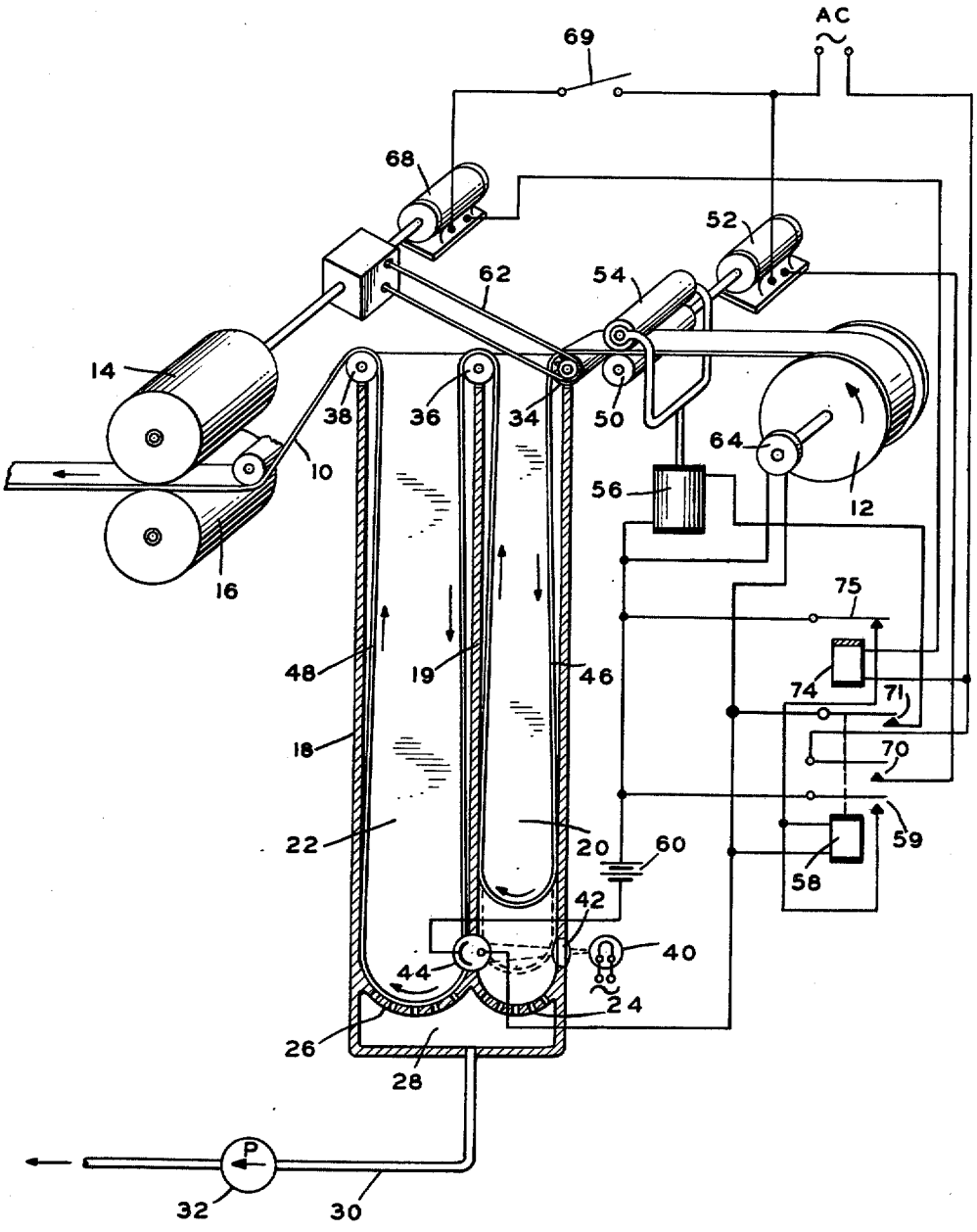
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STORAGE AND FEED MEANS FOR A CONTINUOUS WEB

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STORAGE AND FEED MEANS FOR A CONTINUOUS WEB

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This invention relates to web feed means for use with a high speed machine and more particularly to such apparatus in which the forces acting on portions of the advancing web are utilized in the control of the storage and feed of the web as it is being fed to a high speed machine such as a high speed automatic printing press.

