

July 26, 1960

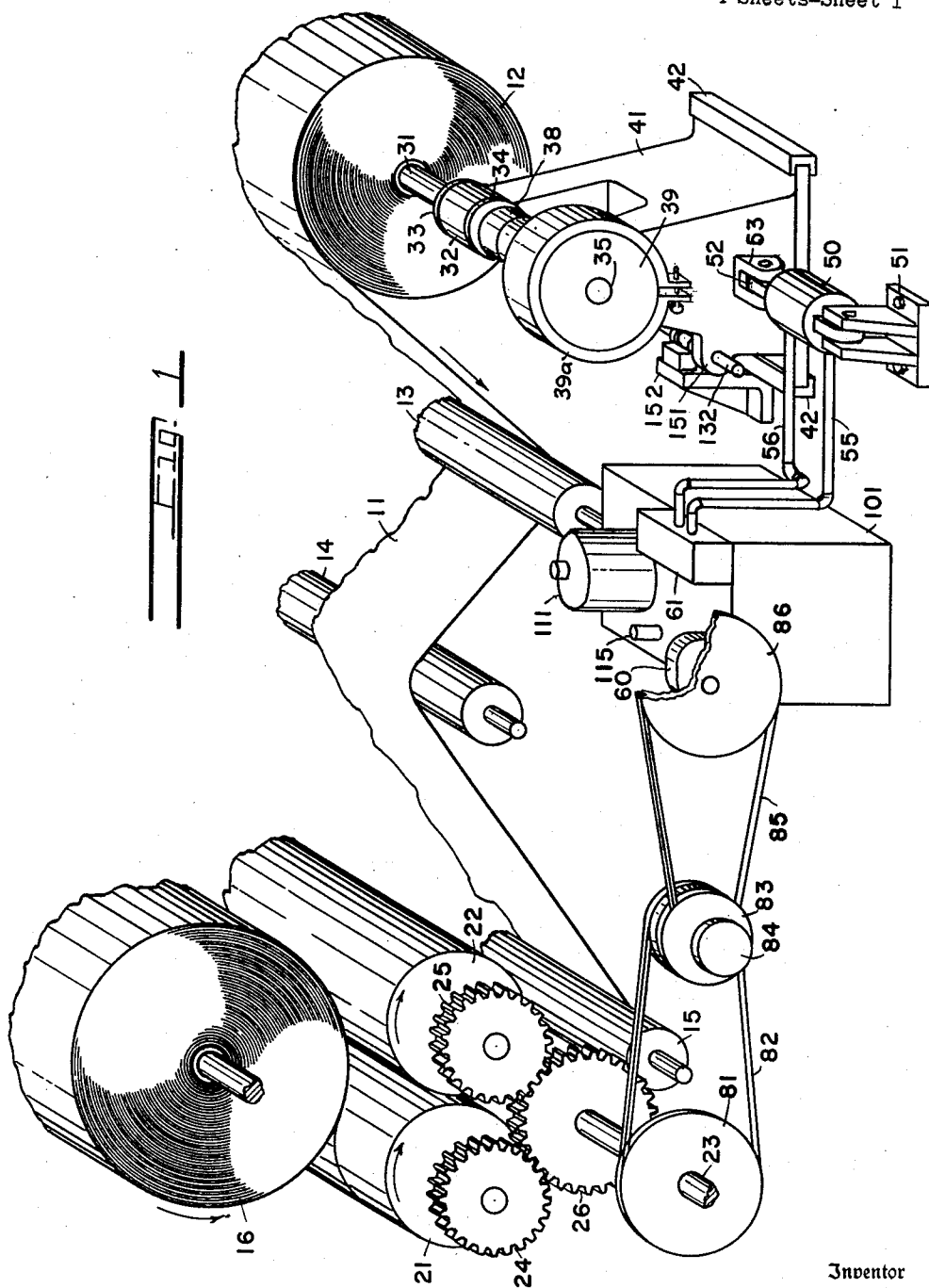
T. N. CARTER

2,946,532

OSCILLATOR FOR WEB WINDING DEVICES

Filed April 4, 1956

4 Sheets-Sheet 1



Inventor

