DEVICE FOR HANDLING WIRE AND STRANDS

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ABSTRACT OF THE DISCLOSURE

A temporary store for wire or the like comprises a stationary disk with bulged periphery onto which the wire is wound and from which sequential loops are produced by a wobble ring to drop along a cylinder of smaller diameter or through a bore from which the wire is unwound to the extent needed. Additional features relate to the speed control of winding and/or unwinding.

The invention relates to a device for temporarily storing elongated material such as wires, cord, strands, cables, strings, endless fibers, etc., which permit reeling and will in the following be called reeling material.

The manufacturing of wire, particularly of high quality electric wires, whether it be insulated or blank requires a constant speed of the wire particularly in the last stages of the manufacturing process, and thus the wire will be withdrawn from the machinery which manufactures the wire, at a constant rate or speed. Particularly in case insulation is applied in one of the manufacturing steps, the speed of the wire withdrawal has to be constant very accurately in order to provide a uniform thickness of the insulation on the wire. On the other hand, the reeling and winding of the wire on individual reels or spools is a process which inherently is a discontinuous or intermittent one, as each spool or reel has only a finite capacity. It follows that there is, on one hand a continuous withdrawal of the manufactured wire and, on the other hand, the next process step for the wire is an intermittent one such as winding on spools, as for an exchange of a full reel or spool for an empty one a particular period of time is required during which wire as manufactured cannot be wound even though the issuing of the wire from the source continues. It follows that for overriding this period it is necessary to provide for temporary storage of the wire, unless one uses two winding mechanisms and alternates between them. There is, however, inherently still a short-duration discontinuation covering the period of time it takes to switch over from one winding mechanism to the other one. Moreover, this duplication of winding mechanisms is disadvantageous. Furthermore, it is desirable to provide for an opportunity to inspect and accept or reject the manufactured material which is difficult to impossible if the material leaves the manufacturing device at a high rate and is wound on a spool instantly. Temporary storage of wire has been used but with limited success, and known devices require particular adaption to either the source or the subsequent processing or both.

It is an object of the present invention to provide for such temporary storage of a reeling material as between a continuous feeder mechanism such as the output side of a manufacturing device, and an intermittent processing of the material such as the winding thereof on different spools or reels, whereby, however, the character of the source nor the type of subsequent processing enters into the basic features of the invention.

In accordance with the present invention, it is suggested to provide a winding device for winding the reeling material at the rate of its supply onto a stationary disk. There are provided means for guiding the material as it leaves its source into the winding axis and the winding mechanism withdraws the material from this axis position. A stationary store, such as a cylinder is provided underneath the disc and having smaller diameter. At the lower end of the cylinder there is a flange larger diameter than the disc, so that the material as it is wound onto the disc can drop in sequential loops onto the flange. A coaxial unwinding mechanism unwinds the material and guides it toward the subsequent processor. The unwinding mechanism is operable independently from the winding mechanism at least to the extent of permitting separate stopping as intermittently of the subsequent processor, such as a spool winder, may demand.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, the objects and features of the invention and further objects, features and advantages thereof will be better understood from the following description taken in connection with the accompanying drawings in which:

FIGURE 1 illustrates somewhat schematically a cross-sectional view into a temporary store for continuously supplied reeling material in accordance with the present invention; and

FIGURE 2 illustrates pertinent portions of a modification of the device shown in FIGURE 1.

Proceeding now to the detailed description of the drawings, reference number 1 denotes the vertical, central axis for the entire reeling device. This device may be mounted in a housing 100 being provided with appropriate rails, arms, flanges, etc. for supporting the several elements as they are arranged along the axis 1. The supporting elements are only shown in some instances, and only to the extent that they do not distract materially from the clarity of the illustration; the location, position and dimension of such supporting elements will be well apparent to one skilled in the art.

