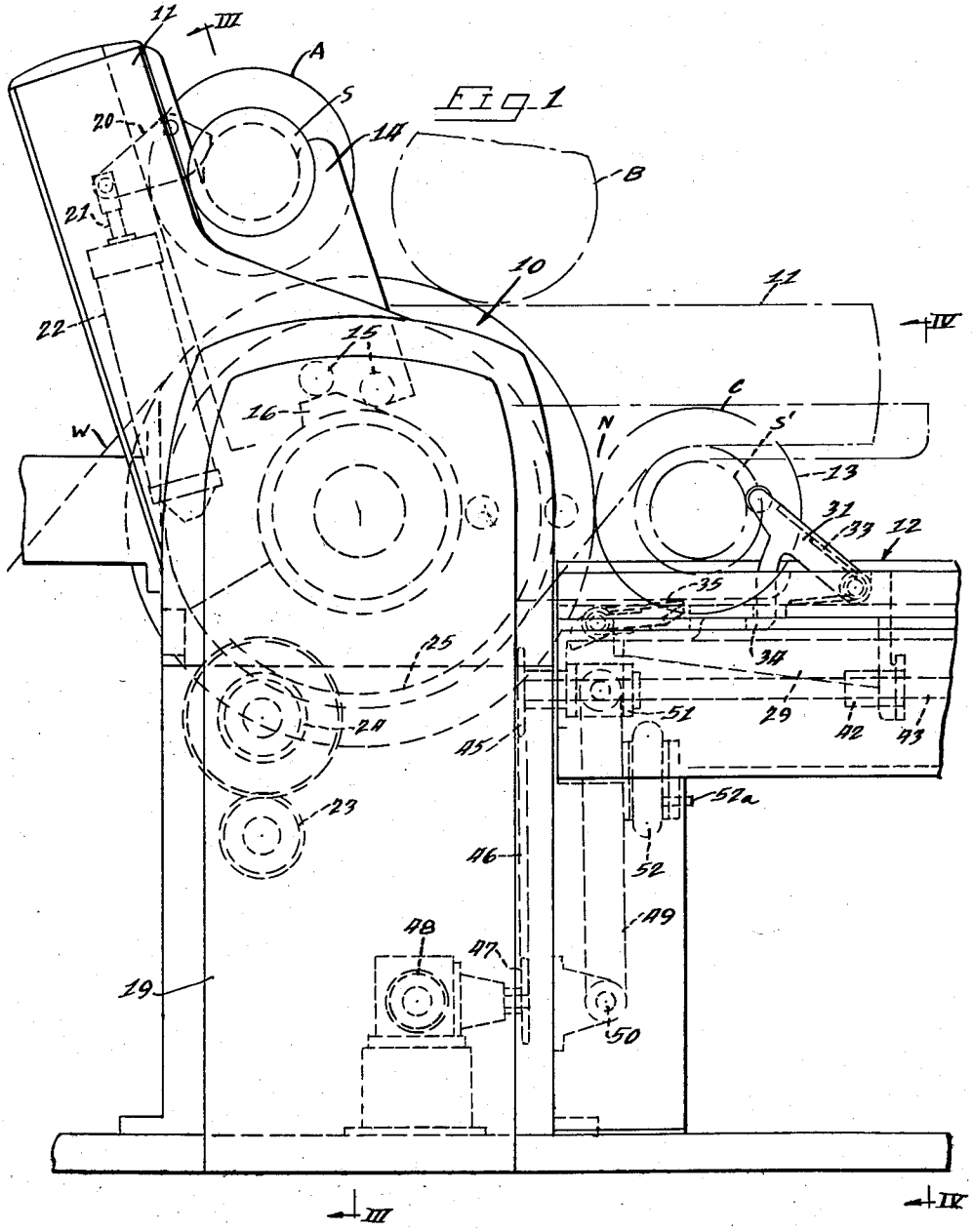
Dec. 31, 1963 L. A. MOORE ETAL 3,116,031