THOMAS N. CARTER

Frederick G. L. Boyer

Attorney

July 26, 1960

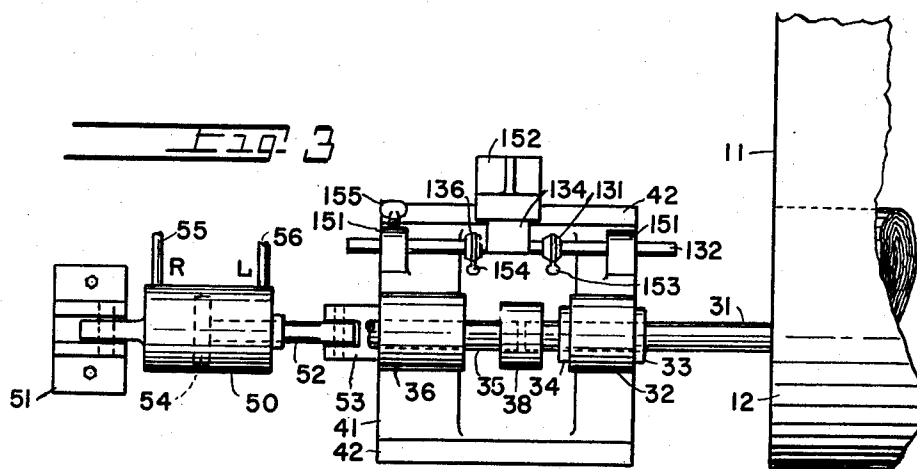
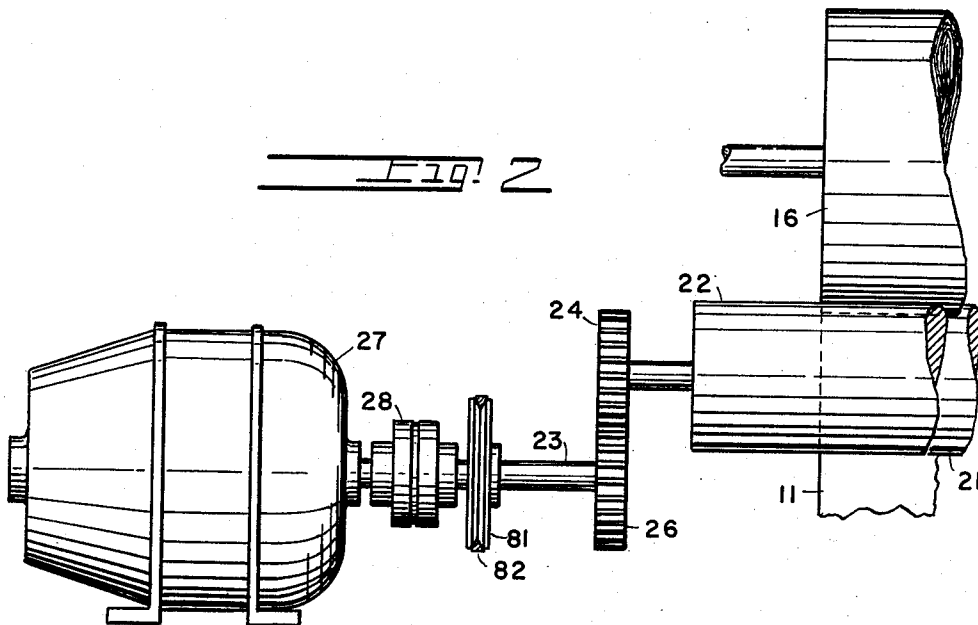
T. N. CARTER

