

Aug. 11, 1959

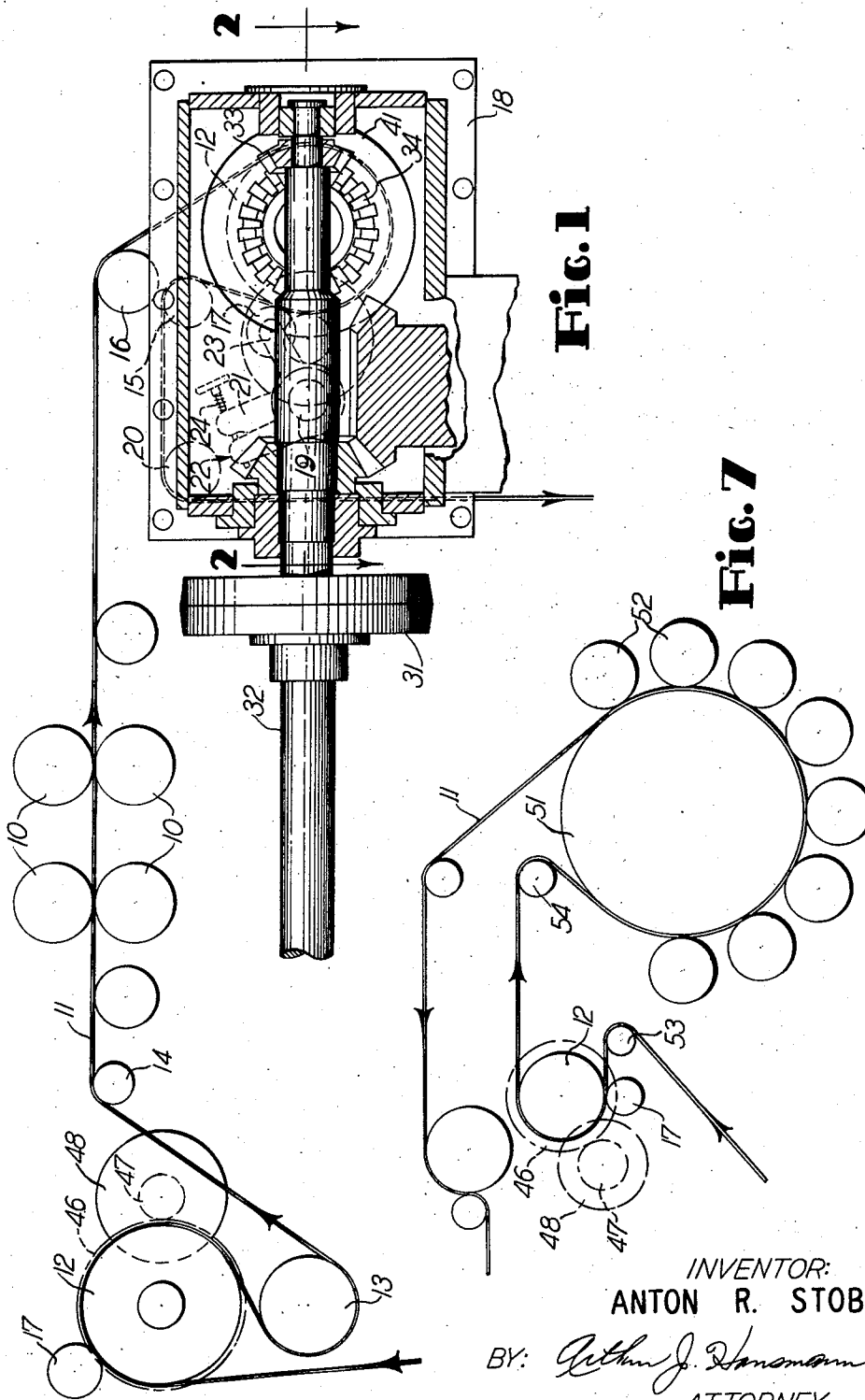
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2,899,199

