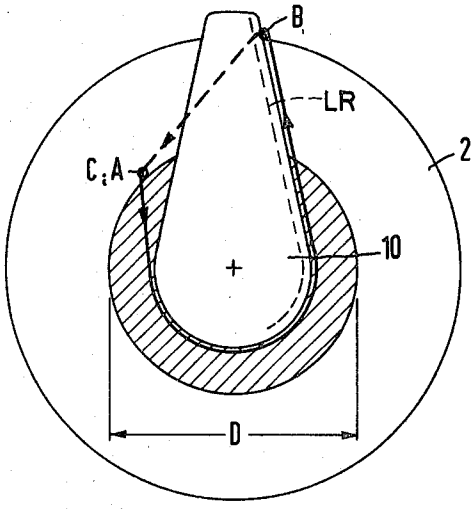


Fig.4

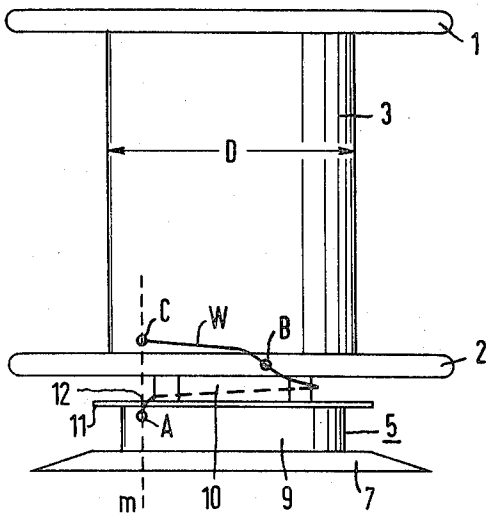


Fig.5

METHOD AND APPARATUS FOR WINDING WIRE

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for winding continuous rod like material on spools and in particular to the transfer of wire from one spool to another during winding.

The winding of wire in predetermined lengths employing a first spool on which the length of wire is first drawn and a second or main spool on which the wire is finally wound is known. Reference is made, for example, to U.S. Pat. No. 2,341,369 to Fornwald in which the wire is drawn by a drive pulley and passed over a deflecting pulley onto the main spool. The deflecting pulley is located to the side of the main spool in the plane of the flange separating the main and the auxiliary spools and is operated by means of a control mechanism so that its axis of rotation may be swung about within an acute angle bound by an arc of 90°. By this swinging of the deflecting pulley the wire may be first fed to the auxiliary spool free of the drive roller and then caused to wind about the main spool. Other transfer apparatus are known through German Patent DAS 1,168,733 and through U.S. Pat. No. 3,368,765. In these arrangements there is shown means by which a more or less defined length of wire is actually formed on the auxiliary spool. Because the wire is thus built on the spool, the spool has a limited life and must be thrown away as metal waste after a relatively short time, although sometimes, if the wear has not been too excessive, the spool may be used to connect succeeding lengths of wire, which are welded to it. A similar arrangement such as these is also seen in British Pat. No. 859,877 which in contrast has the auxiliary and main spools arranged with their axes offset from each other.

The known arrangements have numerous disadvantages. In these the wire may suddenly slip and loose traction creating in the wire a twist or other blow exceeding the strength of the wire. As a result the wire either tears or is deformed, generally in a manner that is not easily noticeable. The latter situation is in particular undesirable, since should the wire be subsequently annealed through the use of electrical resistance heating, then the deformed portion of the wire produces an electrical resistance change which might result in temperatures insufficient for the desired result. The unnoticeable physical or structural changes in the material of the wire which result from the use of the prior art devices create problems of particular importance when the wire itself is actually used, as for example, in the formation of telephone cables, wherein both the conductibility and also the transmission losses of paired or quadrupled wires must be held at a constant, the uniformity in wire diameter as well as wire density is a necessity.

It is the object of the present invention to provide means for winding wire and in particular to an improved method and apparatus for transferring wire from one spool to another which overcomes the disadvantages and defects of the prior art.