The principal object of the invention, as was mentioned above, is the reeling and temporary storage as well as final winding on a spool of continuous strand, cord, wire, thin cable or the like. Such a reeling material is denoted with reference numeral 4 as it emerges from, for example, a payout reel or any other feeder source which is not shown. The main purpose of the invention is the temporary storage of such reeling material where issued by a source continuously. For example, the source may be manufacturing facility drawing thin wires and providing them with an insulating coating. The reeling material 4 is guided towards a guide pulley 5 which is mounted on housing 100 for rotation about a horizontal axis and in a manner which permits pivoting around the vertical axis 1. The pivot motion maintains the axis of pulley in the horizontal, and in any position axis 1 forms a tangent to the periphery of the pulley 5. Thus, the pulley 5 guides the reeling material 4 from an adjustable direction into the axis 1.

The material 4 enters the housing 100 at opening 101 and traverses a hollow shaft 31 to run into the interior of a likewise hollow guiding head 2 mounted on the shaft 31. The guiding head 2 has, for example, an axial slot so
that a second guide pulley 6 can reach into the interior of the guide head 2, to engage the reeling material 4 in axis 1. The head 2 additionally supports a bearing block 61 for the pulley 6 so that the pulley 6 can also rotate about a horizontal axis. As the block 61 rotates together with guide head 2 the pulley 6 can thus be rotated about axis 1. In any position of pulley 6 the axis 1 forms also a tangent to the periphery of the pulley.

The pulley 6 guides the reeling material 4 out of the axial and vertical orientation and out of the guiding head 2 towards a third pulley 7, the axis of which is oblique to the axis 1. The pulley 7 is rotatably mounted on an arm 71 which is attached to the guide head 2 for rotation therewith. The shaft 72 of pulley 7 rests on a motor 3. Thus during normal operation the entire arrangement 2, 6 and 71 and 7 will rotate continuously about the axis 1.

The reeling material 4 envelopes the pulley 7 partially and is guided towards a stationary storage feeder disc 8. During rotation of the head 2, reeling material 4 is continuously pulled out or supplied by the source, and the material is wound upon the disc 8. It can thus be seen, that the winding mechanism takes the reeling material always out of the axis 1 and the entire device is thus independent from the orientation relative to the source of the reeling material. This disc 8 has a bulged periphery, and on its upper portion is seated a wobble ring 9 the plane of which is located in a fixed inclined position to head 2 and which is capable of nutating about the axis 1. The pulley 7 feeds the reeling material towards this feeder disc 8 underneath the wobble ring 9 where having the respective highest position at any instant and at a point on disc 8 above the bulge and progressing around the periphery of disc 8 while the axis of ring 9 continues to point away. Thus the reeling material is wound on disc 8 and the wobble ring in turn pushes the loops of wire as they are being wound upon the disc 8 in downward direction.

In view of the fact that ring 9 is to nutate, it cannot be fixed to disc 8. The nutation is, by definition, an axial oscillation of each point of the ring and at progressing phases along the circumference of the ring. That motion can be accomplished by any well known means requiring the lifting of the ring at one point at a time and letting the point of lifting progress around the ring. In the simplest manner, the lifting can be accomplished by the wire 4 itself as it runs off of wire 7. Wire 4 may engage ring 9 at a point from below lifting it up. As the assembly 7-71 rotates the point of lifting rotates likewise, thus producing the nutation of the ring. It is apparent that the requirement for nutation of ring 9 permits in the alternative employment of any means which provide lift to one point of ring 9 with progression of the point of lifting around the axis, and in the same manner as wire 4 can lift the ring 9.

As stated the disc 8 is stationary while the feeding pulley 7 rotates about the axis 1 and tends to wind the wire onto the disc 8. Due to the bulging configuration of the periphery of this disc 8, the loop that is being wound presently sits on the bulge, but as the wobble ring nutates, all loops are pushed down and the respective lowest loop of the reeling material will tend to drop in downward direction.

A stationary cylinder 10 is preferably releasably connected coaxially to stationary disc 8. This releasable connection permits individual exchange of disc and cylinder. The two elements very likely will wear to a different degree so that it may not be necessary to exchange one while an exchange of the other disc is only necessary at a later time. Cylinder 10 has a diameter which is definitely smaller than the outer diameter of the disc 8, so that the wire loops can drop in downward direction, over the cylinder 10 thereby clearing the same. The lower end of cylinder 10 is provided a very broad flange 11 allowing a diameter which exceeds that of disc 8. As the loops drop from the disc 8 they come to rest on the flange 11. The size of the loops is determined by the diameter of disc 8, and the diameter of flange 11 must exceed that of disc 8 to the extent that no loop can ever drop below the flange.