2,946,532

OSCILLATOR FOR WEB WINDING DEVICES

Filed April 4, 1956

4 Sheets-Sheet 2



Inventor

THOMAS N. CARTER

By

Frederick C. L. Boye

Attorney

July 26, 1960

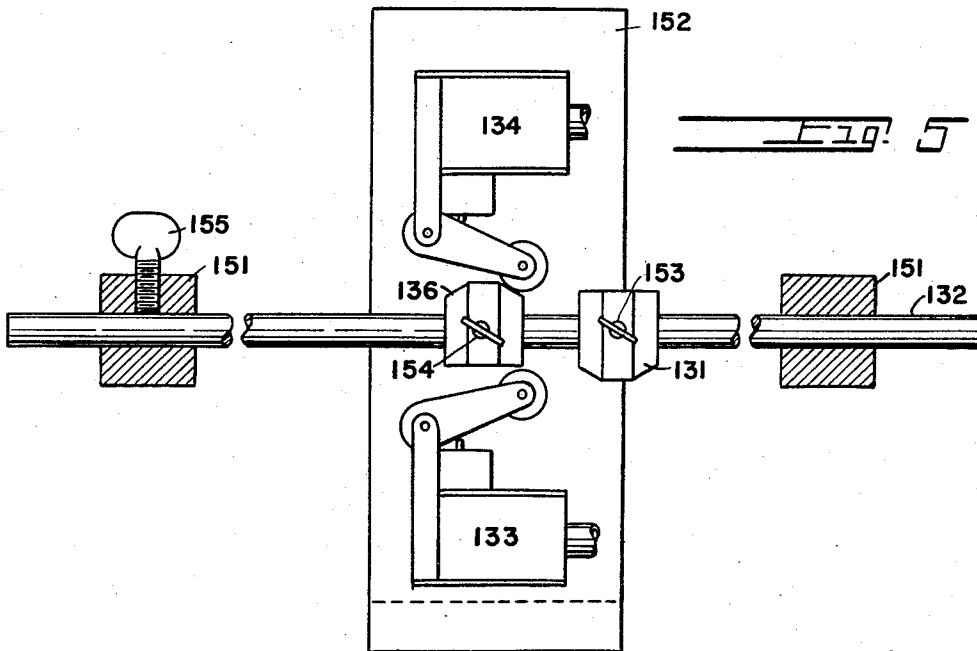
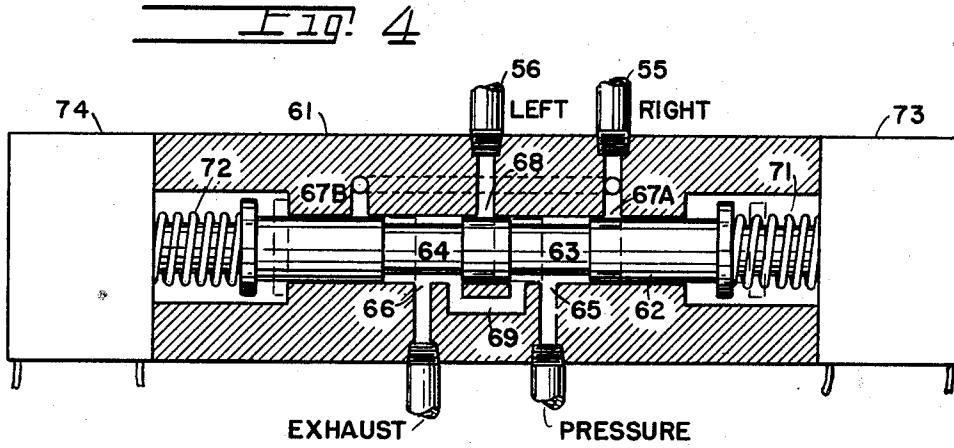
T. N. CARTER