HORIZONTAL REEL

Filed March 2, 1962 4 Sheets-Sheet 1

Fig. 1



INVENTORS
Lawrence A. Moore
BY Elmer E. Crist
Loyal H. Hess

Hill, Sherman, Meroni, Chase & Simpson ATTORNEYS

Dec. 31, 1963 L. A. MOORE ETAL 3,116,031

HORIZONTAL REEL

Filed March 2, 1962 4 Sheets-Sheet 2

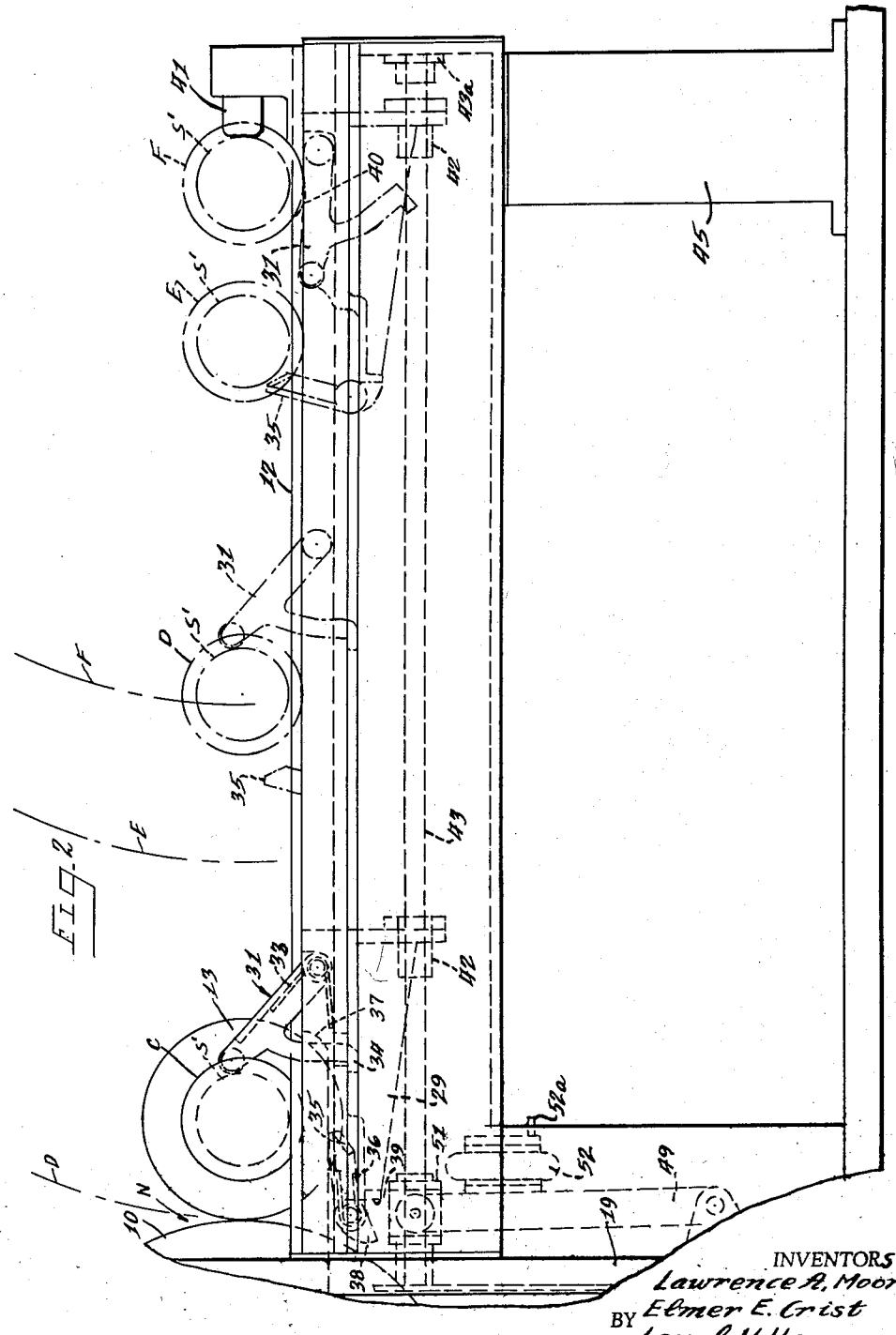


FIG. 2

INVENTORS
Lawrence A. Moore
BY Elmer E. Crist