Underneath the flange 11 there is now provided a take-up supporting device 12 which is capable of rotation in that it is being driven by a motor 13 via a belt drive 131, there being a bearing 132 with which the rotating disc 12 bears against the lower end of flange 11. The take-up supporting device 12 has an arm 151 on which is mounted another reel or pulley 15 having an axis obliquely oriented to the axis 1. Upon rotation of motor 13 the arm 151 will rotate about the axis 1. Since over the pulley 15 the wire will thereby be unwound from the flange 11. The feeder control device 2-71-7 and the take-up device 12-151-15 have the same direction of rotation.

A pulley 16 is positioned and mounted in a manner which is analogous to the pulley 6 to guide the reeling material from the pulley 15, first in radial direction into the axis 1. Thus, the pulley 16 is by itself rotatable about a horizontal axis, and its mounting block 161 sits on a take up head 121 supporting disc 12. The take-up head 121 has a slot which permits guidance of the material 4 into the axis 1. The slot of take up head 121 merges into the hollow space of a hollow shaft 132 defining an orifice 17 through which the material 4 leaves the unwinding device in axial direction. Pulley 16 as mounted on its bearing block 161 is mounted for rotation around axis 1 in a manner that again the axis 1 forms always a tangent on the periphery of the pulley 16. The pulley 16 guides the reeling material downwardly in the axis 1 and through the orifice 17. A take-up pulley 18 guides the reeling material out of the axis 1 and carries a take-up reel 14. The pulley 18 is journaled on a bearing block 181 which may be pivoted around the axis 1 in a manner similar to the pivoting of the pulley 5. Again, this pivot motion is, as far as driving is concerned, independent from the rotation of the winding device 2-71-7 and of the take-up or unwinding device 12-151-15.

One can see that during operation reeling material is continuously fed towards the cylinder 10 for storage on the flange 11 and reeling material is being taken up from the flange 11 pursuant to rotation of the take-up device. The feeding and winding device is driven independently from the take-up device, i.e., the feeder pulley 7 rotates about the axis 1 independently from the rotation of the pulley 15 around the axis 1 so that it is possible to permit any particular portion of the reeling material to be at rest on the flange 11 for an adjustable period of time. Thus the quality of the material for example, of a wire, its diameter, etc. can be tested while at rest on the flange 11.

One can see that the structure of this temporary storage device is rather compact, and one can see also that the device can be located in a manner which is entirely independent from the direction of movement of the wire as it leaves the manufacturing facility. In other words, the temporary storage device operates in a manner which is entirely independent from the direction from which wire 4 is supplied. The device also operates in a manner which offers very little wear on the reeling material. The storage capacity of the device depends on the size, i.e. the axial dimension of the cylinder 10. Moreover, the width of the flange 11 which is to be rather large permits large amounts of wire loops to be seated on the flange 11.

Aside from the possibility of testing, the redundancy of the winding and unwinding operations coupled with a large capacity for storage, the device permits temporary stopping of the unwinding operation. This will be necessary if the reeling material such as wire is to be wound ultimately on spools or reels, such as 14. When such a reel or spool is full, it is exchanged, but the exchange of the wire continues to supply it. Thus, for spool or reel exchange, the take-up device, i.e., the motor 13 must be
stopped for an exchange of the take-up reel or spool 14. The capacity of the store, i.e., the length of cylinder 10 must thus be such that a reel or spool exchange will take less time than the filling of the store with loops. This is a very advantageous arrangement as it dispenses with the duplication of a winding mechanism for the take-up reels which is necessary if there is no intermediate storage of the material to override the period of take-up reel or spool exchange.