2,946,532

OSCILLATOR FOR WEB WINDING DEVICES

Filed April 4, 1956

4 Sheets-Sheet 3



Inventor

THOMAS N. CARTER

28

Frederick G. L. Boyce

Attorney

July 26, 1960

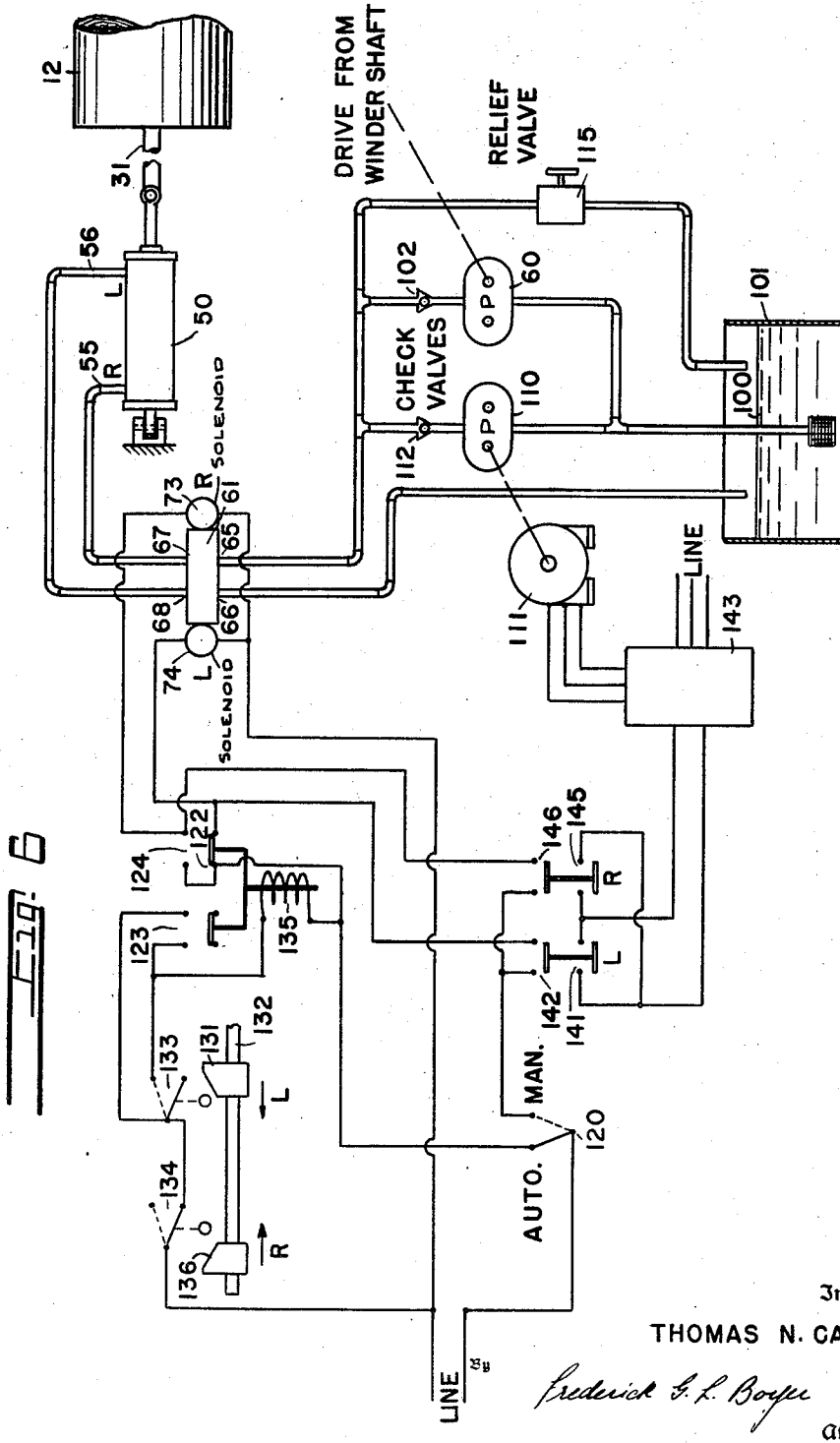
T. N. CARTER

2,946,532

OSCILLATOR FOR WEB WINDING DEVICES

Filed April 4, 1956

4 Sheets-Sheet 4



1

2,946,532

OSCILLATOR FOR WEB WINDING DEVICES

Thomas N. Carter, Hamilton, Ohio, assignor to The Champion Paper and Fibre Company, Hamilton, Ohio, a corporation of Ohio

Filed Apr. 4, 1956, Ser. No. 576,095

10 Claims. (Cl. 242—57.1)

This invention relates to oscillators such as are used in winding devices for webs of paper and other web materials to prevent irregularities, such as wrinkles, thick or thin places, etc., in the web from building up, as successive layers are wound on the roll, and causing irregularities in the finished roll. The types of oscillators commonly used for this purpose possess certain disadvantages. When starting at slow speed or when, for example, the winding device has to be slowed down for any reason, the oscillator operating at its set speed moves the web laterally so far per unit length that wrinkles are drawn into the web and the oscillator has to be stopped to prevent damage to the web. Then when the speed of the winder is stepped up to normal, operators frequently forget to start the oscillator until the troubles which it was designed to prevent, are already built into the roll, and a smooth roll can no longer be obtained.

The primary object of the present invention, therefore, is to eliminate these and other difficulties encountered in the use of the conventional oscillating devices and secure a device which will serve, with a minimum of attention from the operator, to wind rolls of uniform smoothness and hardness regardless of the speed at which the winding has been accomplished, or whether or not this speed has been uniform throughout the winding operation. For the accomplishment of this and other objects, the invention is designed to be used with winders in which some part operates at, or in a fixed ratio to, the approximate speed of the web. In conventional single and multiple-drum winders the winder drums themselves are such parts, whereas in center-driven winders the desired speed is found in rolls around which the web travels. Winders of these types are commonly used on machines which are designed to rewind paper webs which have already been wound into rolls, frequently trimming or slitting the web during the rewinding operation. In the rewinding operation it is in general found more convenient to oscillate the roll being unwound, however in cases where the web is being fed, not from a previously wound roll, but from a source which can not conveniently be oscillated, it may be found desirable to oscillate the winding device itself.