Loyal H. Hess

Hill, Sherman, Meroni, Gross & Simpson ATTORNEYS

Dec. 31, 1963 L. A. MOORE ETAL 3,116,031

HORIZONTAL REEL

Filed March 2, 1962 4 Sheets-Sheet 3

Fig. 3

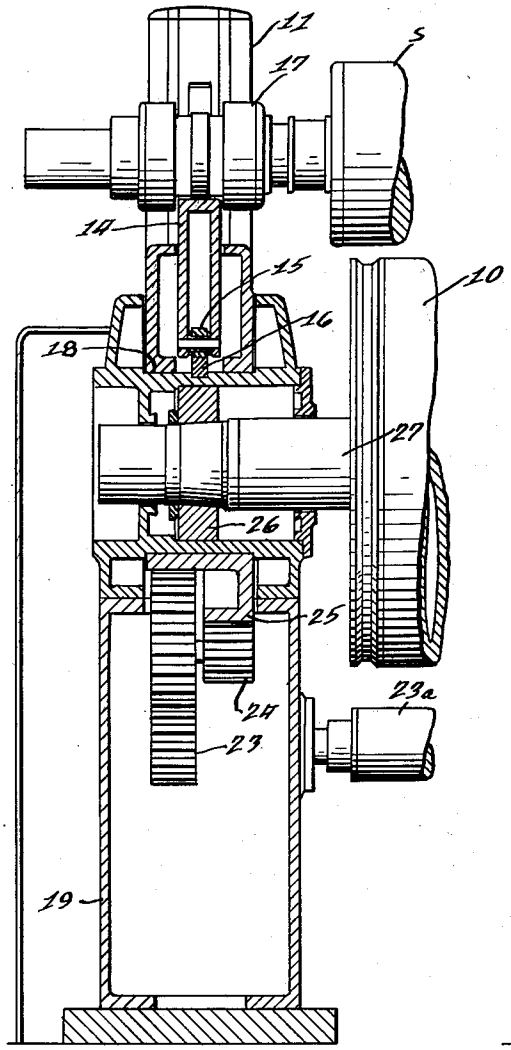
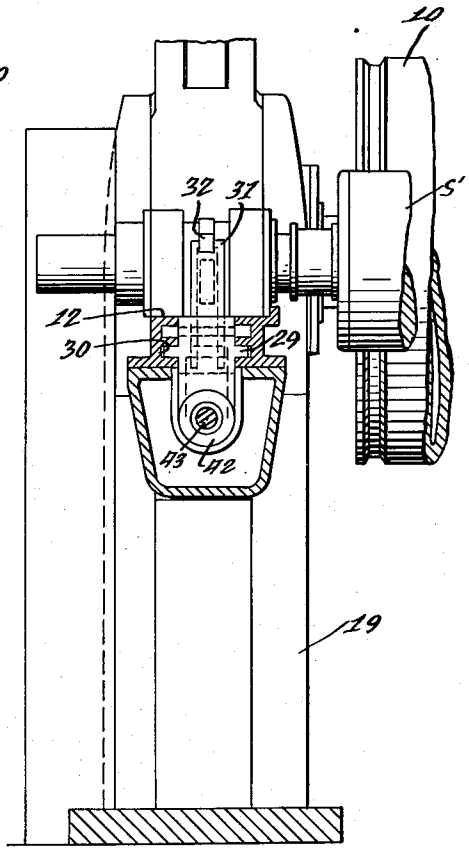


Fig. 4



INVENTORS
Lawrence A. Moore
BY Elmer E. Crist
Loyal H. Hess
Lill, Sherman, Meroni, Gross & Simpson ATTORNEYS