TENSION CONTROL MEANS FOR A WEB OF PAPER

Filed Dec. 16, 1957

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

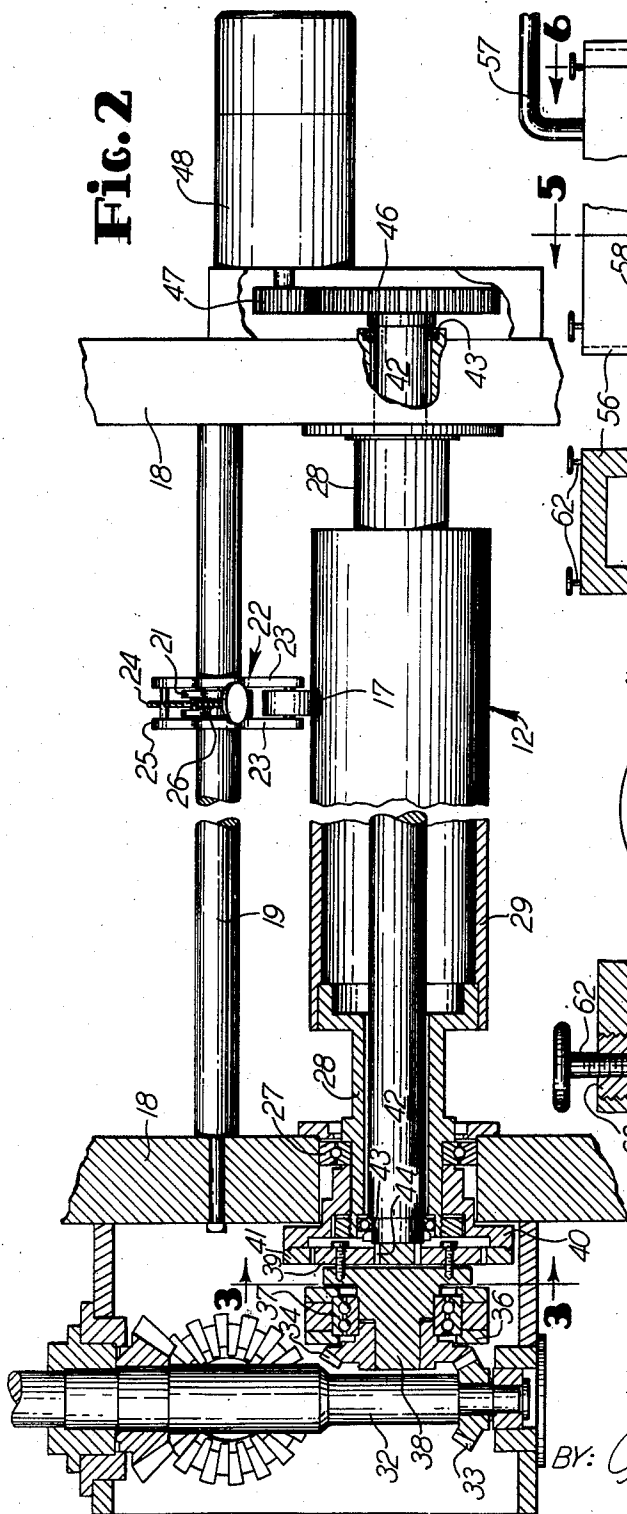


Fig. 2

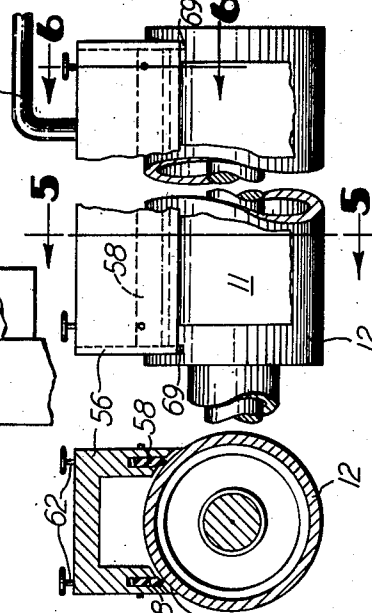


Fig. 4

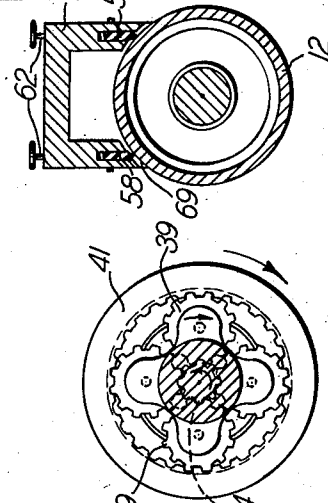


Fig. 5

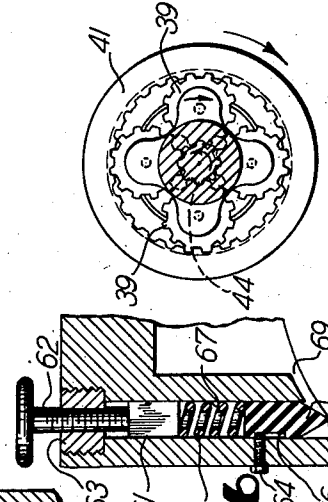


Fig. 6

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3 Sheets-Sheet 3

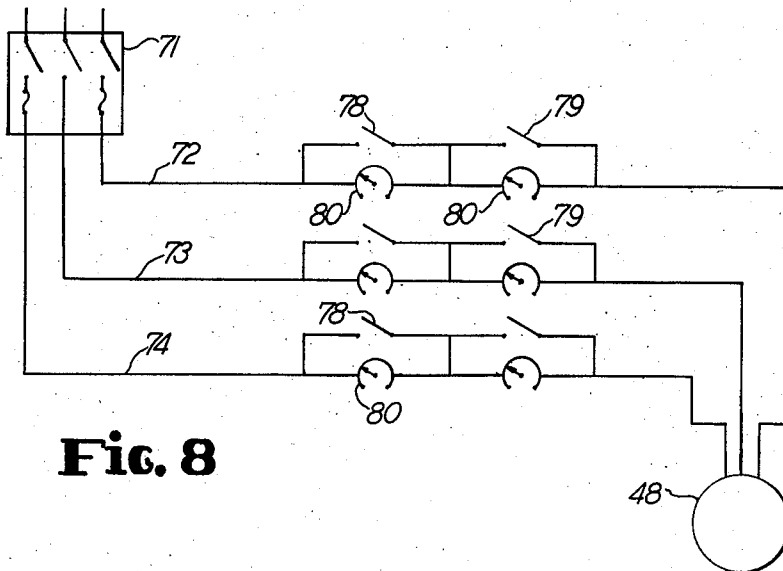


Fig. 8

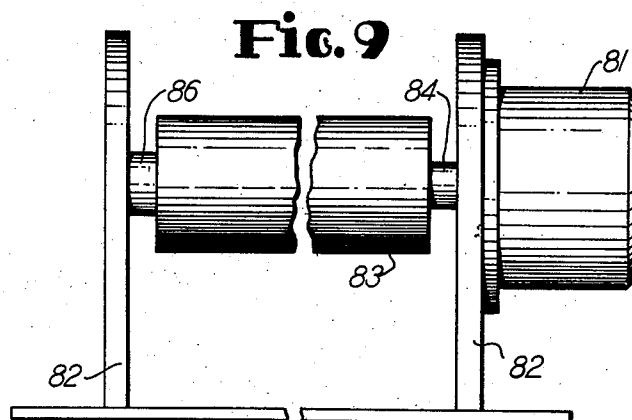


Fig. 9

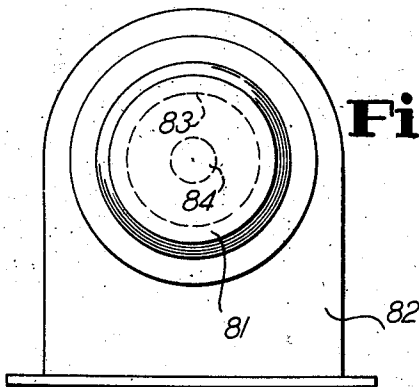


Fig. 10

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TENSION CONTROL MEANS FOR A WEB OF PAPER

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10 Claims. (Cl. 271—2.3)

This invention relates to web tension control means and, more particularly, it relates to means for controlling the tension in a web of paper being fed through a printing press.

In passing paper in web form through a printing press, there is a well-known problem with regard to maintaining the paper in a taut condition under constant tension when the press is being initially started, and when the press is running at full speed, and also when the press is being slowed down or stopped. Without control of the paper tension, the printing will not be as desired, and particularly so in multi-color printing where a plurality of printing cylinders are operating on the paper such that the various impressions or printings must be located in superimposed positions, one over the other, so that there is the desired registration of the various impressions on the web of paper. Also, without control of tension in the web of paper, there will be paper waste, and the paper is sometimes torn when the tension momentarily exceeds the strength of the paper.

Accordingly, it is an object of this invention to provide a means for controlling the tension of a web of paper or the like with said means including provision for placing a constant tension on the paper passing through a printing press when the press is being operated under acceleration and normal running speed and deceleration.

Still another object of this invention is to provide a means for placing a constant tension on a web of paper so that said means can be applied to the paper at a point remote from the roll source or wind-up roll of the paper, and thus the problems of altering the paper linear speed with decreasing or increasing roll diameters are avoided.

Still another object of this invention is to provide an improved means for increasing the frictional contact between a web of paper and a roll over which it is trained. In accomplishing this particular object, the tension in the web of paper can be controlled by the tension control means in conjunction with the frictional increasing means mentioned herein.

Other objects and advantages will become apparent upon reading the following description in conjunction with the accompanying drawings, wherein:

Fig. 1 is a side elevational view of a fragment of a printing apparatus, diagrammatically shown, and showing a web of paper trained through the apparatus, and also showing the disposition of a preferred embodiment of the invention as related to the apparatus; parts are fragmentarily shown and also other parts are shown in section.

