Jan. 1, 1946. L. HORNBOSTEL 2,392,148

REEL

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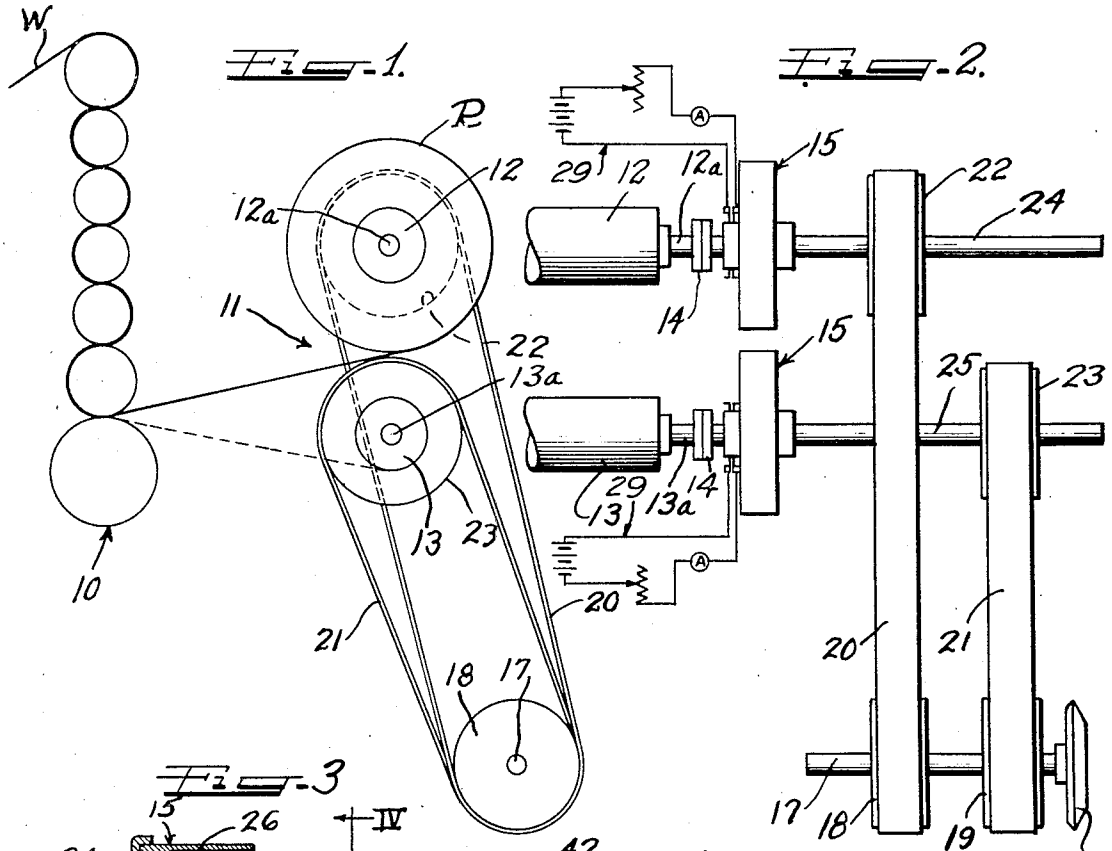

Fig. 1.

Fig. 2.

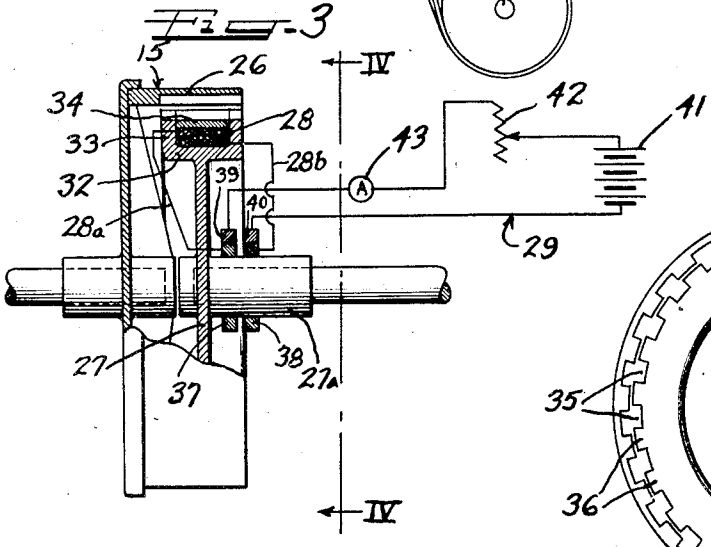

Fig. 3.