In order to avoid the wrinkling of the web which caused trouble in previous oscillating devices when the speed of winding fell below a certain multiple of the speed of the oscillating movement, I arrange to drive the oscillator in a manner which moves the unwinder (or winder) roll axially at a speed which bears a fixed, but adjustable, ratio to the speed of web travel. For this purpose, I have found it advantageous to apply the oscillating movement by drive from the shaft of the winder itself through any suitable type of variable speed transmission and necessary speed reduction. In general, I have found hydraulic power preferable for providing the oscillating motion at a speed suitably related to the winder speed, but electric or mechanical driving means can be used when the circumstances render them more advantageous.

The construction and operation of my improved oscillator will be better understood by reference to the accom-

2

panying drawing which illustrates one embodiment of my invention as applied to a rewinder for paper rolls, and wherein:

Fig. 1 is a fragmentary pictorial view of the drive side of a conventional paper roll rewinder, with framework and other parts omitted to more clearly show the devices of the present invention, applied thereto.

Fig. 2 is a fragmentary elevational view of the winding end and drive as seen from the right in Fig. 1.

Fig. 3 is a fragmentary plan view of the unwinding stand and hydraulic cylinder for imparting oscillating movement thereto.

Fig. 4 is a detail view, partially in section, of a suitable four-way control valve.

Fig. 5 is a detail view of the stops and the reversing switches for controlling the oscillation.

Fig. 6 is a combined wiring and piping diagram showing the hydraulic operating devices and electrical controls.

Referring to the drawing, a paper web 11 is shown in Fig. 1 being unwound, from a roll 12, passing around rolls 13, 14, and 15 to a conventional two-drum winder on which it is wound into a roll 16. The winder comprises two drums 21, 22 rotated in the same direction at the same or commonly slightly different speeds by a drive shaft 23 through suitable gearing illustrated in simplified form as 24, 25, and 26. The shaft 23 is driven preferably at adjustable speed by any suitable means such, as for example, an adjustable speed motor 27 (Fig. 2) driving through a customary flexible coupling 28.

The roll being unwound is mounted on shaft 31, one end of which is carried in bearing 32, and is provided with thrust collars 33, 34 which locate shaft 31 axially. (See also Fig. 3.) The bearing is provided with the customary hinged or otherwise readily removable cap, not shown, to permit replacement with a shaft bearing a fresh roll when the roll 12 becomes exhausted. The other end of shaft 31 is carried in a similar bearing (not shown) but without the thrust collars 33, 34. Aligned with shaft 31 is a short shaft 35 carried in bearing 36 and connected with shaft 31 by a readily detachable coupling 38 to facilitate removal and replacement of shaft 31. On the other end of shaft 35 is provided the customary friction brake, indicated at 39, 39a in Fig. 1, for retarding rotation of shaft 35 and 31 with roll 12 and thereby providing the tension on web 11 which is necessary to successful winding of the web.

The bearings 32 and 36 are conveniently mounted on a unitary stand 41 which is mounted for movement in a direction axial to shaft 31 and roll 12 in suitable guides 42, 42, which advantageously provide rolling support (not shown) for the stand 41. The stand 41 is, in the illustrated embodiment of the invention, arranged to be moved in guides 42 by a hydraulic cylinder 50, one end of which is attached to a fixed bracket 51 and the piston 52 of which is attached to a bracket 53 which is attached to or forms a part of stand 41. Pressure fluid introduced behind piston 54 in cylinder 50 through pipe 55 moves the piston and thereby stand 41, shaft 31, and roll 12 to the right in the figure, while pressure fluid introduced through pipe 56 in front of the piston moves the roll 12 and associated parts towards the left in the figure. Obviously the length of travel possible is controlled solely by the length of the cylinder 50 and the available space on the unwinder itself. I have found, however, that a maximum stroke of about six inches is sufficient to produce a smooth and even roll in most cases encountered in practical experience on paper roll rewinders.

