

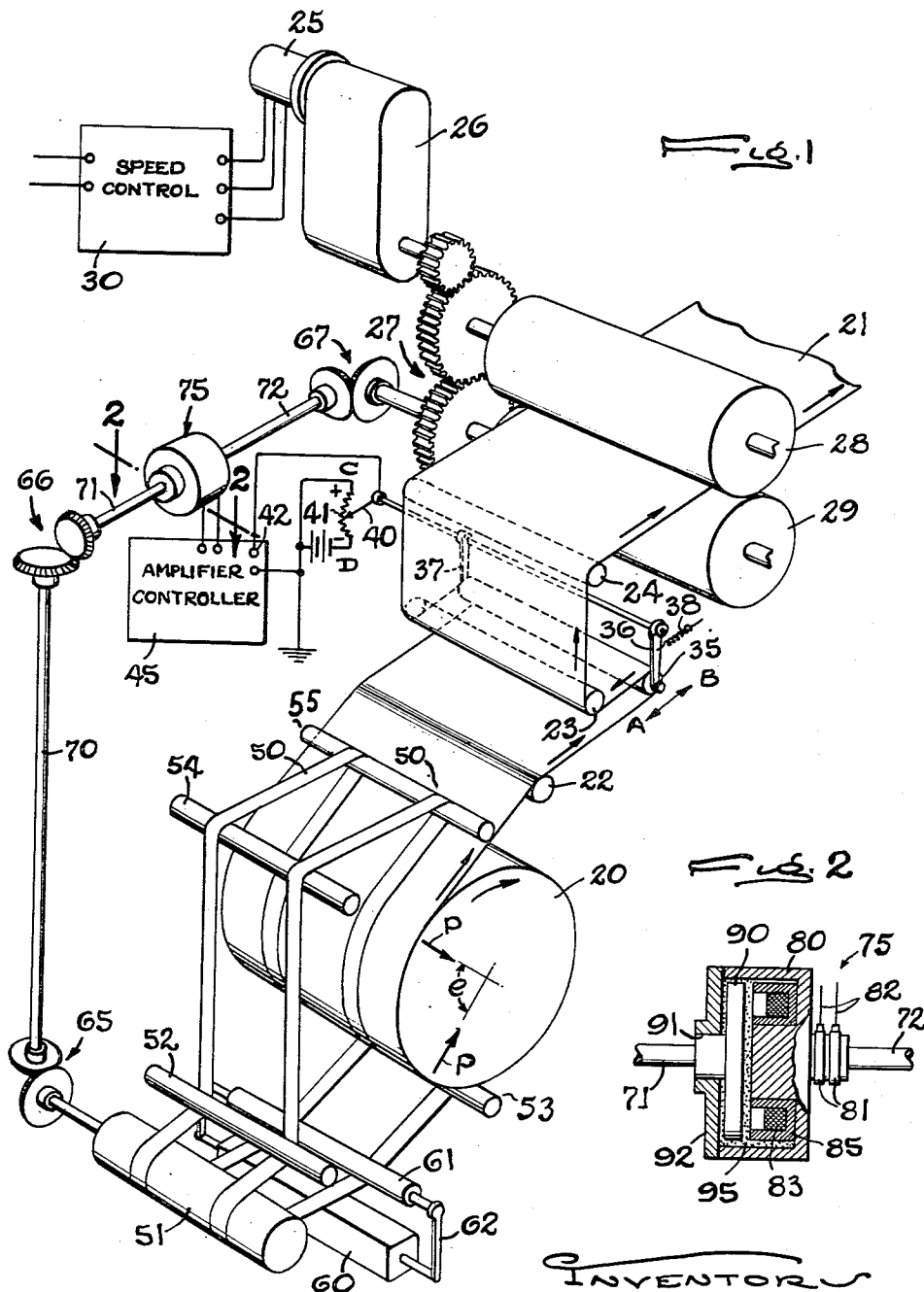
Jan. 14, 1964

C. W. CHASE ET AL

3,117,741

TENSIONING SYSTEM FOR ROLLED PAPER STOCK

Filed Jan. 9, 1961



INVENTORS

Corson Walter Chase
George Vischul

Holfe, Hubbard, Veit & Osann
ATTORNEYS

1

3,117,741

TENSIONING SYSTEM FOR ROLLED PAPER STOCK

Corson Walter Chase, Oak Park, and George Vischulis, Melrose Park, Ill., assignors to Miehle-Goss-Dexter, Incorporated, Chicago, Ill., a corporation of Delaware
Filed Jan. 9, 1961, Ser. No. 81,366
6 Claims. (Cl. 242-75.42)

This invention relates to web tensioning systems and more particularly to systems for controlling the tension of a web drawn from a roll of paper, and especially (although not exclusively) to the tensioning of coated stock such as that used in modern high speed printing presses to print so-called "glossy" paper magazines.

In modern high speed printing presses, paper is commonly fed from a supply roll over a series of rollers or other paper handling devices to cylindrical printing plates, the paper that threads through the press being commonly called the "web." It is quite important to maintain a substantially constant and proper tension in the web to provide the smooth flow of paper which is necessary for clean and neat printed copy and to avoid the hazards of web breakage. The problems relating to the maintenance of uniform web tension are compounded when it is necessary to apply brakes for an emergency stop (sometimes called "red button stops"), or during jogging.

As a generality, webs have been tensioned in the past by means of brake shoes or metal straps which frictionally engage either the core or the periphery of the supply roll. The system where brakes act upon the core is generally used only on small presses since these brakes are not suitable for sudden stops of large rolls at high press speed. When retardation against rotation is produced by stationary metal straps pulled against the periphery of a supply roll, the radial force which must be applied is inversely related to the coefficient of friction between the paper and the braking member, and to the coefficient of friction between adjacent layers of paper on the roll. When coated paper having a relatively smooth or glossy surface is used, it has been necessary to apply such high radial forces to decelerate the roll that the resulting web tension tends to cause an unduly large number of breaks or web ruptures. Moreover, such high radial pressures may cause the retarding member or strap to mar the surface of the paper, and scrape off coating material which then accumulates on the retarding strap.