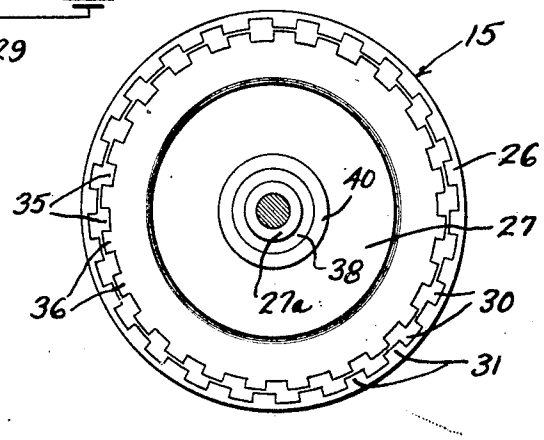

Fig. 4.

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Fig. 5.

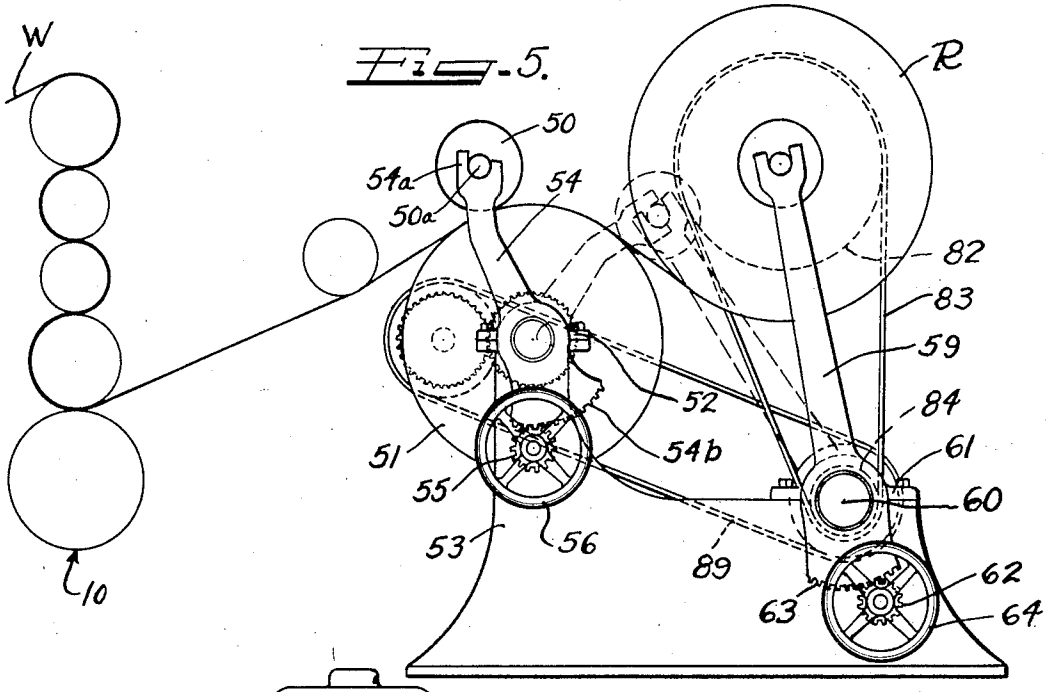


Fig. 6.