Dec. 31, 1963 L. A. MOORE ETAL 3,116,031

HORIZONTAL REEL

Filed March 2, 1962 4 Sheets-Sheet 4

Fig. 5

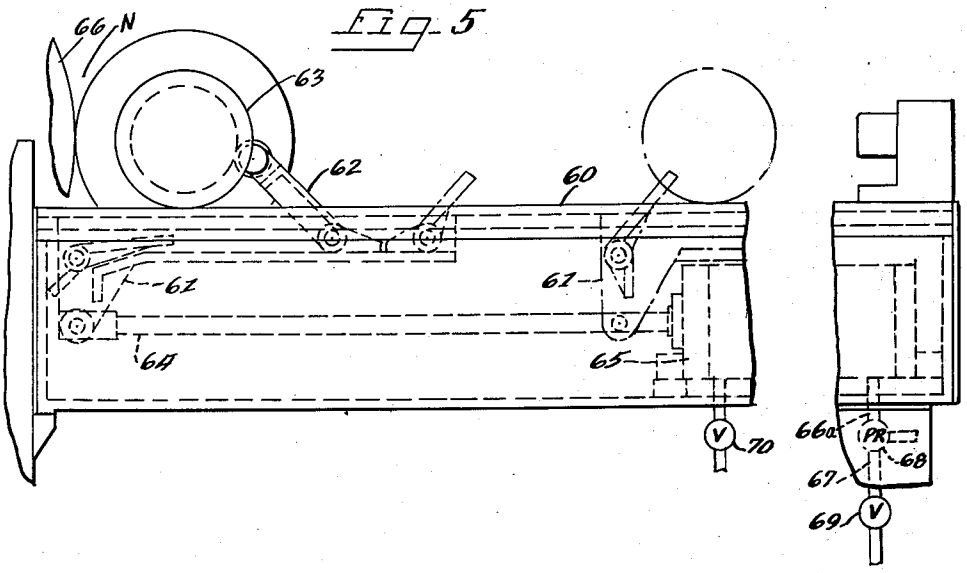
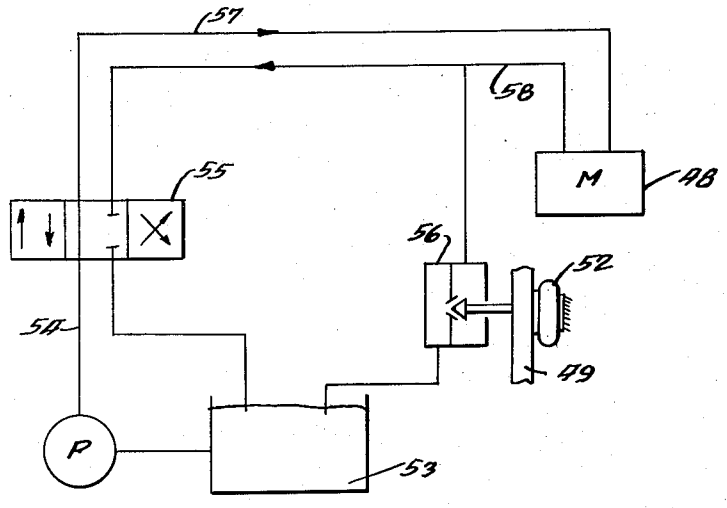


Fig. 6



INVENTORS
Lawrence A. Moore
BY Elmer E. Crist
Loyal H. Hess
Hill, Sherman, Meroni, Gross & Simpson ATTORNEYS

United States Patent Office 3,116,031 Patented Dec. 31, 1963

3,116,031
HORIZONTAL REEL

Lawrence A. Moore, Elmer E. Crist, and Loyal H. Hess, Beloit, Wis., assignors to Beloit Iron Works, Beloit, Wis., a corporation of Wisconsin

Filed Mar. 2, 1962, Ser. No. 176,991
9 Claims. (Cl. 242—65)

The present invention relates to improvements in winding machines for the continuous winding of a web into successive rolls.

The invention relates to a mechanism which is particularly well adapted for winding rolls of paper from a supply, such as received at the delivery end of a papermaking machine. In a paper machine a web of paper is delivered, to be wound on successive rolls, at a uniform speed and the supply is continuous so that as one roll is completed the web must be cut and transferred to start a fresh roll. The webs are conventionally wound on hollow tubular cores or spools which are supported on core shafts.

The completed paper roll in a paper machine is extremely heavy. The weight of the rolls, their rotational inertia, and the relatively high speed of travel of the supply web makes completion of the roll and transfer of the web to a fresh spool a difficult operation, and transfer must be accomplished substantially instantaneously to avoid improperly starting a fresh roll and to avoid the forming of a large bulk of waste paper in the event of failure to properly start a fresh roll. It is therefore of the essence that the mechanism be simple and rugged in construction and operation and simple to handle. It is also essential that the winding operation take place smoothly and accurately, and the accuracy of winding requires winding the paper web on the roll at a uniform controlled pressure between the roll and a winding drum or reel drum surface in order to assure accurately and tightly wound rolls.

Accordingly an object of the invention is to provide a winding machine which accommodates transfer of the web from a filled roll to a fresh roll for handling continuously moving webs, wherein the mechanism is of simplified construction and operation for the various functions embodied in continuous winding and transfer to a fresh roll.

A further object of the invention is to provide a winding reel which is simple, neat in appearance, highly rugged in construction, and which requires a minimum of maintenance.

A further object of the invention is to provide a mechanism which makes it possible to accurately continuously control the pressure between the roll of paper being wound and the drum surface in order to assure accurately and tightly wound rolls.

A still further object of the invention is to provide a winding reel mechanism having simplified elements and functions for the transfer of a completed roll and of a core to start a fresh roll.

Another object of the invention is to provide a winding machine in which the framework and support means is open in order to assure easy access to the area between the front and rear of the machine and to facilitate cleaning up around the equipment.

Yet another object of this invention is to provide a winding reel in which primary and secondary support means are provided respectively for a fresh core and a wound roll and wherein the primary transfer means is returned as soon as possible to its starting position so as to minimize the difficulty experienced if a bad roll start is made.

A still further object of the invention is to provide a winding mechanism having secondary support means capable of discharging a full roll without being limited by operation of a crane.