Heretofore, the alternatives to increasing radial pressure have been either to tolerate coasting of the supply roll due to insufficient braking when the press is decelerated, thus causing an unwinding slack in the web, or to add complicated energy consuming machinery for controlling the speed at which the roll rotates during deceleration.

An object of this invention is to provide new and improved web tension control systems for use in connection with printing presses, and more particularly in connection with high speed "glossy paper" magazine presses, which substantially eliminates the difficulties described.

It is another object of this invention automatically to apply rotational restraining forces to a roll of paper stock wherein such forces vary as a function of the tension of the web and independently of radial pressure acting on the roll.

A related object is to apply substantial radial pressures to a roll of paper stock without marring the surface thereof and without increasing web tension.

A further object of this invention is to provide simple and reliable means for controlling the tension in a web pulled from a large heavy roll of glossy, coated paper stock having a low interlayer or paper-to-paper coefficient of friction.

2

Yet another object of this invention is to decelerate large, heavy rolls of paper when rotating at a high speed without unduly increasing tension in the web that is drawn therefrom.

Still another object of this invention is to prevent slack either in the web or in the outer layers of the roll of paper when it is necessary to make emergency stops or to jog the press.

The above mentioned and other objects and advantages of this invention will be apparent upon reading the attached detailed description and upon making reference to the drawing in which:

FIGURE 1 diagrammatically shows a perspective view of a web tensioning device used in connection with a high speed printing press; and

FIG. 2 is a horizontal sectional view of a magnetic particle clutch taken substantially along line 2-2 of FIG. 1.