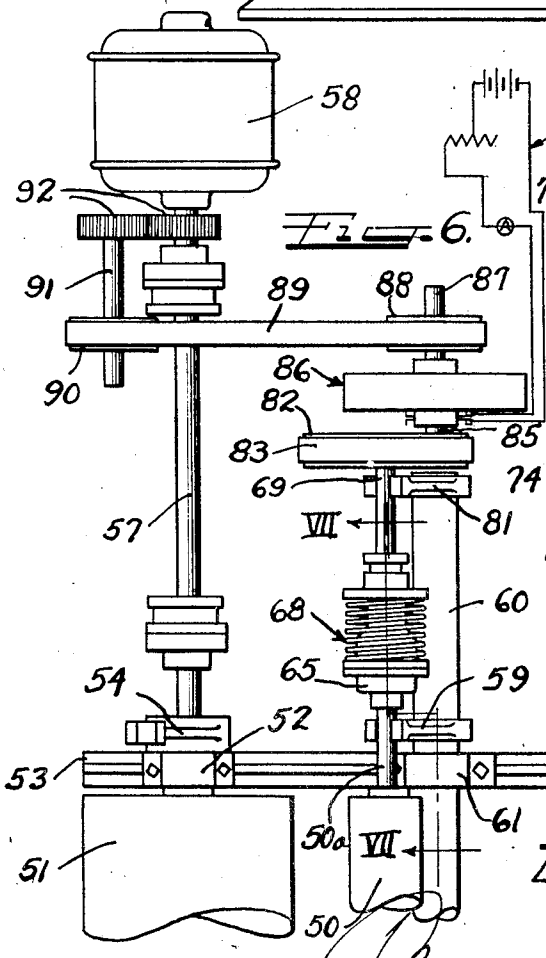
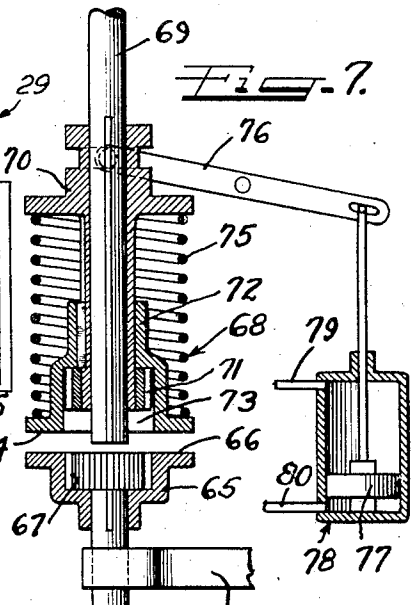


Fig. 7.



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UNITED STATES PATENT OFFICE

2,392,148

REEL

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6 Claims. (Cl. 242—65)

This invention relates to reel assemblies especially adapted for the winding of paper as it issues from a paper making machine into a roll. More specifically the invention relates to a drive assembly for winding reels which rotate the winder shaft at decreasing speed but under increasing torque as the roll builds up, so as to keep the material being wound under a constant predetermined tension.

Paper issuing from a paper making machine moves continuously at a constant rate of travel and must be immediately wound into rolls so as to prevent puckering and wrinkling thereof. As the roll of paper increases in diameter, each revolution of the roll effects the winding of a greater length of paper because the roll has a constantly increasing circumference. Furthermore, as the roll increases in diameter, more driving effort is required to rotate a substantially completed roll of paper than is required to rotate the winder shaft alone or a partially completed roll of paper, due to the paper being wound at a continually increasing radius, which in turn means increasing driving effort or torque at the shaft to keep the paper tension constant.

In accordance with this invention, reels are now equipped with a driving mechanism which permits a reduction in driving speed in terms of revolutions per minute to maintain a constant paper speed, so that the paper will be held under constant tension. In other words, as the roll builds up the driving mechanism of this invention automatically slows down.

Another feature of the driving mechanism of this invention is the automatic increase of torque output or driving effort to the roll being wound as the roll increases in size and weight. In other words, as more torque on the driving mechanism is needed as the roll gets larger, the driving effort or torque capacity of the driving mechanism increases. The increase in driving effort or torque is automatically taken care of simultaneously with the decrease in speed of the roll being wound.

The automatic increase in driving effort or torque as the roll gets larger is accomplished by means of a dynamatic clutch or eddy current coupling composed of an armature drum, a magnetic spider and coil, and means for exciting the coil to create a magnetic field inducing eddy currents in the drum and spider, acting as a slip coupling between the drum and spider. These clutches or couplings have no rubbing parts and always slip to an extent predetermined by the torque or driving effort applied and the excitation of the coil. When the coil is deenergized, the parts are completely uncoupled. When the coil is fully energized, slippage will still occur. The faster the clutch slips the more driving effort or shaft twist it transmits.

It is then an object of this invention to provide a reel assembly for winding webs into rolls while automatically maintaining a constant tension on the web being wound.