A further object of the invention is to provide a winding mechanism in which the bearing for supporting the spool for a fresh roll is held in place in a socket and is not floating in an open gap as heretofore has been common to most machines, and wherein transfer means are provided formed of pivotal arms which are short to make them less susceptible to damage.

A feature of the present invention is the provision of a winding mechanism having a primary transfer means including a pair of pivotal arms and a secondary transfer means including a pair of horizontal rails each coacting with a rotatable winding drum and operative to transfer a fresh core between a core receiving position, a driving position wherein the core is in engagement with the drum, and a winding position wherein the core is supported on the rails, and wherein the fully wound roll is transferred from the machine on the rails.

A further feature of the invention is the provision of a spool holding mechanism for engaging the ends of the roll during winding and maintaining a uniform nip pressure between the roll and winding drum utilizing a drive which moves the spool support away from the drum at a rate which is a function of the pressure at which the spool is held against the drum so that uniform pressure will be mained.

Other objects, advantages and features will become more apparent with the disclosure of the preferred embodiment of the invention in the specification, claims and drawings in which:

FIGURE 1 is a side elevational view of the forward end of a winding machine constructed in accordance with the principles of the present invention;

FIGURE 2 is a side elevational view of the delivery end of the mechanism of FIGURE 1, and FIGURES 1 and 2 should be viewed together as illustrating the winding machine as an entity;

FIGURE 3 is a vertical sectional view taken substantially along line III—III of FIGURE 1;

FIGURE 4 is a vertical sectional view taken substantially along line IV—IV of FIGURE 1;

FIGURE 5 is a fragmentary side elevational view showing another form of mechanism for holding the roll against the reel drum; and

FIGURE 6 is a diagrammatic showing of a fluid system for operating a drive motor.

As shown on the drawings: FIGURES 1 through 4 show the winding mechanism as having a reel drum **10** which is supported for rotation and is driven in rotation at a constant speed to carry the web W. A spool S on which the web is to be wound is first positioned by primary transfer means shown in the form of a pair of pivotal arms **11**. During winding the spool is supported on a secondary transfer means shown in the form of a pair of parallel horizontally extending rails **12** which extend radially away from the drum **10**.

As will be appreciated, the spools and wound rolls are long, and are supported at the ends by mechanism similar in construction and therefore only the front end of the machine is shown and described, and the mechanism at the rear end of the machine will be of similar construction. For example, arms **11** will be positioned at each end of the reel drum **10**, and spaced rails **12** will be positioned at each end of the drum for supporting the ends of the spool.

The arms **11** receive the fresh spool at a position A, and transfer it to position B to be in peripheral contact with the surface of the drum so that it will be rotated and brought up to the surface speed of travel of the drum before the web W is wound thereon. A spool S' is shown in the winding position C supported on the rails **12** with

the roll 13 forming a winding nip N with the drum 10. FIGURE 2 shows the roll 13 in its successive positions in the dotted line positions D, E and F. The roll and the spool S' will reach the position D when the roll is fully wound. At that point the web W is cut and started on the fresh spool S, and the wound roll 13 rolls along the rails 12 through the position E to the stop position F.

In greater detail, the arm 11 supports a slide 14 which has a roller 15 resting upon a stationary arcuate cam 16. The cam is supported on the bearing housing 18 at the top of the stand 19 at the end of the machine. The bearing housing pivotally supports the arm 11.

The ends of the spool S have dumb-bell bearings 17 which rest in the upper socket formed by the bifurcated end of the slide 14.

The bearing 17 is locked in place by a pivotal clamping dog 20 mounted on the slide 14, and pivoted to a locked position as shown in FIGURE 1 by a piston rod 21 connected to a piston within a cylinder 22 mounted on the arm 11. The cylinder 22 is connected to suitable fluid pressure lines for pivoting the dog 20 between the locked position as shown in FIGURE 1, and a release position wherein the piston rod 21 is extended so that the spool can move upwardly out of the socket of the slide 14, or so that a fresh spool can be placed in the slide. The dog locks the spool in place so that it may rest against the drum 10 in position B and the spool is held by the dog 20 and cylinder 22 against the drum with sufficient pressure so that it will be driven at the peripheral speed of the drum.

Pivotal movement of the arm between the positions A, B and C is obtained by a segment gear 25 which is driven by a pinion 24 mounted on a shaft containing another gear that is part of a gear train 23 for driving the pinion. The gear train is driven through a suitable operator such as an electric motor, not shown, that is controlled in steps to move the arm 11 through the positions shown from the solid to the dotted line positions of FIGURE 1. The gear train 23 is suitably interconnected with a similar gear train on the other side of the machine by a cross shaft 23*a* to insure that the arms on the front and back of the machine will always be positioned at the same pivotal angle.