It is a further object of the present invention to provide apparatus for the transfer of wire from one spool to another which may be used with single and double spool feed means wherein a predefined lengths of wire are wound about the main spool absolutely free of

stresses and strains and injurious effects on the wire even though at high speeds.

It is a further object of the present invention to provide means for the transfer of wire from one spool to another which is simple and which is automatic and tension-free.

It is a specific object of the present invention to provide such apparatus which may be used independently as new equipment or which may be used as replacement parts or as auxiliary mechanisms to up-date and modernize existing machinery so as to make such machinery more economical and productive.

These objects together with other objects, as well as numerous advantages will be seen from the foregoing description of the present invention.

SUMMARY OF THE INVENTION

According to the present invention, material is wound about a main spool by providing an auxiliary spool coaxial therewith and by winding a predetermined length of the material such as the wire about the auxiliary spool. Subsequently the wire is fed linearly or end-wise over a loop forming device having a smaller periphery than the core of the auxiliary or main spool and thereafter continuously over an annular flange of the main spool to be wound on the core of the main spool.

In carrying out the present invention, the apparatus is characterized by the fact that the loop forming device is formed from a disk arranged intermediate the auxiliary and main spools. The wire contacts at least a portion of the edge to form a loop thereabout, the thickness or width of the disk being at least equal to the diameter of the wire.

It is preferable that the disk forming the looping device be provided with a radially extending portion which extends beyond the flange of the main spool and is simultaneously bent in the direction of the main spool. This extending portion is contacted by the wire and serves to conduct or lead the wire from the looping device over the flange on to the main spool. Also, it is advantageous that the bearing surface along the edge of the diskmember forming the loop device with which the wire comes into contact, is at least provided with highly frictional or high traction portions such as longitudinal grooves or splines.

According to the present invention the length of the wire loop can be adjusted so as to control the winding operation. This is obtained by forming the disk about which the wire is looped of two parts, at least one of the two parts being reciprocably adjustable with respect to the other through manual, electrical, mechanical, pneumatic, or hydraulically operated means. Preferably, the adjustment of the looping device is accomplished automatically from without the apparatus so as to make the apparatus fully automatic and instantaneously responsive to wire gauging and feeding measuring devices such as a computer or the like without the need to stop the wire during operation.

It is also advantageous to arrange an annular guide ring between the auxiliary spool and the looping device, which ring has a radial slit bent in the direction of the auxiliary spool, to direct the wire smoothly and without stress from the auxiliary spool onto the looping device. Preferably, the looping and/or the annular guide ring are swingable about the axis of the spools and there fixed in place at any desirable position, so

that the offset between the slit in the annular ring and the guide surface on the extending portion of the disk forming the looping device, can be offset predetermined distances from each other. It is also possible to form the auxiliary spool and the annular split ring of a unitary assembly or of an integral construction.

Full particulars of the present invention are set forth in the following description and are seen in the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

In the drawings:

FIG. 1 is a front elevational view of apparatus embodying the present invention showing a main spool, an auxiliary spool and a loop forming device located therebetween;

FIG. 2 is a sectional view taken along lines II—II of FIG. 1 in which the looping device is shown in elevation;

FIG. 3 is a sectional view taken along lines III—III of FIG. 2 in which the annular slit ring is shown;

FIG. 4 is a view similar to FIG. 2 showing a one piece looping device arranged in normal position so that the looping of the wire runs from points A – C over a point B wherein the points A and C are arranged on the same axis;

FIG. 5 is a plan view corresponding to FIG. 4; and

FIG. 6 is a perspective view of the apparatus showing the feeding of the wire from the auxiliary spool over the loop forming device and thereafter over the flange of the main spool to the winding portion thereof wherein the points A and C lie on different axial lines.

DESCRIPTION OF THE INVENTION

In the following the winding apparatus is only schematically described and shown since it follows, except for the inventive feature, conventional and well known structural and operational concepts. References for example can be made to the earlier mentioned patents for details of the spool construction, wire feed, spool rotation means, etc.