Of particular advantage is the bulged contour of the disc 8. The device would operate without such bulged periphery; however, it was found to be of great advantage for the uniformity of operation that such a bulged periphery permits the tight winding of the reeling material by operation of the winding drive 71-7. The wobble ring 9 then pushes the reeling material down, over the bulge, so that it can drop freely onto the store. Basically it is not essential that the two devices, i.e., the feeding device for storage and the take-up device are being driven by two different motors. However, this may be of advantage for purposes of control. It is, however, possible to drive only the take-up reel 14. The tension thereby exerted upon the take-up mechanism 12 as transmitted through the reeling material will cause the take-up device 12 to rotate around the axis 1. Due to the resulting wear on the reeling material this may not be too desirable. A Sturdy material, however, may permit this simplification. A modification is shown in FIGURE 2. It is possible to use a common drive such as drive 3 for the feeder or winding elements of the store device as well as for the unwinding device, i.e., the head 121 and the head 2 could be driven, for example, by the motor 3. The motor 3 is not shown in FIGURE 2, but the take-up or unwinding control disc 12 sits at the low end of a shaft 134 which is connected to or is integral with head 2, thus traversing cylinder 10 and disc 8. There is, however, a reusable clutch 135 interposed between shaft 134 and disc 12, as it is necessary to stop the unwinding mechanism.

A brake 133 is provided engaging head 121 or disc 12 to decouple the unwinding device from the motor 3 and from the rotating shaft 134 when, as mentioned above, the full spool 14 has to be exchanged for an empty one.

As further shown in FIGURE 1 of the drawings, there is provided a photoelectric control device 19 shown only schematically and comprising two photoelectric sensing stations 19a and 19b mounted on the interior rate of housing 100 and facing light sources 191a and 191b respectively; these light sources are mounted in cylinder 10 and are flush with the periphery thereof. These two stations are positioned in different heights of the flute 11. Should the device 19a monitor that the height of the wire as deposited on flute 11 drops below the level as determined by the photoelectric device 19a then a control stage 20 will cause the take-up drive 13 to slow down. It may even be desirable to adjust the control of the motor 13 so that the motor will stop entirely when the height drops below this level as determined by the photoelectric device 19a.

On the other hand, the higher positioned photoelectric device 19b will determine that the take-up motor 13 has to run considerably faster if the wire as deposited on the flute 11 has reached the height of the photoelectric device 19b and motor 13 will be caused to speed up. As long as the loops on flute 11 reach a height above the level as determined by detector 19a, covering light source 191a, but not covering light source 191b, control device 20 will cause motor 13 to speed up to reach the speed of motor 3. For purposes of exchanging the take-up reel 14 the motor 13 is being stopped, for example, by means of a switch (not shown). Thereafter the amount of loops that will be deposited on flute 11 will continuously increase. If after an exchange of the take-up reel 14 the motor 13 is again turned on, then the control will take over and should the loops have reached level 19b in the meantime, inherently this take-up device 12 advances at a much faster rate than the supply rate to reduce the amount of reeling material that is being stored and deposited on the flute 11, until the level drops below the level as determined by the photoelectric device 19b. After the normal speed relation will be resumed with motors 3 and 13 running at speed synchronism. It is apparent that the height of the cylinder 10 and here particularly a rather large capacity of this cylinder 10 permits large phases of asynchronous rotation of the two drives 3 and 13.

It is apparent that the dropping loops from the disc 8 down towards the flute 11 necessarily passes the photoelectric barrier as set up by the two photoelectric control devices 19a and 19b. It is of course undesirable to cause a response of the photoelectric devices when a portion of the reeling material passes through the scanning range. Therefore, one will include in the control device 20 circuitry which processes the signals as provided by the photoelectric devices 19a and 19b to provide delays or reduction of the response of the elements so that only quasistationary changes in the illuminating conditions are actually being monitored by the two photoelectric devices.

It is advisable to control the drive which runs the take-up reel or spool 14 for constant tension of the reeling material. This means that the drive 141 for the take-up reel 14 will be controlled indirectly in response to behavior and performance of the drive for the take-up device 12. This is advisable because the reeling material should be subjected to very little wear and tear and tensioning in this post-manufacturing process stage.