As the arm 11 moves from position A to position B the roller 15 rolls down the inclined surface of the cam 16, as shown in FIGURE 1 to permit the slide to descend and rest the spool S on the drum 10. The slide 14 is mounted in suitable guides on the arm 11 to permit radial reciprocation thereon.

The drum 10 is supported on bearings 26 in the bearing housing 18 on end shafts 27.

The roll 13 is held against the drum 10 by a pressure or holding dog 31 engaging the end of the spool S'. The holding dog is supported on a travelling slide or carriage 29 which slides in track grooves 30 in the track 12. The holding dog 31 is pivotally mounted on the carriage and is urged up toward its holding position by a torsion spring 33 and its upward movement is limited by its foot 34 which rides beneath a surface on the track 12.

As the roll 13 begins to build up in size a retracting or following dog 35 moves up behind the spool S' as shown in the successive positions of FIGURE 2. This following dog 35 is also pivotally mounted on the carriage or slide 29, and when the carriage is at its far left position in FIGURE 2 the following dog is cammed downwardly to the retracted position shown at the left, by the cam surface 37 on the track 12. As the carriage moves to the right a torsion spring 36 will raise the following dog to a position behind the spool S'. The pivotal movement of the dog 35 is limited by a stop finger 38 which engages a stop surface 39 on the carriage 29.

When the carriage moves to the far right position, as shown in FIGURE 2, a curved cam surface 40 pushes the holding dog 31 to the retracted position shown at the right, so that it is out of the way of the spool S' so that the spool can move to the end of the track 12 against a stop 41.

The pressure or holding dog 31 has a roller 32 which engages the spool S' and a lateral winding pressure is applied to the spool to control the pressure of the winding nip N. As the roll 13 builds up in size, the holding dog 31 will be retracted radially away from the drum 10 to maintain a substantially constant winding nip pressure. This is accomplished by controlled movement of the carriage or slide 29.

The carriage 29 is connected to a travelling nut 42 on a shaft 43. The nut is preferably of the type known as a "ball nut" wherein a plurality of ball bearings are held in a continuous track in the nut and engage in the grooves of threads in the shaft. As the shaft 43 is driven in controlled rotation, the carriage 29 will move along the track 12.

The shaft 43 is rotated by a sprocket 45 at its end over which is trained a chain 46 driven by a sprocket 47 on the shaft of the drive motor 48 which is operated at a controlled speed.

The shaft is supported at its end in a bearing 43*a*, mounted on a stand 45 which also supports the end of the track 12, and the bearing 43 provides radial support for the shaft but accommodates axial movement thereof. An axial force is applied to the shaft during its rotation to control the force applied by the holding dog 31 to the spool, and to thereby control the nip pressure. This axial force on the shaft is applied by an arm 49 pivotally mounted on the stand 19 at 50, and the arm is connected to the shaft at its upper end by a rotatable bearing 51 having a journal which is axially secured to the shaft. Lateral pressure is applied to the arm 49 by a closed air chamber 52 in the form of a bellows having one side rigidly supported and the other movable side or wall connected to the arm 49. The bellows 52 is pressurized through an air fitting 52*a* with air at a predetermined constant pressure, although other biasing means may be employed such as a spring.

In accordance with the principles of the invention the shaft 43 is rotated at a speed which changes as a function of the change in pressure applied by the holding dog 31, and the pressure is thereby maintained constant. The shaft thus provides a drive support with the nut acting as a drive. In other words, as the pressure applied by the dog tends to decrease, the speed of the shaft is slowed so that as the diameter of the roll 13 increases, the pressure will increase. Also, as the pressure applied to the dog 31 increases, the speed of the shaft is increased to thereby maintain a constant pressure.

This is accomplished by a variable speed control for the motor 48, which is driven by the arm 49. A control circuit is shown in FIGURE 6 with the motor illustrated as being a hydraulic motor driven by hydraulic fluid delivered by a pump P. Hydraulic fluid is obtained from a reservoir 53 and delivered through a pump delivery line 54 to a main control valve 55. Actual speed of the motor 48 is regulated by a proportioning or modulating valve 56 operated by the arm 49.

In the normal operating position of the main valve 55 as shown schematically in FIGURE 6, fluid flows through a line 57 to the motor 48 and is returned through a line 58 through the control or modulating valve 56. The modulating valve or proportioning valve 56 regulates the amount of hydraulic fluid being pumped through the motor 48 and thereby regulating the speed of the motor. In effect this provides a specific speed of the screw shaft 43 for each position of the arm 49 which automatically adjusts the position of the carriage 29 as the roll of paper builds up.