A further object of this invention is to provide a paper reel assembly with a driving mechanism including an electric slip coupling that permits the roll being wound to slow down as it increases in size, while at the same time delivering more driving effort to the roll as it gets larger in diameter.

Another object of this invention is to provide a reeling apparatus which automatically takes care of imparting more driving effort to the roll being wound as the roll increases in size.

A specific object of this invention is to provide a paper reel mechanism with eddy current slip couplings acting as cut-off clutches to disconnect a reel spool from the driving mechanism whenever the full size roll has been wound.

A further object of this invention is to provide a reeling mechanism wherein the reel spool is initially rotated in contact with an under drum until the roll reaches a predetermined size, whereupon the roll is rotated out of contact with the winder drum at decreasing speeds which maintain a constant surface speed to retain constant tension in the web.

Other and further objects and features of the invention will be apparent to those skilled in the art from the following detailed description of the annexed sheets of drawings, which, by way of preferred examples, illustrate two specific forms of the invention.

On the drawings:

Figure 1 is a somewhat diagrammatic side elevational view of a vertical reel, including a pair of superimposed reel spools which are separately driven and adapted to successively receive paper from the calender stack of a paper machine;

Figure 2 is a fragmentary front elevational view of the vertical reel shown in Figure 1 and illustrating the drives for the reel spools;

Figure 3 is a side elevational view, with parts broken away and shown in vertical cross section, of a dynamatic or eddy current clutch used in the drive assembly for the reels shown in Figures 1 and 2;

Figure 4 is a view taken along the line IV—IV of Figure 3;

Figure 5 is a side elevational view of a modified form of reel wherein the reel is initially wound in contact with an under drum until it reaches a predetermined size and is then shifted out of contact with the drum and rotated through an electric slip coupling shown in Figures 3 and 4;

Figure 6 is a fragmentary top plan view of the reel illustrated in Figure 5 and particularly showing driving mechanism for the winding drum and reel spools; and

Figure 7 is an enlarged view, with parts in longitudinal cross section, taken along the line VII—VII of Figure 6.

As shown on the drawings:

In Figure 1 the reference character W designates a web of paper passing around the rolls of a calender stack 10 of a paper making machine (not shown). The web is directed from the calender stack 10 to a vertical reel assembly indicated generally at 11 and composed of a top spool 12 and a bottom spool 13. As shown in solid lines, the web is wound into a roll R on the reel spool 12. As shown in dotted lines, the web can next be wound on the bottom reel spool 13 when the roll R is completed. The reel spools 12 and 13 are removably mounted in suitable bearings so that, if desired, the completed roll can be removed from the vertical stack and additional reel spools inserted in the stack for receiving the web W. The web is alternately wound on the top and bottom spools, so that the reeling operation is uninterrupted.

As shown in Figure 2, the spool 12 has an axle 12*a* joined through a coupling 14 to the driven part of a dynamatic or eddy current clutch 15. Likewise, the spool 13 has an axle 13*a* joined to another dynamatic clutch 15 through a coupling 14.

A main drive shaft 17 has pulleys 18 and 19 thereon for driving belts 20 and 21 to pulleys 22 and 23, respectively, on shafts 24 and 25 which drive the dynamatic clutches 15. Each reel spool 12 and 13 is thus driven from the same main drive shaft through separate dynamatic clutches 15.

As shown in Figures 3 and 4, each dynamatic clutch 15 is composed of an armature drum 26, a magnetic spider 27 within the armature drum, a coil 28 wound in the magnetic spider, and a direct current energization circuit 29 for the coil 28.

The armature drum 26 is interiorly slotted around the periphery thereof, as at 30, to provide inwardly extending spaced transverse teeth 31.

The spider 27 has a rim portion 32 with upstanding or radially extending end flanges 33 providing a chamber for the coil 28. A plate of nonmagnetic material 34 covers the coil, and the plate and flanges 33 are grooved as at 35 to provide radially extending transverse teeth 36 around the periphery of the spider. The teeth 36 are spaced inwardly from the teeth 31, as best shown in Figure 4, and are never fully aligned therewith, since the spider and the drum preferably do not have the same number of teeth. If the same number of teeth are used they are of different relative sizes or spaced apart in a manner so that they will never be fully aligned.