In recognition of the necessity for coordinating the supply rate of a web to a utilization device in accordance with variations in the demand rate of the utilization device, numerous arrangements have hitherto been proposed for controlling the feed of the web to the utilization device. Such arrangements with which I am familiar have left much to be desired particularly due to the presence of undesirable inertial effects of parts operating intermittently or at variable rates.

A principal object of the present invention is, therefore, to provide a web feed and storage apparatus which is highly compact, in which the web is maintained under a substantially constant tension and characterized by substantial minimization or avoidance of inertial effects which would disturb the desired constant web tension.

A feature of the present invention is the provision of low inertia means for applying a force to a web so that under the influence of said force, it is withdrawn from a source of web supply to maintain an accumulation of the web under a substantially uniform tension in advance of the utilization device.

In a preferred embodiment suction means are utilized to create unequal forces on two longitudinally spaced portions of the web at each of which an accumulation of the web is normally maintained as it passes from supply means to the utilization device. The smaller force acts on the accumulation of the first portion of the web and differential in the forces acting on the two accumulations results in the first accumulation being depleted before the second accumulation, the latter being nearer to the utilization device. When the utilization device withdraws the web at a rate greater than the rate at which the smaller force acting on the web causes its withdrawal from the supply means, the first accumulation is depleted first. Means are provided for increasing the rate of withdrawal from the supply means in response to depletion of the first web accumulation.

Further advantages of the present invention will be apparent from the following description thereof and the accompanying drawing, the single figure of which is a diagrammatic and schematic representation of a preferred embodiment of the invention.

In the drawing there is shown a web **10** such as paper from a supply reel **12** being fed to a machine such as a printing press, represented by printing rolls **14, 16.** To compensate for variations between the speed of the web leaving the supply roll and the speed of the web entering the printing press, storage space is provided for a supply of paper at all times in a storage tank **18** between the supply roll and the press. In an embodiment that is especially well suited for use in connection with a high speed, automatic card printing press, the storage tank is a

rectangular box approximately 3¼ by 10 by 40 inches, and open at the top. The box is divided into two storage or accumulator compartments by a vertical partition **19** parallel to the greatest dimension of the tank. In the drawing the storage compartments are designated **20** and **22** respectively. The bottom of each of the compartments **20, 22** is formed by perforated semi-cylindrical guides, **24** and **26** respectively. The portion of the tank interior below the guides **24, 26** is a vacuum compartment **28** which is connected by a conduit **30** with a vacuum pump **32.** The cross-sectional areas of the compartments **20, 22** are made unequal, the compartment **22** being wider than the compartment **20** so that the force exerted downward (as viewed) on the web by the vacuum in the compartment **22** is greater than that exerted in the compartment **20,** to facilitate control of the web as will appear more fully hereinbelow. In the embodiment hereinabove mentioned the ratio of the widths of the compartments is approximately three to two. At the top of the tank **18** are mounted a driven roll **34** and idler rolls **36, 38** located respectively at the edge nearest the supply roll **12,** at the partition **19,** and at the edge nearest the press. The web from the supply roll **12** passes over the roll **34,** loops down into the compartment **20** to form a first accumulation, passes over the idler roll **36,** loops down into the compartment **22** to form a second accumulation, passes over the idler roll **38,** and thence to the press. Near the bottom of the compartment **20,** a lamp **40** is arranged to send a beam, as through a lens or window **42** in the wall of compartment **20** nearest the supply roll. The beam is arranged to impinge upon a photo-electric cell **44,** which cell is preferably embedded in the partition wall **19.** When the loop **46** of the web falls close to the bottom of compartment **20,** the loop **46** interrupts the light beam.