The main control valve 55 is shown schematically to adjust the delivery from the pump P to operate the motor 48 at a constant speed, or to reverse the motor 48. If the valve 55 is shifted to the right, as shown schematically in FIGURE 6, the modulating valve 56 will be by-passed

and the motor 48 will operate at a constant speed. This will in effect increase its speed so that the carriage 29 will move to the right and the roll 13 will be moved away from the drum 10 to open the nip N. This is done when the roll 13 is filled in position D. When the nip is opened, the fresh spool S will be in position B. The paper web will then be cut as by means of an air jet and quickly wrapped around the already rotating spool S. The filled paper roll 13 continues to move to the right through position E to position F.

The arm 11 will then be pivoted downwardly so that the fresh spool S moves down into position C of FIGURE 1 as shown by the dotted line position of the arm 11. As the roll increases in size the spool will be moved out of the socket of the slide so that the arm can be pivoted back to the solid line position of FIGURE 1. The motor 48 is then reversed by shifting the main valve 55 to the far left as shown in FIGURE 6, and the carriage 29 will travel back to the position of FIGURE 1. The main valve 55 will then be set at its intermediate position as shown in FIGURE 6, and automatic pressure operation will again begin.

FIGURE 5 shows a modified support arrangement wherein the screw and nut arrangement has been exchanged for an air cylinder pressure applying means. The secondary transfer means is shown by a track 60 having ways for a slide or carriage 61. A pressure holding dog 62 is pivotally mounted on the slide 61 and holds a spool 63 against a reel drum 66. The slide is urged to the left by a piston rod 64 attached to a piston slidable within a cylinder 65. An air supply line 66*a* will deliver air at a constant pressure beneath the piston within the cylinder 65, from a pressure line 67 as controlled by a pressure regulating valve 68. The valve will maintain a substantially constant pressure in the cylinder 65 so that a substantially constant force will be applied by the holding dog 62. Valves 69 and 70 will be operated to move the slide 61 when the nip N is to be opened in FIGURE 5 and when the finished roll is to be moved to the right on the track 60. The piston will also move the carriage back to the left when the fresh spool is in position for winding a new roll.

Thus it will be seen that we have provided an improved winding mechanism which meets the objectives, advantages and features above set forth. The mechanism is reliable and accurate in operation for maintaining a constant nip pressure, and the apparatus is rugged and will not require adjustment or attention, and is well suited for handling very heavy equipment which is necessary for paper machines.

It will be noted that from position B through position C there will be a constant nip pressure between the spool S, as it begins winding, and the reel drum 10. This is maintained by the cylinder 22. At position C nip pressure is maintained constant, but the nip applying force is transferred from the cylinder 22 to the arm 31 by the action of the bellows or air chamber 52. This transfer of force can be accomplished by a suitable control, such as a pressure proportioning valve or the like.

The drawings and specification present a detailed disclosure of the preferred embodiments of the invention, and it is to be understood that the invention is not limited to the specific forms disclosed, but covers all modifications, changes and alternative constructions and methods falling within the scope of the principles taught by the invention.

We claim as our invention:

1. A winding mechanism for winding a web on a spool comprising a reel drum driven in rotation and carrying a web, means for supporting a spool in engagement with the drum forming a winding nip therebetween, holding means urging the spool against the drum, threaded shaft and nut members with one of the members connected to the holding means and the shaft member extending radially away from the drum, means having an element connected to and applying a pressure to the other of said members for urging the holding means against the spool and determining the holding pressure applied to the spool, and means having a drive member connected to and rotating said other member to move the holding means away from the drum as the size of the web wound on the spool increases.

2. A winding mechanism for winding a web on a spool comprising a drum adapted to be driven in rotation for carrying a web, means for supporting a spool in engagement with the drum forming a winding nip therebetween, holding means for urging the spool against the drum, a threaded shaft extending radially away from the drum, a support for the shaft accommodating axial movement thereof, a nut threaded on the shaft and connected to the holding means, means connected to the shaft for driving the shaft in rotation to move the holding means away from the drum and accommodate increase in diameter of the spool as the web is wound thereon, and means applying a biasing force to the shaft urging it toward the drum tending to move it axially in said support for applying a pressure to the spool.

3. A winding mechanism in accordance with claim 2 wherein the nut has a plurality of balls riding in a continuous channel within the nut and supported in the threads of the shaft for connecting the nut to the shaft.