To supply pressure fluid to the cylinder 50 at the rate required to give a constant speed of axial movement to roll 12, a constant delivery positive displacement pump such, for example as gear pump 60 (Figs. 1 and 6) is provided. The flow of pressure fluid from pump 60 to

the two ends of cylinder 50 in turn, and the exhaust from the other end of the cylinder, is advantageously provided by a solenoid operated four-way valve 61 (see also Fig. 4) which is arranged, when operated in one direction by one solenoid, to connect one end of the cylinder 50 to the pump 60 and the other end to exhaust, and when operated in the other direction, by the other solenoid, to reverse these connections. The valve 61 is desirably arranged so that, when neither solenoid is activated, the valve is spring-centered (as shown in Fig. 4) to positively close the connections to each end of the cylinder and thereby lock the piston 54, the shafts 35 and 31, and the roll 12, against axial movement. Advantageously, though not necessarily, the valve, when so spring-centered, makes a direct connection between the pressure line and the exhaust, thereby preventing the build-up of unnecessary pressure in the system and saving the power which would otherwise be required to drive the pump against the maximum pressure head whenever the oscillation is shut off.

Referring now in particular to Fig. 4, it may be seen that the operative parts of the valve are the housing or cylinder designated 61 and the piston or spool 62 which is axially movable therein. This piston or spool 62 has two portions 63 and 64 of reduced diameter to form fluid passages around it from one port to another. Opening into the valve cylinder there is a port 65 leading from the pressure pump 60; a port 66 leading to exhaust ports 67-A and 67-B, which are interconnected; lead through conduit 55 to one end R of the pressure cylinder 50; and a port 68 which leads through conduit 56 to the other end L of the cylinder 50. There is also a by-pass 69 which, when the spool or piston 62 is centered in neutral position, as shown in the drawing, serves to by-pass pressure fluid from inlet port 65 to exhaust port 66, thus avoiding an undesirable build-up of pressure in the system when it is not needed. Normally the spool 62 is held in the central or neutral position shown, by two balanced springs 71 and 72. When the unwinding reel is to be moved to the right, a solenoid 73 is energized, pulling the spool 62 to the right, as indicated by broken lines in Fig. 4. From the figure it can be seen that this opens right hand port 67A to pressure supply port 65 and opens left hand port 68 to exhaust port 66 and closes off by-pass 69. In order to reverse the movement of the unwinding reel, solenoid 73 is deenergized and solenoid 74 is energized, pulling the spool 62 to the left hand position, not shown, which reverses the connection, connecting left hand port 68 to pressure supply port 65, and right hand port 67B to the exhaust, and again closes by-pass 69.

In order that the hydraulic fluid supplied by the pump may move the roll 12 at a speed directly proportional to the rate of travel of the paper web, the positive displacement pump 60 is arranged to be driven from the winder shaft 23 (or other shaft positively connected thereto). For this purpose any suitable driving connections and variable speed transmission may be used. I have found the driving mechanism illustrated in the drawing to be highly satisfactory. Referring to Fig. 1, it will be seen that a V-belt sheave 81 is mounted on winder drive shaft 23. The V-belt 82 drives a known type of speed adjusting device 83 which comprises a double sheave with complementarily variable diameters, and an adjusting knob 84 whereby the diameter of one sheave is increased while that of the other is decreased. From this double sheave 82 the V-belt 85 drives a sheave 86 on the positive displacement pump which may advantageously be a gear pump 60. By this means the discharge of pump 60 and the consequent speed of the oscillating movement of the unwinder reel will bear a direct and fixed ratio to the speed at which the web is wound onto the reel. This fixed ratio can be adjusted at will by adjustment of the knob 84, to increase or decrease the axial movement of the unwinding reel for each foot of web travel. With

the types of paper I have tried, an adjustment from 0.001 in. to 0.003 in. per lineal foot of paper travel constitutes a satisfactory range and is not so rapid as to cause the web to be drawn into wrinkles. However, with other webs, a different range may be found desirable.

The operation of the hydraulic system will be best understood by reference to Fig. 6, the combined wiring and piping diagram. The pump, indicated as a gear pump 60, is shown drawing hydraulic fluid from a supply 100 in tank 101. The pressure side of the pump 60 is connected through a check valve 102 to the pressure inlet port in four-way valve 61. The outlet 67 from this valve is connected to the end marked R of power cylinder 50 and when pressure fluid is supplied through conduit 55 to this end of the cylinder by energizing solenoid 73, the piston, and thereby the unwinding reel, is moved to the right. When solenoid 74 is energized, pressure from pump 60 is supplied through outlet port 68 and conduit 56 to the end of the cylinder marked L and the unwinding reel is thereby moved to the left. The exhaust port 66 of valve 61 is arranged to return exhaust fluid by suitable piping to the supply tank 101.