While the invention is described in connection with a preferred embodiment, it will be understood that the invention is not limited to the specific embodiment shown and described, and that the appended claims are intended to cover the various alternative and equivalent constructions which are included within the spirit and scope of the invention.

Portions of a web processing device or printing press are illustrated in FIG. 1, including a rotatably mounted roll of paper stock 20 which supplies a web 21 that travels or runs over guide rollers 22-24. A motor 25, acting through a gear box 26 and a power transmitting gear train 27, drives rotary printing cylinders 28, 29 which draw the web 21 therebetween and produce printed copy on the web. The cylinders 28, 29 pull the web 21 and thus cause rotation of the supply roll 20 in an unwinding direction, i.e., clockwise as viewed in FIG. 1. The speed of the motor 25 may be adjusted over a wide range and controlled by any suitable device 30. To sense the tension of the web 21, a floating roller 35 is mounted on rocker arms 36, 37 and biased against the pull of web tension by a spring 38. When the tension of the web 21 increases, the floating roller 35 is pulled against the bias of the spring 38 in the direction of arrow A, thereby causing rocker arms 36, 37 to move a sliding contact 40 toward the end C of a potentiometer 41. When the tension of the web 21 decreases, the biasing spring 38 pulls the floating roller 35 in the direction of arrow B thereby causing rocker arms 36, 37 to move the sliding contact 40 toward the end D of the potentiometer 41. Hence, the potential appearing at the sliding contact 40 and applied to an input terminal 42 of an amplifier-controller 45 varies as a function of the tension of the web 21.

In accordance with the invention, one or more endless belts, made preferably of a material having a high coefficient of friction, are supported by means such as an array of rollers which not only afford running or travel of the belts, but also guide the latter to engage and partially wrap the surface of the supply roll 20. Suitable means are provided to tighten the running belts so that they are urged with considerable radial force against the surface of the supply roll, and so that they maintain such force as the roll is consumed and its diameter decreases. However, provision is made to adjustably oppose the running motion of the belts by applying a controllable braking torque to one of the belt-supporting rollers through a variable torque coupling back to the press drive. When the printing cylinders 28, 29 turn and thus pull the web 21 to unwind the roll 20, the roll drives the retarded belts, and is thus retarded itself so that tension is created in the web. So long as the belts do not slip relatively to the supply roll or other rollers, and they are sufficiently tightened to prevent this, the tension created in the web

21 is not related to or dependent upon the degree to which the belts are tightened. Web tension depends, rather, upon the retarding effect produced by the variable torque coupling to the press drive. Because the belts move or run with the surface of the supply roll, there is no possibility of marring the glossy surface of coated paper, and because the radial force of the belts on the surface of the roll can be made very great, substantially all possibility of slippage between adjacent layers of papers, during deceleration or emergency stops, is avoided.

As shown by way of specific example in the drawing, one or more endless retarding belts 50 are trained over a series of pulleys or rollers 51-55, which are clustered about the roll 20 in such a manner that the belts partially wrap the roll, the angle of wrap being shown at *e*. The amount of radial pressure (indicated by arrows P-P) exerted by the belts 50 upon the roll 20 is determined by the tensioning forces which are applied to the belts by any suitable means such as a weight 60 suspended from a floating roller 61 by arm 62. The belt tightening effect of the weight 60 is sufficient to prevent slippage between the belts and the surface of the supply roll 20, and also to prevent slippage between adjacent layers of paper when the press cylinders 28, 29 are quickly decelerated. The weight 60 is increased if greater radial pressure is required, and decreased if less radial pressure is required. Alternatively, other well known belt tensioning devices may be substituted for the weight, such as the well known pneumatically controlled cylinders. The radial pressures thus produced create frictional forces between the belts 50 and the roll 20 which are sufficient to make the roll drive the belts and to make the belts retard rotation of the roll when running movement of the belts is restrained.