4. A winding mechanism for winding a web on a spool comprising a reel drum adapted to be driven in rotation, means for supporting a spool in engagement with the drum for forming a winding nip therebetween, holding means urging the spool against the drum, a threaded shaft extending radially away from the reel drum, a nut threaded on the shaft and connected to a member on the holding means, a mount for the shaft accommodating axial movement thereof, means for driving the shaft in rotation to move the holding means away from the drum and accommodate increase in diameter of the roll on the spool, and a closed fluid pressure chamber having a movable wall connected to the shaft for axially urging it toward the drum so that pressure in the chamber will urge the holding means against the spool.

5. A winding mechanism for winding a web on a spool comprising a reel drum supported for rotation, means for supporting a spool in engagement with the drum forming a winding nip therebetween, holding means urging the spool against the drum, a threaded shaft extending radially away from the reel drum, a nut threaded on the shaft and connected to the holding means, means having a drive member connected to the shaft for driving the shaft in rotation to move the holding means away from the drum and accommodate increase in diameter of the roll on the spool, a mount for the shaft accommodating axial movement, a closed fluid pressure chamber having a movable wall connected to the shaft for axially urging it toward the drum so that pressure in the chamber will urge the holding means against the spool, and a variable speed control for said driving means operated by said movable wall for changing the rotational speed of the shaft to maintain a constant position for said wall so that the axial force on the shaft will remain uniform.

6. A winding mechanism for winding a web on a spool comprising a reel drum rotating at a constant speed for supplying the web to the spool, horizontal spool support rails extending radially away from one side of the drum and spaced to support the ends of the spool, transfer arms pivotally mounted coaxial with the drum for supporting a fresh spool and transferring the spool to the rails, radial slides in the transfer arms supporting the fresh spool, a clamping dog mounted on each of the slides, means for moving said clamping dogs between a spool release position and a spool holding position, stationary radial cams controlling the radial position of the slides and shaped to drop the spool into peripheral contact with the drum as the arms are moved toward the rails, a spool holder engaging the end of the spool and urging it toward the drum

controlling the pressure between the drum and spool, a carriage movable laterally along the rails for supporting the spool holder, a horizontal threaded rod extending parallel to the rails and having a travelling nut thereon connected to the carriage, a follower member on the carriage positioned behind the spool opposite the spool holder, means to individually elevate said spool holder and said follower member to a position for engaging the spool and for retracting the holder and follower member to a position out of engagement with the spool, driving means having a member connected to the rod for driving the rod to regulate the travel of the carriage and holder as the size of the roll on the spool increases, a fluid pressure operated member urging the rod in the direction to increase the force of the holder against the spool, and a control for said driving means driving the holder at a speed to maintain a substantially constant pressure against the spool.

7. A winding mechanism for winding a web on a spool comprising a reel drum supported for rotation, means for supporting a spool in engagement with the drum forming a winding nip therebetween, holding means urging the spool against the drum, a variable speed drive means drivingly connected to the holding means retracting it radially from the drum as the spool builds up in size, a yieldably mounted drive support for the drive means, a resilient pressure means connected to the drive support to urge the drive means and holding means toward the spool, a mount for said pressure means, and a control for said drive means varying the drive speed in response to change in distance between said mount and said drive support for maintaining a substantially uniform pressure applied by the holding means.

8. A winding mechanism for winding a web on a spool comprising a reel drum supported for rotation, means

for supporting a spool in engagement with the drum forming a winding nip therebetween, holding means urging the spool against the drum, a variable speed fluid operator motor means connected to the holding means retracting it radially from the drum as the spool builds up in size, a yieldably mounted drive support for the motor means, a resilient pressure means connected to the drive support urging the motor means and holding means toward the spool, a mount for said pressure means, and a valve controlling flow of fluid to said motor connected between said mount and said drive support for varying the speed of the motor means in response to change in distance between said mount and said drive support for maintaining a substantially uniform pressure applied by the holding means.

9. A winding mechanism for winding a web on a spool comprising a reel drum supported for rotation, means for supporting a spool in engagement with the drum forming a winding nip therebetween, holding means urging the spool against the drum, a variable speed drive means drivingly connected to the holding means retracting it radially from the drum as the spool builds up in size, a yieldably mounted drive support for the drive means, an expansible fluid pressure chamber connected to said drive support urging the drive means and holding means toward the spool, a mount for said pressure chamber, and a control for said drive means varying the drive speed in response to change in distance between said mount and said drive support for maintaining a substantially uniform pressure applied by the holding means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,475,480	Clem et al.	July 5, 1949
2,703,683	Evans et al.	Mar. 8, 1955