With this I proceed to the preferred relation among the several drives. The temporary store described is to be a largely autonomous unit. On the other hand, it is conceivable to couple the transmission 32 driving the winding and feeding device for the store, to the source for the reeling material 4, as for reasons of careful treatment of the material it should be wound at exactly the same rate as it is being supplied. In case one uses the drive 3, one can see that the speed of the drive 3 is determined primarily or even exclusively by the speed with which the source for the wire delivers the reeling material 4. Therefore, this drive 3 can either be controlled in synchronism with or in direct dependence upon the operating mechanism in the source, which in case of manufactur-
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slaved to drive 3. It follows therefore, that the winding mechanism constituting the input for the store is controlled with the rate of supply of the material; the unwinding mechanism is controlled in accordance with the state of filling of the store and will normally run at the same rate as motor 3 (which in case of FIGURE 2 is of course inherently the case). With detector 19a in the on state and detector 19b in the off state, the synchronism of the drives may be a direct one to be overridden only by a change in the control state of detectors 19a and 19b. Alternatively, motor 13 may run somewhat slower with detector 19a off, detector 19b on. When detector 19b is also off, motor 13 is then caused to run faster. In this case motor 13 would only in the average have the same speed as motor 3. Tension drive 14 then in turn follows drive 13.

The relation between drives 13 and 141, however, can be reversed; drive 141 is controlled, as before, for constant tension, but drive 13 is a follower drive synchronized thereto, while detectors 19a and 19b can override the control if the store becomes too full or almost empty. Details of the control will be apparent to one skilled in the art, nor is a particular type of control essential as long as drive 3 follows the supply rate of the material, and drive 13 follows the intermittivity of the subsequent processing as well as the filling state of the store.

The invention is not limited to the embodiments described above but all changes and modification thereof not constituting departures from the spirit and scope of the invention are intended to be covered by the following claims.

What I claim is:
1. A temporary store for interconnection between a continuous supply source of wire, cord, thread or strand like reeling material and a discontinuous process device for the material, comprising:
   a stationary disc having a periphery permitting the reeling thereon of the material in sequential loops;
   means for winding said continuously provided material onto the periphery of said disc;
   a stationary cylinder having a diameter smaller than said disc and being positioned in relation to the disc so that the respective lowest loop when dropping from the disc clears the circumference of the cylinder;
   a flange underneath the cylinder extending radially therefrom at a diameter larger than said disc;
   means for unwinding the loops from the flange as they sequentially drop from said disc along said cylinder, and means for winding said material into the axis; and
   means for withdrawing said material from its position in said axis and for feeding it towards said discontinuous process device.
2. A device as set forth in claim 1, said disc having a bulged periphery.
3. A device as set forth in claim 1, said stationary disc and said cylinder being releasably connected to permit independent changing thereof.
4. A temporary store for interconnection between a continuous supply source of wire, cord, thread or strand like reeling material and a discontinuous process device for the material, comprising:
   a stationary cylinder having a vertically oriented axis and a flange on its lower end;
   a disc on the upper end of the cylinder having a diameter larger than the cylinder but smaller than the flange;
   first means for rotating about said axis in the vicinity of said disc for winding the material onto the disc in sequential loops, the loops sequentially dropping from the disc onto the flange;
   second means for rotation about said axis for unwinding the material from the flange;
   means for driving the first means in accordance with the rate of continuous supply of the material; and
   means for driving the second means in relation to the intermittivity of operation of the discontinuous process device.
5. A temporary store according to claim 4, comprising means for providing a representation of the amount of material on the flange and for controlling the speed of the second means in response to said representation.
6. A temporary store for interconnection between a continuous supply source of wire, cord, thread or strand like reeling material and a discontinuous process device for the material, comprising:
   a stationary cylinder having a vertically oriented axis and a flange on its lower end;
   a disc on the upper end of the cylinder having a diameter larger than the cylinder but smaller than the flange;
   first means for rotating about said axis in the vicinity of said disc for winding the material onto the disc in sequential loops, the loops sequentially dropping from the disc onto the flange;
   second means for rotation about said axis for unwinding the material from the flange;
   means for feeding the unwound material towards a spool;
means for driving the spool at a rate of constant tension of the material as fed to the spool; and means for driving the first means continuously and the second means intermittently.

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