The retarding force opposing travel of the belts 50, which thus retard rotation of the roll 20 and create tension in the web 21, is derived from the press drive through a slippable coupling or clutch controllable as to the torque it transmits and preferably having the characteristic that the torque is independent of the slip between its two elements. The slippable coupling is interposed between the press drive and the belts 50. More particularly, the tensioning system includes beveled gears 65-67, drive shafts 70-72 and a clutch 75 which has an electrically controlled variable torque. The gears 65, 66 and shafts 70, 71 are coupled between the roller 51 and one side of the clutch 75, while the beveled gears 67 and drive shaft 72 are coupled between the power transmitting gear train 27 of the press drive and the other side of the clutch 75. The ratios of gears 67, 66 and 65 are chosen so that the shaft 72 always rotates slightly slower than the shaft 71. Thus, there must be some slippage in the clutch to accommodate this differential speed.

Preferably there is approximately 1/2% to 5% slippage, i.e. the shaft 71 turns 1/2% to 5% faster than the shaft 72. Since the velocity of the web 21 depends upon the speed of the cylinders 28, 29, and the surface velocity of the roll 20 and running speed of the belts 50 are always equal to the web speed, the percentage of slip in the clutch 75 will remain constant as the press drive is adjusted by the control 30 from a very slow to a maximum speed. With this arrangement, the press drive continuously exerts a restraining force through clutch 75 and the associated gear train to roller 51, thereby creating a restraining force in the belts 50. The belts 50, in turn, exert a restraining or retarding torque on the roll 20, thus providing the desired web tension and roll deceleration. The magnitude of the retarding torque applied to the roll 20 is determined solely by the torque transmitted between the slipping elements of the clutch 75, the latter torque being controlled as described below.

An important feature of this arrangement is that radial pressure applied by the belts 50 to the supply roll 20 and web tension created by retarding the supply roll are independently variable. The radial pressure P—P is set at

any desired value by a proper selection of the weight 60. The web tension is held uniform at any desired value by controlling the torque of the clutch 75. Therefore, when coated paper is used, radial pressure may be increased to compensate for low coefficients of friction (either paper-to-paper friction, or belt-to-paper friction) without increasing the tension of the web 21. In contrast, in certain known systems the retarding torque on the supply roll and the web tension are varied by changing the radial force exerted by stationary straps against the roll surface. A sufficient radial pressure to prevent paper-to-paper slippage when the roll is decelerated will result in an extremely high web tension which may rupture the web. In the present system the radial pressure of the belts 50 against the roll surface is sufficient to prevent slippage between the belts and the surface of the roll, so that the belts must move in unison with the roll surface. Thus there is static friction between the belts and roll instead of the kinetic friction that exists in systems which rely upon belt-to-paper slippage. Since the static coefficient is greater than the kinetic coefficient, the roll may be decelerated more efficiently.

Turning next to FIG. 2, the variable torque, slippable coupling 75 is there shown as a magnetic particle clutch interconnected between the drive shafts 71 and 72. However, it should be understood that reference to such a magnetic particle clutch is made for purposes of description only and that other clutches having controllable torque transmission characteristics may be used also.

More particularly, the clutch includes a nonmagnetic housing 80 attached to and turning with shaft 72 which also carries slip rings 81 having sliding brushes 82 associated therewith to complete an electrical circuit between the amplifier-controller 45 (FIG. 1) and a coil 83 (FIG. 2). The coil 83 is wound on a bobbin 85 which may be made of soft iron or other magnetic material to provide a field structure having magnetic flux therein controlled in density by energization of the coil 83. Attached to and turning with the shaft 71 is a clutch plate 90 journaled by a bearing 91 in a face plate 92. The plate 92 seals and turns with the housing 80 as it is rotated by the shaft 72. The space within the housing 80 which is occupied by the clutch plate 90 is filled with a mixture 95 comprising magnetic metal particles suspended in a suitable vehicle such as oil, for example.