As seen in the drawings a pair of space flanges **1** and **2** define the axial limits of a core **3** of a main spool **4** having a diameter D and a circumferential area **8'** about which a length of wire W may be continuously wound. Coaxially arranged as for example about a common shaft, in tandem with the main spool **4** is an auxiliary spool **5.** The auxiliary spool **5** extends outwardly from the main spool and terminates in a flange **7** on which a clamping and cutting device **6** is arranged. The spool **5** is also provided with a core **9** having a diameter D1 equal to the diameter D of the core **3,** although it may, if desired, be different. The circumferential area **8** of the core **9** provides a winding space which is defined at its outer limits by the flange **7.** The clamping and cutting means **6** is arranged in a radially elongated hole L (FIG. **6**) and is thus adjustable so as to be positionable in a fixed location in relation to the wire speed, to provide a larger or smaller circumferential orbit as desired.

A loop forming device **10** and a transfer ring **11** are arranged between the two spools **4** and **5.** The ring **11** defines the inner limit of core **9** and is formed of an annular piece of sheet metal having a generally radially extending slit **12,** as seen in FIG. **3.** The adjacent ends or lapping edges **13** formed by the slit **12** are bent outwardly in the direction of the winding area **8** so that the wire W can be securely transferred from the core **9** of the auxiliary spool to the loop forming device **10.**

The loop forming device **10** itself is formed as a flat disklike member **14** whose width S is at least the same or greater than the diameter of the wire W. The disk member **14** as seen in FIG. **1** and **2** is formed to have a semi-circular bottom portion **16** over which the wire loops in sliding engagement and a radially extending upper portion **17** which has at least one edge bent as at **15** to extend over the edge of the adjacent flange **2.** A longitudinal groove LR is formed in the peripheral surface of the disk **14** in which the wire is adapted to run. Preferably, the upper portion **17** has both its edges bent in the direction of the winding area **8'** of the main spool **4** so that a guiding slide surface on which the wire W may ride is formed.

In the embodiment seen in FIGS. **1** and **2,** the two portions **16** and **17** of the disk member **14** are separable and adjustable relatively to each other, while as seen in FIG. **4,** the looping device may be formed of one piece, disk member **14** having a lower portion **16** and an upper portion **17.** In either case the disk member **14** is so arranged as to be rotatable relatively about the axis of the spools. Preferably, the radius of the lower portion **16** of the disk member **14** is less than the radius of both of the cores **3** and **9** of the main and auxiliary spools, as seen in FIG. **2,** so that the periphery of the looping device intermediate the two spools, is smaller than either of the cores **3** and **9.**

In operation, the overlapping edges **13** of the slit **12** provides the initial point A for the transfer of the wire from the auxiliary spool **5** to the main spool. The wire W then loops about the intermediately located disk member **14** and up over the extending portion **17** to engage the flange **2** at a point B. Finally, the wire engages the core **3,** about which it is wound, at a point C, forming the covering of the main spool **4.** Point C lies along the surround cover defined by the layer of wire wound about the core **3.**

Under normal operating conditions, Point A defining the beginning of the loop would lie on the same axial line m, parallel to both cores **3** and **9,** as the point C as seen in FIGS. **4** and **5.** Thus, since the diameters *D* and *D1* of the spools are the same the wire length of the loop about the disk **14** from point A to point C over the point B would be equal to $D \times \pi$.

In those cases, where for example the intermediate disk member **14** of the looping device has a larger diameter than the core of spools or for some other reason, does not have a sufficiently small radius to accomodate the diameter of the wire, then it is necessary to either turn the annular ring **11** or the intermediate disk member **14** about the longitudinal axis of the spools so as to adjust the position of the slit **12** relative to the looping device so that the wire W is passed over and runs over the loop forming device **10** at an earlier stage. That is, the point A is made to lie, for example, along an axially parallel line offset from line m closer to or even coinciding with the point B. In this way it will be noted that the loop length from A to C over the point B then equals $D \times \pi + X$ whereby X is a correction factor which in practice defines the measure of the arc between points A and C as if a linear addition were made based upon a planar development of the points A and B, and for the arc between B and over flange **2** in the same manner. As seen in FIG. **6** the points A and B thus lie upon the axial line *m'*, being on the cover of

the wound wire, while the point C is offset therefrom and lies along a parallel line *n*.