In order to make possible manual shifting of the roll to secure proper alignment at a time when the winder is not in operation, or for other reason, another pump 110 is provided. This is driven by a motor 111 which is manually controlled in a manner to be described. The pump 110 connects to the suction and pressure lines used by pump 60 and is provided with a check valve 112 which seats when there is pressure in the line and pump 110 is not operating. A suitable adjustable pressure relief valve 115 is provided in the high pressure line leading from the pumps, in order to prevent damage in case of mechanical blockage or other cause.

The electrical controls will be best understood by reference to the wiring diagram in Fig. 6. Mention has been made of the possibility of manual as well as automatic control. The selection between these is made by the switch 120, which is illustrated as set for automatic control. This automatic operation will be first described. Current from the line through the automatic control switch passes through normally closed switch 122 to solenoid 74 which admits pressure fluid through conduit 56 to the end marked L of cylinder 50, thus moving the unwinding reel to the left. When the desired limit of movement in that direction has been reached, an adjustable stop 131, on a bar 132 which moves with the oscillating unwinder reel, closes the normally open limit switch 133. This establishes contact through normally closed limit switch 134 and solenoid 135 through the automatic control switch 120 back to the line. The action of this solenoid 135 opens switch 122 and closes switches 123 and 124. The circuit is now completed through switches 120 and 124 to solenoid 73 moving the piston 62 in valve 61 to the right and admitting pressure fluid through conduit 55 to the end marked R of cylinder 50, thus moving the unwinding reel to the right.

As soon as motion to the right is initiated, limit switch 133 reverts to its normally open position. However, circuit through the solenoid 135 is maintained through now closed switch 123, which is held in closed position by the solenoid 135. Then, when the desired limit of movement to the right has been reached, an adjustable stop 136 mounted on bar 132, which moves with the oscillating unwinder reel, opens the normally closed limit switch 134 and breaks the circuit through solenoid 135, allowing switches 122, 123 and 124 to resume their normal positions shown in the drawing.

Movement to the left is then initiated and switch 134 resumes its normally closed position. Limit switch 133, however, is in its normally open position so that no current flows through solenoid 135 and switches 122, 123 and 124 remain in their normal position shown in the drawing until movement to the left has been completed. The oscillating movement then continues automatically as

described so long as current is maintained through the automatic control switch 120.

When a new roll has been placed in the unwinder, and before the web has been threaded through the machine and the winding operation begun, it is frequently 5 desired to shift the roll axially to line up the web with trimmer or slitter knives, or for other purpose. To accomplish this, the switch 120 is set for manual control. To manually initiate movement to the left, the push button marked L is pressed to close switches 141 and 142. 10 Switch 141 serves through starter 143 to start motor 111 and pump 110 driven thereby into operation to supply pressure fluid to the system even though the winding drum from which pump 60 is driven is not in operation. Switch 142 makes the circuit through manual control switch 120 to solenoid 74 which moves the piston 62 15 in valve 61 to the left, admits pressure fluid from port 68 through conduit 56 into the end of cylinder 50 marked L, thus moving the unwinding reel to the left. When the push button is released, the circuit is broken, motor 111 and pump 110 are stopped, solenoid 74 is deenergized, and the spool or piston 62 in valve 61 returns to its normal position under the influence of springs 71, 72 thus closing the ports to both ends of cylinder 50 20 and locking the unwinding reel in the axial position to which it was shifted. Similarly, if the push button R is depressed closing switches 145 and 146, the motor 111 and pump 110 are set in operation as before. The current through manual control switch 120 and push button switch 146 serves to energize solenoid 73, moving 25 piston 62 in valve 61 to the right and supplying pressure fluid through conduit 55 to the end marked R of cylinder 50, thus causing the unwinding reel to move towards the right so long as the push button remains depressed. As before, release of the push button breaks all the circuits, stops the pump 110, and permits the piston 62 30 in valve 61 to resume its normal position, thus locking the reel in the position to which it has been adjusted.

The mechanism by which the limit switches 133, 134 are actuated can be seen in Fig. 1, but is more fully 40 illustrated in Fig. 5. The bar 132 which carries the adjustable stops 131 and 136 is slidably mounted in two brackets 151 extending outward from the stand 41, to which oscillating movement is imparted by cylinder 50. Bar 132, therefore, oscillates with the unwinding reel. 45 A bracket 152 is mounted on the stationary base, and on this are mounted the limit switches 133 and 134. The stops 131 and 136 can be slid along on bar 132 to whatever positions are desired as end points of the oscillating movement and held in position by any suitable means such as thumb screws 153 and 154. In case the 50 length of oscillation is set as desired, but the position of the two ends of the oscillation need to be moved in one direction or the other, I provide that the bar 132 be somewhat longer than the distance over the brackets 151 and that the bar 132 be slidable in these brackets to any desired position, being held in place, when adjusted, 55 by suitable means such as thumb screw 155.