To control the torque that is transmitted between the shafts 71 and 72, the coil 83 is energized by a variable exciting current applied through the slip rings 81 to control the stiffness of the mixture 95 between the clutch plate 90 and the housing 80. That is, when the coil is energized with a relatively high current, the magnetic particles in the mixture cluster about the ends of the field structure or bobbin 85 and a relatively high torque can be transmitted between the rotating housing 80 and the clutch plate 90. Conversely, when the coil is energized with a relatively low current, the particles of the mixture tend to spread more evenly throughout the housing 80 and there is less torque transmitted between shafts 71 and 72. Hence, it is seen that the torque transmitted through the clutch 75 varies as a function of the electrical signal applied from the sliding contact 40 (FIG. 1) through the slip rings 81 (FIG. 2) to the coil 83.

In operation, the web tensioning system functions in the following manner. The roll 20 rotates as the web 21 is drawn through the printing cylinders 28, 29. The radial pressure P—P causes the belts 50 to move in unison with the roll 20, thereby feeding energy through the roller 51, an associated gear train, and the clutch 75 to the press drive 27. The press drive both receives the feedback energy and restrains the rotation of gears 65, 66 by a degree which is determined by the amount of torque transmitted through the clutch 75. The braking force transmitted through the clutch 75, restrains movement of the belts 50, thereby restraining rotation of the roll 20

5

since there is no slippage between the surface of the roll and the belts.

If tension in the web 21 is reduced, as when the press cylinders are decelerated rapidly and the roll 20 due to its inertia tends to overrun and create slack in the web, the floating roller 35 moves in direction B to reposition the sliding contact 40 toward end D of the potentiometer 41. Responsive thereto, the current in the winding of the clutch 75 is increased, thus increasing the amount of torque transmitted through the clutch, and increasing the decelerating forces applied from the press drive 27 to the roll 20 by increased opposition to movement of the belts 50. Conversely, if the tension of web 21 increases, floating roller 35 moves in direction A on arms 36, 37 to reposition sliding contact 40 toward end C thereby decreasing the current in the winding of the clutch, decreasing torque transmitted through the clutch, and reducing the rotation-opposing effects produced by belts 50 on the roll 20.

Of particular advantage is the fact that the clutch 75 may be made relatively small in size and without special provisions for dissipating large amounts of heat generated by the slip therein. The speeds of the clutch elements 90, 80 need not differ more than about 1/2% to 5%, and a part of the work or energy abstracted from the roll 20 to retard the latter is actually transferred back to the press drive, rather than being dissipated. The slippable coupling 75 interposed between the bolts 50 and the press drive thus provides significant advantages over an arrangement in which the belts 50 are retarded by a brake, the latter necessarily dissipating all of the energy taken from the supply roll.

Although the invention has been described in connection with the control of web tension drawn from a roll of coated paper stock, it should be understood that the same principles may be applied to similar devices such as those which control the unwinding and tensioning of any web-like material.

We claim as our invention:

1. In a system for tensioning a web drawn into a web-processing device, the combination comprising a rotatable web supply roll, at least one endless retarding belt, means including rotatable members for supporting said belt with the latter partially wrapping the periphery of said supply roll, means for tightening said belt sufficiently to prevent slippage between it and said roll, drive means for pulling a web from said roll and thus rotating the latter so that the roll drives said belt without slippage, a slippable coupling, means drivingly connecting said coupling with said drive means and said belt to make said coupling slip and so that torque transmitted by the coupling retards the belt without slippage between said belt and the web during continuous unwinding of the web from said supply roll, means for producing a signal which varies according to the tension in said web, and means responsive to said signal for adjusting the torque transmitted by said coupling.