The looping device is constructed in two parts as seen in FIG. 2 in order to enable it to be quickly and securely adjusted to correspond to any modification in the wire diameter and modification in the circumference D × π, which would cause any change in the length of the loop. The portion **17** of the looping device, which normally extends over the flange **2**, is fixedly secured to the flange while the lower portion **16** is provided with a rectangular hole through which an eccentrically mounted or an eccentrically peripheral cam **18** extends. Rotation of the cam **18** about its axis will reciprocate the portion **16** upwardly or downwardly with respect to the portion **17** along in the direction shown by the double arrow **19** in FIG. **2.** Thus the looping device is adjustable to change the length of the loop to accomodate both factors. To insure linear reciprocation, the portion **16** is provided with a vertical slot **21** through which a pin fixed to a flange **2** extends, and a tail-like portion extending into a conforming slot formed in the upwardly extending portion **17.** In this manner, the portion **16** may be made to move further away or further toward the portion **17** without lateral deflection, thus extending or contracting the looping length with which the wire is intended to come into contact with. The surface of the portion **16** with which the wire comes into contact is preferably formed with longitudinal grooves or splines to provide increased traction for the transfer. The cam **18** extends outwardly of the auxiliary spool and terminated in a square key **20** by which it may be manually adjusted. The key **20** may, on the other hand, be connected by known pulley or transmission means to a suitable electrical or pneumatic or hydraulic motor of any known type so that it may be automatically adjusted. The motor means chosen for this operation may be connected to a computer or similar automatic control mechanism through which the tension as well as the winding of the wire is sensed and in response to which the cam **18** may be adjusted. The automatic operation of key **20** is preferred when the diameter of the material is very variable and a continuous adjustment in the looping length is desired. In this manner a fully continuous shock free transfer of the wire from the auxiliary to the main spool can be obtained.

The present apparatus functions in the following manner:

The wire W is fed in the direction of arrow A to the apparatus from a stationary or even rotating coil storage drum, either by hand or by a suitable automatic feed. The wire is first fastened to the clamping mechanism **6** and a suitable or desirable length of wire such as the damaged end is cut therefrom and wound in one or more windings on the core **9** of the auxiliary spool **5.** The cut end of the wire W is then inserted within the lapping edges **13** of the annular plate **11** by conventional apparatus, not shown in the drawings. As soon as the wire W is placed in this position it becomes fixed at the point A defining it at beginning of the loop. By conventional means, such as mounting the main spool on a rotating mandrel, the spools are rotated about their central axis and the wire is passed over the looping device, where it is transferred and thereafter wound about the main spool in the direction of the arrow **22** as seen in FIG. **6** (the wire being shown by the dot-dash line). Initially the wire W takes the form of a loose or open loop stored about the intermediately positioned looping means **10** and extends to the point B over which it passes the flange **2** onto the main spool. Thereafter, the wire passes onto the core **3** of the main spool contacting it at the point C. At the moment of transfer to the loop from **10** or **14** the wire runs at the same speed as the spool **5** due to mass inertia, and therefore does not initially contact the part **16.** After a small rotation of the spools (about one-half turn) the wire is gripped at the point B and placed over flange **2.** Until the wire comes into contact with the part **16,** it has an additional length which is necessary for it to pass over points B and C. Once the wire reaches the main spool it is thereafter in known manner wound on the main spool being distributed and layed for example in accordance with U.S. Pat. Nos. 3,596,844 or 3,011,730.

The apparatus provides means for maintaining the wire in stress-free condition, as the windings are being transferred from the auxiliary spool **5** to the main spool **3.** Under ordinary conditions the stress-free winding can only be obtained, if the winding length removed from the auxiliary core **5** is equal to the winding length placed on the main core **3.** This is not normally possible in using a main core which is flanged, since either the wire length must be increased to pass over the flange or the wire itself is stressed and stretches to do so. By passing the wire over the intermediate loop forming device comprising the parts **16** and **17,** a length of wire equal to that to be placed on the core **3** can be removed from the auxiliary core **5,** and guided so as to be placed onto the main core without stress. By forming the intermediate loop forming device of two parts, namely the semi-circular portion **16** and the extended portion **17,** the amount of wire looped thereon can be selectively adjusted to maintain this length. Normally, the diameter of the portion **16** is smaller than the core, so that the wire can be accomodated on the portion **17** which must radially extend over the flange.