As best shown in Figure 3, the spider 27 has a hub portion 27*a* carrying slip rings 37 and 38 in insulated relation. Brushes 39 and 40, respectively, are provided for the rings 37 and 38 to engage the same in electrical contact therewith. The brushes 39 and 40 are stationary and have rubbing contact with the rotatable rings 37 and 38.

The coil 28 is wound annularly around the spider 27 and one end 28*a* thereof is connected to the ring 37, while the other end 28*b* thereof is connected to the ring 38.

The brushes 39 and 40 are joined in the circuit 29 which includes a source 41 of direct current, a rheostat 42 and an ammeter 43.

The armature drum 26 is driven by a shaft 24 or 25 in the drive assembly shown in Figure 2. The spider 27 drives a coupling 14 which is joined to the axle 12*a* or 13*a* of the reel spools 12 or 13.

When the coil 28 is deenergized the armature 26 will rotate freely around the spider and the spool controlled by the clutch will not be rotated. However, when the coil 28 of the clutch is energized, a magnetic field or flux surrounding the coil 28 is created in the spider and armature and this field tends to serve as an electrical coupling between the spider and armature. The electrical coupling always allows a certain degree of slippage between the drum and the spider, so that the drum will always rotate faster than the spider. The degree of slippage is controlled by the diameter of the roll of paper being wound and by the rheostat 42 in the circuit 29, which determines the driving effort or torque transmitted through the clutch.

When paper W is being wound on the reel spool 12 as shown in Figure 1, the dynamatic clutch 15 controlling this spool has the coil thereof energized while the coil in the other clutch 15 is deenergized. The reel spool 12 will thereby be rotated, while the reel spool 13 will be at rest, even though both shafts 24 and 25 are being rotated. The clutches therefore serve as a cut-off for the spools from the driving mechanism.

The rheostat 42 is set to deliver a predetermined amount of excitation from the source 41 to the coil 28 sufficient to produce the correct amount of clutch torque or driving effort to the spool 12 to maintain proper tension in the web between the calender stack 10 and the spool. As the roll of paper R builds up on the spool 12, the clutch slip increases, thereby causing the clutch to produce more driving effort. This takes place automatically, without resetting the rheostat 22.

When the clutch slips faster it also delivers more driving shaft twist or torque to the spool 12, thereby automatically taking care of the increased torque necessarily resulting from the increased diameter of the roll.

When the roll R is completed the paper is severed from the roll and directed around the reel spood 13. The clutch controlling the spool 12 has the coil thereof deenergized, while the clutch controlling the spool 13 has the coil thereof energized to effect rotation of the spool 13. A roll is thus built up on the reel spool 13 while the roll R on the spool 12 is removed from the apparatus by merely uncoupling the spool from the coupling 14. A new spool is placed in the coupling 14, to be ready for operation when the roll on spool 13 is completed.

The drive assembly for the vertical reel described above is practically fool-proof and is entirely automatic in operation. The rolls of paper wound by the reels are uniform and the paper is always maintained under a tension which is readily determined by the degree of excitation of the coils in the dynamatic clutches.

In the modification shown in Figures 5 to 7, the web W from the calender stack 10 is directed

around a reel spool 50 driven by contact with a drum 51 which is rotatably mounted in suitable bearings 52 on a frame 53. Arms 54 are swingably mounted at the ends of the drum 51 and have forked ends 54a receiving the axle ends 50a of the reel spool 50. The arms are adapted to be swung for carrying the reel spool around the drum 51 by means of pinions 55 acting on gear segments 54b at the bottom of the arms. The pinions 55 are rotated by means of a hand wheel such as 56.

As shown in Figure 6, the drum 51 is directly coupled to a shaft 57 driven by a prime mover such as an electric motor 58. A second set of arms 59 are fixedly mounted on a shaft 60 extending through the frame 53 and rotatably supported from the frame in bearings such as 61. The shaft is adapted to be rotated to swing the arms toward and away from the winder drum 51, as illustrated in Figure 5, by means of a pinion 62 which meshes with the gear segments 63 on one or both of the arms 59. The pinion or pinions are rotated by a hand wheel 64.