2. In a system for creating tension in a web drawn into a printing press, the combination comprising a paper supply roll, drive means for pulling a web from the roll and into the press, at least one running retarding belt engaging said supply roll, means for urging said belt radially against the surface of the roll to prevent slippage therebetween so that rotation of the roll by said drive means drives said belt, a slippable coupling including two elements and means for transmitting torque therebetween which varies according to an electrical signal, means connecting the two elements of said coupling respectively with said belt and said drive means so that the first element turns faster than and slips relative to the second, tension sensing means for producing an electrical signal proportional to the tension in the web drawn from said roll, and means for applying said signal to control said slippable coupling for variably opposing rotation of said roll and maintaining the desired tension in said web, said

6

web tension being controlled during continuous unwinding of the web without relative slippage between said belt and the web.

3. In a system for tensioning a web drawn into a web-processing device, the combination comprising a rotatable web supply roll, at least one endless running belt partially wrapping the periphery of said supply roll, means for causing said belt to apply a radial pressure on said roll and to prevent slippage between said roll and said belt, drive means in said web-processing device for pulling the web from said roll thereby rotating said roll and causing the latter to drive said belt without slippage, a slippable coupling, means including said belt and said slippable coupling drivingly connected with said roll and said drive means to make said coupling slip and thus feed energy from said rotating roll to said drive means, tension sensing means for producing a signal proportional to the tension of said web, and means controlled by said signal for varying the torque transmitted by said coupling, said torque transmitted by said coupling effecting retardation of said belt without relative slippage between said belt and the web during continuous unwinding of the web.

4. In an automatic web tensioning control system, the combination comprising a rotatably mounted web supply roll of paper stock, means including a press drive for pulling the web from said roll, a member bearing with pressure against the surface of said roll and moving therewith without slippage relative thereto as said press drive pulls said web from said roll, means including a floating roller for producing a signal which varies with tension in said web, means including a variable torque slippable clutch interconnecting said drive and said member, said last-named means including means for making said clutch slip while nevertheless transmitting torque so that the press drive retards movement of said member, said torque transmitted by said clutch effecting retardation of said belt without relative slippage between said belt and the web during continuous unwinding of the web, and means responsive to said signal for increasing and decreasing the torque of said clutch in response to decreases and increases in web tension to control said web tension independently of the bearing pressure of said member.

5. In a system for creating tension in a web drawn into a web-processing device, the combination comprising a rotatable web supply roll, drive means for pulling said web through said device thereby rotating said roll, means comprising at least one endless tensioning belt partially wrapping said roll and mounted for movement in unison with said roll, means for applying a predetermined tension to said belt to urge the latter with radial pressure against said roll and preventing slippage between said roll and said belt, means for providing an electrical signal which varies as a function of said tension in said web, means including a magnetic particle clutch controlled by said signal for opposing the movement of said belt, said opposition to belt movement being effected without relative slippage between said belt and the web during continuous unwinding of the web, said last-named means including said belt and said clutch drivingly connected with said roll and said drive means to make said clutch slip while feeding energy from said rotating roll to said drive means.

6. In a system for controlling the tension in a web drawn into a web-processing device by a rotating part driven at adjustable speeds, the combination comprising a web supply roll, an endless running belt partially wrapped about said roll, means for urging said belt radially against the surface of the roll to prevent slippage therebetween, a drive connection including a slippable coupling interposed between said endless belt and said rotating part, said drive connection including means for making said slippable coupling slip to make the latter retard movement of the former, said coupling having means for varying the torque transmitted thereby independently of the slippage therein, means for sensing the tension in

said web, and means responsive to said sensing means for increasing or decreasing the torque transmitted by said coupling between said endless belt and said rotating part when the web tension respectively decreases or increases, so that the value of the web tension is maintained substantially constant as the roll is accelerated or decelerated, said web tension being controlled during continuous unwinding of the web without relative slippage between said belt and the web.

5

References Cited in the file of this patent

UNITED STATES PATENTS

1,910,878	Bernard	May 23, 1933
1,972,676	Bolza	Sept. 4, 1934
2,268,980	Durham	Jan. 6, 1942
2,272,140	Tollison et al.	Feb. 3, 1942
2,682,027	Willis	June 22, 1954