The loop **48** of web in the compartment **22** is intended at all times to extend entirely to the bottom of the compartment **22** where it is held in slidable contact with the perforated guide **26** by the force resulting from the pull of the vacuum which is, as hereinabove mentioned, greater than the force in the compartment **20,** inasmuch as the same vacuum acts over a larger area of the web in compartment **22** than in compartment **20.** Whenever the web is drawn into the press at a faster rate than it is leaving the supply roll, the greater force holds loop **48** down while the loop **46** rises upward in the compartment **20,** uncovering the light beam if the loop is not already above the level of the beam. As will be more fully explained hereinbelow, the uncovering of the light beam resulting from depletion of the web accumulation in compartment **20** actuates a mechanism for increasing the speed at which the web leaves the supply reel.

The press is driven by motor **68** which, together with a retarded relay **74** connected in series therewith, is connected in circuit with a suitable source when start switch **69** is closed.

Normally when the press is started up into operation from a standstill the web loops **46, 48** both are extended to the bottom of their respective compartments, providing in the embodiment hereinabove described a reserve supply of about fourteen linear feet of paper. When the press is started it is permitted to accelerate to full speed without motor control because the storage tank contains a sufficient supply of paper at an essentially uniform low tension suitable for feeding into the press. This tension is governed by the pull of the vacuum upon the web loop **46** in compartment **20.** It will be noted that in the event the rate at which paper is withdrawn by the press exceeds the rate of infeed from supply reel **12,** then the differential in the forces acting on the loops in compartments **20** and **22** results in the length of the loop in compartment **22** being maintained at the expense of the loop in compartment **20.** Thus, the press in effect withdraws

paper from the accumulation in compartment 20 which is the compartment nearest the supply reel.

A power-driven roll 50 is provided between the driven roll 34 and the supply reel 12 and is driven as by an electric motor 52, which motor may be designated the accelerator motor. Rotatably mounted above the roll 50 is a pressure roll 54 which may be used to press the paper against the driven roll 50 under the control of a solenoid 56. A relay 58 connected in series with photocell 44 and its source, battery 60, is provided for controlling, by means of its contacts 70, the supply of current to the accelerator motor 52 from a suitable source. The accelerator means just described functions during the start up cycle of the apparatus and is not required during normal operation. To this end, contacts 70 and 71 of relay 58 are connected in series with the motor 52 and the solenoid 56, respectively. Normally closed contacts 75 of retarded relay 74 are connected in series with the winding of relay 58 and in parallel with the holding contacts 59 of relay 58. The delay of retarded relay 74 is sufficiently long so that its contacts 75 remain closed following the closing of switch 69 for a time interval long enough for the press to withdraw web from compartment 20 and uncover the light beam from lamp 40. Photocell 44 now becomes conductive and relay 58 picks up its contacts 59, 70 and 71. Now when relay 74 drops out at the end of its delay period relay 58 remains energized through its holding contacts 59 so long as the photocell 44 is illuminated by the light beam from lamp 40, thereby keeping the circuits to accelerator motor 52 and solenoid 56 closed. The accelerator means functions to bring the supply reel up to speed with a somewhat slower rate of acceleration than the rate of acceleration of the press. The initial operation of the press tends to deplete the accumulation in compartment 20 but the web is rapidly restored in compartment 20 due to the operation of the accelerator.

A magnetic drag-brake 64 is located adjacent to the hub of reel 12, the energization circuit of which is also controlled by photocell 44 so when lamp 40 is uncovered and photocell 44 is energized, the brake 64 is released.

During the start cycle, as soon as the light beam is uncovered by the rise of the web loop, the electric circuit is established through the photo-electric cell 44 and the battery 60 actuating the solenoid 56 and the relay 58, thereby drawing the pressure roll 54 down upon the web and starting the accelerator motor 52. At the same time magnetic brake 64 is released. The supply reel is then brought quickly up to a speed at which it is capable of putting paper into the storage tank at a faster rate than it is withdrawn by the press running at full speed. This causes the loop 46 to descend until it blocks the light beam thereby causing the pressure roll solenoid 56 to release, the accelerator motor 52 to be shut down and the magnetic brake 64 to retard rotation of supply reel 12.