As shown in Figures 6 and 7 the extending axle portion 50a of the reel spool 50 has a coupling 65 secured on the end thereof and presenting a flat clutching face 66 and an internal ring gear 67 to a syncromesh clutch indicated generally by the reference character 68. As best shown in Figure 7, the clutch 68 is slidably keyed on a shaft 69 and is composed of a slidable sleeve 70 with a gear 71 on the leading end thereof adapted to mesh with the ring gear 67.

A coupling 72 is slidably keyed on the sleeve 70 and provides a chamber 73 surounding the gear 71, together with a friction face 74 adapted to frictionally engage the face 66 of the coupling 65. A spring 75 urges the face portion 74 of the coupling 72 beyond the gear 71, so that the friction face 74 will initially engage the friction face 66.

The sleeve 70 is actuated toward and away from the coupling 65 by a lever 76 controlled by the piston 77 of a fluid pressure operated jack 78. Air or oil is introduced to either side of the piston in the jack through tubes 79 or 80 for controlling the coupling or uncoupling of the syncromesh clutch. When the piston is actuated to slide the sleeve 70 toward the coupling 65 the faces 74 and 66 will initially engage to bring the speed of the coupling 72 up to the speed of the coupling 65. Continued movement of the sleeve 70 will effect a compression of the spring 75 so that the gear 71 can project from the chamber 73 to mesh with the ring gear 67 and lock the axle 50a to the shaft 69.

As shown in Figure 6, the shaft 69 is rotatably supported in the bearing end of an arm 81 which is secured on the shaft 60. A pulley 82 is secured on the end of the shaft 69 beyond the arm 81 and is driven through a belt 83 from a pulley 84 on the driven shaft 85 of a dynamatic clutch 86. The shaft 85 is aligned with the shaft 60 so that shaft 60 can be rotated to swing the spool 50, the syncromesh clutch 68, the shaft 69, and the pulley 82, without interfering with the driving of these parts.

The driving shaft 87 for the dynamatic clutch 86 has a pulley 88 thereon driven by a belt 89 and a pulley 90 on a stub shaft 91 which is geared through gears 92 to the main drive shaft 57 driven by the motor 58.

The dynamatic clutch 86 is exactly the same as the clutch 15 illustrated in Figures 3 and 4 and described above.

The reel spool 50 is initially mounted in the yoked ends 54a of the arms 54 and is allowed to rest on the directly driven winder drum 51. The web of paper W passes between the spool 50 and the winder drum 51 and is wound around the spool. The drum 51 is driven at a speed synchronized with the speed of travel of the paper issuing from the calender stack 10 and the spool is rotated by frictional contact, through the paper, with the drum 51.

The starting of the winding of a roll of paper on a driven drum is highly desirable, as it makes it possible to start the sheet around the new reel spool without breaking the paper between the calender and the reel. However, as the roll increases in weight the reel drum tends to press into the roll, forming a depression therein and changing the winding radius. Therefore it is highly desirable that a different set of winding conditions be used to complete the winding of the roll once it has been started. In accordance with the machine shown in Figures 5 to 7, the partially wound roll is then moved over the surface of the winder drum 51 by actuation of the hand wheel 56 to swing the arms 54 for depositing the partially wound roll and reel spool into the arms 59. The reel spool, however, has to be positively driven when it is moved out of driving engagement with the winder drum 51, and this is accomplished through the syncromesh clutch 68 and the driving connection shown in Figure 6. The driving connection is through a dynamatic clutch which always slips, as explained in connection with Figures 3 and 4, and which automatically slows down as the roll diameter increases. However, as the roll slows down, the dynamatic clutch must slip faster and this automatically increases the driving torque capacity of the clutch so that additional power is available for handling the increased torque at slower rotating speed. The arms 59 are then swung by the hand wheel 64 to move the roll out of contact with the winder drum.

The reel shown in Figures 5 to 7, therefore, provides two sets of winding conditions, each especially adapted for carrying out the desired functions at various stages of the winding operation.

As the roll R is completed on the arms 59 a new reel spool can be mounted in the arms 54 for receiving the web of paper as soon as the same is severed from the roll R, and the winding operation can continue without interruption. It is quite easy to switch the web to a new spool, since the web passes through a nip between the new spool and the drum 51.

The dynamatic clutch drive for the reel mechanism shown in Figures 5 to 7 automatically maintains uniform tension in the web of paper being wound.