With the device as described, I have been able to secure dependable positive oscillation at a speed which bears 60 a constant ratio to the speed of the web, regardless of whether that speed is constant or variable, and can never be so great as to draw wrinkles into the web. It is thus possible with this device to build smooth, wrinkle free rolls of substantially uniform hardness throughout their length. The distance of oscillation and the speed of 65 oscillation can be adjusted, or the change made from automatic to manual oscillation or the reverse, while the winder is in operation at any speed. The winder can be slowed down or stopped and restarted with the oscillator on automatic control, without attention of the operator and without the deleterious effects experienced with the usual types of oscillators.

I claim:

1. In a web-winding device comprising a source from 75

which a web to be wound is supplied, a reel on which the web is wound, means for oscillating the reel and the source relative to each other in a direction transverse to the web, and means for driving said reel to wind the web at variable speed; the improvement which comprises means for maintaining a predetermined ratio between the speed of the oscillatory movement and the speed of movement of the web.

2. The improvement defined in claim 1, wherein means is provided for adjusting the magnitude of the ratio between the speed of the oscillatory movement and that of the web.

3. The improvement defined in claim 1 wherein the means for maintaining the predetermined ratio between the speed of the oscillatory movement and the web speed comprises operative connections between a part of the device, which operates at a speed substantially directly proportional to the speed of the web, and the oscillating means.

4. In a drum type web-winding device comprising an unwinding reel from which a web to be wound is supplied, a reel on which the web is wound, drum means for winding the web on said reel at a web speed substantially equal to the surface speed of said drum means, means 25 for driving said drum means at variable surface speed, and means for oscillating said unwinding reel relative to the winding reel, in a direction transverse to the web; the improvement which comprises means, operatively connected with said drum means, for driving said oscillating means at a speed bearing a predetermined relation to the speed of the web.

5. The improvement defined in claim 4 wherein the means for driving the oscillating means include a variable speed transmission driven from a part operating at a speed bearing a fixed relation to the speed of said drum means.

6. The improvement defined in claim 4 wherein the oscillating means comprises a hydraulic cylinder, a positive displacement pump and means, associated with said drum means and said pump, for driving said pump at a speed bearing a predetermined ratio to the speed of said drum means, to supply pressure fluid to said cylinder at a measured rate substantially proportional to the speed 45 of the paper web.

7. The improvement defined in claim 6, wherein four-way valve means is provided for controlling the flow of pressure fluid to and from said hydraulic cylinder and directing it alternately into opposite ends of said cylinder while opening the other end to exhaust.

8. The improvement defined in claim 7 wherein two solenoids are provided, one for operating, when energized, said valve in each direction to admit pressure fluid into the corresponding end of the hydraulic cylinder and open the opposite end to exhaust, and wherein spring-centering means is provided to hold said valve in neutral position in which pressure fluid is by-passed directly to exhaust and each end of the hydraulic cylinder is closed to entrance or exhaust of fluid and the parts are locked 55 against oscillatory movement.

9. The improvement defined in claim 7 wherein means is provided for operating the four-way valve to reverse the direction of the oscillatory movement when the unwinding reel has reached a predetermined position relative to the winding reel in either direction of travel, and wherein the positions of reversal are independently adjustable to vary the amplitude of the oscillatory movement, and simultaneously adjustable to change the positions of reversal while maintaining the amplitude of the oscillation unchanged.

10. The improvement defined in claim 8, wherein switch means is provided for energizing the solenoids by turns as the oscillatory movement reaches a preset limit in each direction, and wherein push button means is provided for manually selectively energizing the solenoids to impart movement in the corresponding direction

to the oscillatable parts, and switch means for effectuating the choice between manual and automatic operating connections.

References Cited in the file of this patent

UNITED STATES PATENTS

1,775,856	Hauser	Sept. 16, 1930
2,130,332	Davis	Sept. 13, 1938

2,558,761	Kentis	July 3, 1951
2,575,385	Killoran	Nov. 20, 1951
2,672,299	Jones	Mar. 16, 1954

OTHER REFERENCES

5 "Hydraulic Operation and Control of Machines" (McNeil), published by The Ronald Press Co. (New York), 1955; pages 92, 93, 94, 247 and 248 relied on. (Copy in Scientific Library.)