When the press is running normally, the paper is drawn from the supply reel, rotation of which is now retarded by brake 64, by the action of the vacuum upon the loop 46. Stabilization is effected by means of the roll 34 which is driven from motor 68 as is the press and at a speed which is faster than the demand speed of the press. In the embdoiment that has been operated, the roll 34 is driven at about four percent above the web demand speed of the press. The speed of the roll 34 follows proportionately all speed variations of the press in every phase of press operation. The web is maintained taut against the roll 34 by means of the vacuum in compartment 20. The web is continually in sliding engagement with the face of driven roll 34, the rate of revolution of which is independent of the speed at which the web travels. Consequently, when the rate of travel of the web over roll 34 changes as brake 64 is successively energized and deenergized, the web is not affected by the inertia of roll 34 as would be the case if roll 34 were an idler. Thus, the roll 34 acts as a dynamic stabilizer on the web.

The present apparatus is especially well suited for use with an automatic splicer whereby the operation of the press is not interrupted when the supply reel is replenished due to the presence of the accumulation of web in the tank 18. Such an automatic splicer splices the end of one reel of paper to the beginning of a new reel. This operation may be made very rapid, requiring perhaps no more than one-tenth of a second for its completion. During the splicing operation, the web from the reel is cut and stopped, during which time the press draws paper from the storage tank against the force resulting from the vacuum provided by the air pressure means which includes vacuum pump 32. Upon completion of splicing, contacts, not shown, also in parallel with contacts 59 of relay 58 are momentarily closed to complete the energizing circuit of relay 58 which then closes its contacts 59 and 70 and accelerator motor 52 is energized until the beam from lamp 40 is once again blocked. The new reel is accelerated to full speed as hereinabove described and the storage tank is refilled in the same manner as hereinabove described in connection with starting the press.

The proportions of the storage tank may be varied within wide limits while still remaining within the scope of the invention. Also it will be evident that the invention is not limited to use with a printing press but may be used in connection with other machines and processes which operate upon material in the form of a web. Materials other than paper may constitute the web, and other controls, such as hydraulic or pneumatic controls, may be used where electric or electronic controls are shown.

The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

What is claimed is:

1. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device, means defining a path for said web and forming a compartment, means communicating with said compartment for maintaining an air pressure differential across said web to thereby apply a force to said web and withdraw it from the source thereof and maintain a web accumulation in said compartment, control means responsive to the accumulation of web in said compartment, and means governed by said control means for normally retarding withdrawal of the web from its source while the web is moving under the influence of said force from its source to said compartment, said control means in response to depletion of the accumulation of the web causing said means governed thereby to reduce its retarding effect upon the withdrawal of the web from its source.

2. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device, means defining a path for said web and forming a compartment, means communicating with said compartment for maintaining an air pressure differential across said web to thereby apply a force to said web and withdraw it from the source thereof and maintain a web accumulation in said compartment, control means responsive to the accumulation of web in said compartment, means governed by said control means for normally retarding withdrawal of the web from its source while the web is moving under the influence of said force from its source to said compartment, said control means in response to depletion of the accumulation of the web causing said means governed thereby to reduce its retarding effect upon the withdrawal of the web from its source, and accelerating means adapted to be energized upon start up of the utilization device for accelerating with-

drawal of the web from its source, said control means upon restoration of the web accumulation being adapted to deenergize said accelerator means.

3. An apparatus as set forth in claim 2, comprising means for preventing reenergization of said accelerator means following deenergization thereof by said control means during continued operation of said utilization device.

4. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device, means defining a path for said web and forming a compartment, a roll on the infeed side of said compartment, means for continuously rotating said roll at a speed having a predetermined relation to the speed of operation of the utilization device, means communicating with said compartment for maintaining an air pressure differential across said web to thereby apply a force to said web and withdraw it from the source thereof and maintain a web accumulation in said compartment, said force maintaining said web taut against said roll, control means responsive to the accumulation of web in said compartment, and means governed by said control means for normally retarding withdrawal of the moving web from its source, said control means in response to depletion of the accumulation of the web causing said means governed thereby to reduce its retarding effect upon the withdrawal of the web from its source.

5. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device having a variable web demand rate, first means for receiving a web on one side thereof and accumulating a first portion of said web, second means on the other side of said first means for receiving said web from said first means and accumulating a second portion of said web, said first and second portions of said web being spaced in that sequence longitudinally along the web in the direction it advances toward the utilization device, and means for maintaining a first and second force on said first and second portions respectively of said web in a direction to oppose depletion of the web accumulations, said second force being greater than said first force, said first force serving to withdraw the web from the source thereof, whereby on the occurrence of an increase in the demand rate of said utilization device the first accumulated web portion is depleted before the start of depletion of the second accumulated web portion.

6. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device having a variable web demand rate, first means for receiving a web on one side thereof and accumulating a first portion of said web, second means on the other side of said first means for receiving said web from said first means and accumulating a second portion of said web, said first and second portions of said web being spaced in that sequence longitudinally along the web in the direction it advances toward the utilization device, and air pressure means for maintaining a first and second force on said first and second portions respectively of said web in a direction to oppose depletion of the web accumulations, said second force being greater than said first force, said first force serving to withdraw the web from the source thereof, whereby on the occurrence of an increase in the demand rate of said utilization device the first accumulated web portion is depleted before the start of depletion of the second accumulated web portion.

7. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device having a variable web demand rate, first means for receiving a web on one side thereof and accumulating a first portion of said web, second means on the other side of said first means for receiving said web from said first means and accumulating a second portion of said web, said first and second portions of said web being spaced in that sequence longitudinally along the web in the direction it advances toward the utilization device, and means including a vacuum pump communicating with said web portions for maintaining a first and second force on said first and second portions respectively of said web in a direction to oppose depletion of the web accumulations, said second force being greater than said first force, said first force serving to withdraw the web from the source thereof, whereby on the occurrence of an increase in the demand rate of said utilization device the first accumulated web portion is depleted before the start of depletion of the second accumulated web portion.

8. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device having a variable web demand rate, first means for receiving a web on one side thereof and accumulating a first portion of said web, second means on the other side of said first means for receiving said web from said first means and accumulating a second portion of said web, said first and second portions of said web being spaced in that sequence longitudinally along the web in the direction it advances toward the utilization device, means including a vacuum pump communicating with said web portions for maintaining a first and second force on said first and second portions respectively of said web in a direction to oppose depletion of the web accumulations, said second force being greater than said first force, said first force serving to withdraw the web from the source thereof, whereby on the occurrence of an increase in the demand rate of said utilization device the first accumulated web portion is depleted before the start of depletion of the second accumulated web portion, control means responsive to said first accumulated portion of said web, and means governed by said control means for controlling the rate of withdrawal of said web from its source.

9. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device having a variable web demand rate, first means for receiving a web on one side thereof and accumulating a first portion of said web, second means on the other side of said first means for receiving said web from said first means and accumulating a second portion of said web, said first and second portions of said web being spaced in that sequence longitudinally along the web in the direction it advances toward the utilization device, means including a vacuum pump communicating with said web portions for maintaining a first and second force on said first and second portions respectively of said web in a direction to oppose depletion of the web accumulations, said second force being greater than said first force, said first force serving to withdraw the web from the source thereof, whereby on the occurrence of an increase in the demand rate of said utilization device the first accumulated web portion is depleted before the start of depletion of the second accumulated web portion, control means responsive to said first accumulated web portion, means governed by said control means for normally retarding withdrawal of the web from its source while the web is moving under the influence of said first force from its source to said first means, said control means in response to depletion of said first accumulated web portion causing said means governed thereby to reduce its retarding effect upon the withdrawal of the web from its source, and accelerating means adapted to be energized upon start up of the utilization device and for accelerating withdrawal of the web from its source, said control means upon restoration of said first accumulated web portion being adapted to deenergize said accelerator means.

10. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device, means defining a path for said web and forming first and second compartments each

adapted to receive respectivley a first and second web accumulation with the cross-sectional area of the accumulation in said second compartment being greater than that of the accumulation in said first compartment, perforate web guide members supported in said compartments, vacuum pump means communicating with each of said compartments on one side of said web through said guide members for maintaining an air pressure differential across each of said accumulations and thereby create forces urging said web into said compartments toward said guide members for maintaining said accumulations with the force acting on said second accumulation greater than that acting on said first accumulation, a roll on the infeed side of said first compartment, means adapted for response to the speed of operation of said utilization device for continuously driving said roll, the force acting on said first accumulation maintaining said web taut against said roll and serving to withdraw the web from its source, control means responsive to depletion of said first accumulation and withdrawal of said web away from said guide member in said first compartment, means governed by said control means for normally retarding withdrawal of the web from its source while the web continues to move from its source to said first means, said control means in response to depletion of said first accumulation causing said governed means to reduce its retarding effect upon the withdrawal of the web from its source, accelerator means for accelerating withdrawal of the web from its source, and means controlling energization of said accelerator means, said control means upon restoration of said first accumulation being adapted to deenergize said accelerator means.

11. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device, means defining a path for said web and forming a compartment, means communicating with said compartment for maintaining an air pressure differential across said web to thereby apply a force to said web and withdraw it from the source thereof and maintain a web accumulation in said compartment, control means responsive to the accumulation of web in said compartment, means governed by said control means for normally retarding withdrawal of the web from its source while the web is moving under the influence of said force from its source to said compartment, said control means in response to depletion of the accumulation of the web causing said means governed thereby to reduce its retarding effect upon the withdrawal of the web from its source, accelerator means for accelerating withdrawal of the web from its source, and means controlling energization of said accelerator means, said control means upon restoration of the web accumulation being adapted to deenergize said accelerator means.

12. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device, means defining a path for said web and forming a compartment, a roll on the infeed side of said compartment, means for continuously rotating said roll at a speed having a predetermined relation to the speed of operation of the utilization device and

which is greater than the web demand rate of said utilization device, means communicating with said compartment for maintaining an air pressure differential across said web to thereby apply a force to said web and withdraw it from the source thereof and maintain a web accumulation in said compartment, said force maintaining said web taut against and in sliding engagement with said roll, control means responsive to the accumulation of web in said compartment, and means governed by said control means for normally retarding withdrawal of the moving web from its source, said control means in response to depletion of the accumulation of the web causing said means governed thereby to reduce its retarding effect upon the withdrawal of the web from its source.

13. In an apparatus for supplying continuous web under substantially uniform tension from a source thereof to a utilization device, means defining a path for said web and forming first and second compartments each adapted to receive respectively a first and second web accumulation with the cross-sectional area of the accumulation in said second compartment being greater than that of the accumulation in said first compartment, perforate web guide members supported in said compartments, vacuum pump means communicating with each of said compartments on one side of said web through said guide members for maintaining an air pressure differential across each of said accumulations and thereby create forces urging said web into said compartments toward said guide members for maintaining said accumulations with the force acting on said second accumulation greater than that acting on said first accumulation, a roll on the infeed side of said first compartment, means adapted for response to the speed of operation of said utilization device for continuously driving said roll at a peripheral speed greater than the web demand rate of said utilization device, the force acting on said first accumulation maintaining said web taut against and in sliding engagement with said roll and serving to withdraw the web from its source, control means responsive to depletion of said first accumulation and withdrawal of said web away from said guide member in said first compartment, means governed by said control means for normally retarding withdrawal of the web from its source while the web continues to move from its source to the first said means, said control means in response to depletion of said first accumulation causing said governed means to reduce its retarding effect upon the withdrawal of the web from its source, accelerator means for accelerating withdrawal of the web from its source, and means controlling energization of said accelerator means, said control means upon restoration of said first accumulation being adapted to deenergize said accelerator means.

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