I claim as my invention:

1. A reel comprising a winder drum, arms swingably mounted at the ends of said drum, a reel spool removably seated in said arms for movement therewith over the periphery of the winder drum, means for driving said winder drum at a constant rate, a second set of swingably mounted arms adjacent said winder drum adapted to receive the reel spool from the first mentioned set of arms, a syncromesh clutch swingable with said second mentioned arms and adapted to drive the reel spool, an electric slip coupling driving said syncromesh clutch, and means connecting said slip coupling with the driving means for said winder drum.

2. A reel comprising a winder drum, a motor

for rotating said winder drum, means for rotatably supporting a reel spool against said winder drum for rolling a web of paper around the spool, means for removing the partially wound roll of paper from the winder drum, means driven by said motor for driving the partially wound web of paper out of contact with the winder drum, and an eddy current slip coupling interposed between the driving means for the winder drum and the means for driving the roll out of contact with the winder drum to maintain constant tension of the paper being wound.

3. A reel comprising a winder drum, a prime mover directly coupled to said winder drum, a reel spool, means for moving the reel spool from a position cooperating with said drum to be driven by the drum to a position spaced from said drum to be free from driving cooperation with the drum, an armature driven by said prime mover, a magnetic spider driven by said armature, a clutch releasably coupling the magnetic spider with said reel spool when the spool is in spaced relation from the winder drum, and a direct current energization circuit for said magnetic spider to electrically slip couple the spider and armature for relative slipping movement therebetween whereby said reel spool, driven through said armature and magnetic spider, will maintain the same surface speed of the roll being wound as it increases in size for maintaining a constant tension on the material being wound.

4. A reel device adapted for winding a relatively wide web of paper into rolls as it issues from a paper making machine which comprises a reel spool, means for rotating the reel spool to wind a wide web of paper around the spool into a roll, an eddy current slip clutch including driving and driven parts between the reel spool and said means, said driving and driven parts having spaced opposed parallel radial teeth with a continuous air gap therebetween, said teeth of said parts being arranged so that the teeth of one part are always progressively misaligned with the teeth of the other part, a coil on one of said parts for creating an electrical coupling between the teeth of said parts, and means for providing a fixed exciting current for said coil whereby said parts will be electrically slip coupled together to drive the spool from said driving means with the driving part always rotating faster than the driven part and slipping relative to the driven part in amounts which automatically increase as the roll of relatively wide paper being wound on the spool increases in size and weight to drive the spool at lower angular speed but with an increased driving twist.

5. A winder comprising a winder drum, arms swingably mounted at the ends of said drum, said arms adapted to removably receive a spool to guide the spool over the periphery of said winder drum, a motor for driving said winder drum, a second set of swingably mounted arms adjacent said winder drum adapted to receive a spool from the first mentioned set of arms for carrying the spool out of contact with the winder drum, a clutch swingable with said second set of arms adapted to drive a spool seated in said second set of arms, and an eddy current coupling having a driving part driven by said motor and a driven part driving said clutch, said coupling having an excitation coil to slip couple the driving and driven parts thereof, and an energization circuit for said coil for exciting the coil to couple the driving and driven parts as they slip relative to each other whereby the rate of slippage will increase as the material being wound on the spool increases in size and weight to drive the spool at lower angular speeds but with increased driving torque.

6. A reel assembly for winding relatively wide paper into rolls as the paper issues from a paper making machine which comprises a pair of superimposed rotatably mounted reel spools adapted to successively receive the paper from a paper making machine, a main drive shaft, an auxiliary drive shaft for each of said reel spools, means coupling said auxiliary drive shafts with said main drive shaft, an eddy current clutch interposed between each auxiliary drive shaft and a reel spool for coupling the spool with its auxiliary drive shaft, said eddy current clutch including driving and driven parts having spaced opposed parallel radial teeth with a continuous air gap therebetween, said teeth of said parts being arranged so that the teeth of one part are always progressively misaligned with the teeth of the other part, a coil on one of said parts for creating an electrical coupling between the teeth of said parts, and means for providing a fixed exciting current for said coil whereby said parts will be electrically slip-coupled together to drive the spool from said driving means with the driving part always rotating faster than the driven part and slipping relative to the driven part in amounts which automatically increase as the roll of relatively wide paper being wound on the spool increases in size and weight to drive the spool at lower angular speed but with an increased driving twist.

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