As seen from the above, the wire is at all times under proper traction within the looping device, and possibility of its slipping or loosing hold as it is transferred is virtually eliminated. Further, the wire is transferred from one spool to another in a smooth continuous manner without undue twist or damage to its surface or density. Adjustment of the looping device to provide a greater or lesser loop length and adjustment of the slit guide disk relative to the looping device enables even greater surety and speed during operation. The provision of a looping device, having an edge, with which the wire is in continuous contact during transfer, which edge is of sufficient circumference and provided with traction means, enables the storage of a sizable loop intermediate the auxiliary and main spools. Further, the stored loop prevents twisting or damage to the wire as it is wound.

The auxiliary spool **5,** the annular guide ring **11** and the looping device may be formed of a unitary assembly, in which the parts are rotatably secured together, and the whole is adjustably and removably attached to the flange **2.** The apparatus is simple and may be inexpensively made from stamped sheet and stock metals. Thus the apparatus may be provided as original equipment for new winding machines or upgrading equipment for existing machinery so as to modernize and increase their productive capacity.

The present invention may also be used to great advangage in those devices employing a well known

"dancer" or looping pulley. The accumulation of wire surplus, in a very short time interval, can be easily retained on the present loop forming device, compared to the dancer which is not able to respond quickly enough to the created surplus to equalize the loop, since the mass inertia of the dancer and the wire speed lie in an entirely different order of magnitude.

Various other changes and modifications to the present invention may be made. It is therefore intended that this disclosure be illustrative only and should not be taken as limiting of the present invention.

What is claimed:

1. Apparatus for transferring wire or the like from one spool to another comprising a main spool and an auxiliary spool coaxially arranged therewith about a central spindle said main spool having a core and a flange at each end, loop forming and storage means mounted about said spindle between said main and auxiliary spools, said loop forming and storage means comprising a first member having an arcuate peripheral edge over which said wire is adapted to move and a second member having an extending portion for guiding said wire over the adjacent flange, said peripheral edge having a radius smaller than the core of said main spool, and said extending portion protruding radially beyond said flange, and means for feeding a predetermined length of wire to said auxiliary spool to be wound thereabout, said wire being subsequently fed to said loop forming and storage device and thereafter wound about said main spool.

2. The apparatus according to claim **1** wherein said first member comprises a flat disk the width of said disk member being at least equal to the diameter of said wire.

3. The apparatus according to claim **1** wherein the extending portion is bent over the associated flange in the direction of said main spool and is adapted to permit said wire to slide thereon.

4. The apparatus according to claim **1** wherein the peripheral edge is provided with longitudinal grooves adapted to receive said wire.

5. The apparatus according to claim **3** wherein said disk is formed with a peripheral edge portion separable from said extending portion, and means for movably mounting said portions to be adjustable toward and away from each other to thereby vary the length of the loop stored thereon.

6. The apparatus according to claim **5** wherein said adjustment means includes a cam extending outwardly of said auxiliary spool and engaging within a hole formed in said peripheral edge portion.

7. The apparatus according to claim **1** including an annular plate arranged between said loop forming and storage means and said auxiliary spool, said plate having a diameter greater than said auxiliary spool and a radial slit through which said wire is adapted to pass.

8. The apparatus according to claim **7** wherein said slit in said annular plate has an edge turned outwardly in the direction of said main spool.

9. The apparatus according to claim **8** wherein said annular plate and said looping and storage means are mounted to be radially adjustable about the axis of said spools relative to each other.

10. The apparatus according to claim **9** wherein said auxiliary spool, said annular plate and said looping and storage device are assembled in a unit separate from said main spool.

11. The apparatus according to claim **1** wherein said loop forming and storage means is fixed to said spindle to rotate conjointly therewith.

* * * * *