Fig. 2 is a partially sectioned view taken on the line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary view of an alternative means for maintaining a web of paper in tight contact with a roll over which the paper is trained.

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4.

Fig. 6 is an enlarged sectional view taken on the line 6—6 of Fig. 4 and showing a fragment of the latter.

Fig. 7 is a view of other printing apparatus showing a web of paper trained thereto and showing the utilization of only a part of the construction shown in Fig. 1.

Fig. 8 is a wiring diagram for control of the electric motor employed.

Fig. 9 is an elevational view of another embodiment of this invention.

Fig. 10 is an end elevational view of Fig. 9.

The same reference numerals refer to the same parts throughout the views.

Fig. 1 shows printing press cylinders 10, and with the cylinders being shown in two sets, they can be referred to as a multi-color press with each set of cylinders placing its respective color and impression on a web of paper 11 which is trained through the press and between the cylinders 10 as shown. The paper 11 originates from a supply roll, not shown, and travels around a cylinder or incoming roller 12 which is rotatably mounted, and the paper continues on, around guide rollers 13 and 14 to the printing cylinders 10, as mentioned. On the outlet side of the printing press, the web 11 is trained over the guide roller 16 and continues on to an outgoing roller 17, which is the same as incoming roller 12, and then to other guide rollers 15 and 20 from where the web may go to a cutting and folding mechanism, not shown. The arrows on the web 11 show the direction of movement, and the view is somewhat diagrammatic, but it is adequate for a complete disclosure of this invention.

In the operation of a multi-color press, it should be understood that it is important to register the various colors in their positions, and in order to do so, the tension of the paper web 11 must be precisely controlled, and such control requires that the paper be held at a constant tension from, say, the point of the roller 12 on the incoming side of the press to the side of the roller 12 on the outgoing side of the press so that the tension of the paper is under the desired tension throughout its run through the press. Also, it should be understood that the printing cylinders 10 do not normally bear against the paper and thereby print the paper for a full three hundred and sixty degree rotation of the cylinders, but usually a maximum of three hundred degrees of rotation is utilized in the printing length of the cylinder, and thus the paper is not continuously held between the pairs of cylinders 10 so that the paper could be linearly displaced with respect to the linear displacement of the circumference of the printing cylinders 10.

Referring to Figs. 1 and 2 and with attention directed to the cylinder 12, it will be seen that the web 11 is trained between the cylinder 12 and the smaller roller or cylinder 17 which is mounted to be under spring tension and thus pressed against the paper 11 so that the latter is pressed between the roller 17 and the cylinder 12 and is wrapped around three-fourths of the cylinder 12. The paper 11 is thus controlled or held between these two rollers or cylinders, and it will be noted that there is duplicate structure at the entrance and exit side of the press so there is the same arrangement at each side of the printing cylinders. The rollers 12 and 17 are suitably supported in a frame 18 which has spaced-apart frame members 18, shown in Fig. 2, and a shaft 19 extends between the frame members for supporting the roller 17 in its spring mounting, as mentioned. Figs. 1 and 2 show a support arm 21 which is conventionally clamped onto the shaft 19 to be in a fixed position thereon while a bell crank 22 with a spaced-apart arms 23 is rotatably mounted on the shaft 19. A screw 24 is then

slidably mounted through the arm 21 to be mounted between the arm 21 and the other end 25 of the bell crank 22 to which the screw is threaded so that the bell crank 22 can be maintained in a rotated position such that the roller 17 will bear on the paper 11 trained over the roller 12. Also, a spring 26 is shown disposed on the screw 24 between the arm 21 and the head of the roller 17 on the paper 11. Of course, several of the rollers 17 could be and normally would be employed along the roller 12 for the purpose mentioned.

It will also be seen that the roller 12 is suitably mounted in the frame members 18 by means of ball bearings 27 which are at each end of a sleeve 28, as indicated on the shown end, and the sleeves 28 are on both ends of the roller 12 to support the hollow cylinder 29 of the roller 12. The important feature of this invention resides in controlled rotation of the roller 12, and such control will now be described. Fig. 1 shows a pulley 31 which is driven along with the usual and conventional drive means of the printing press or the cylinders 10, and a shaft 32 is thus rotated by the pulley 31, and it will be seen that the shaft drives a bevel gear 33 which is in mesh with the bevel gear 34 mounted in frame members 36 and with ball bearings 37. This is a conventional drive relation between the press and the paper feed. The gear 34 drives the spider member 38 which rotatably supports the four planetary gears 39 as shown in Fig. 3. The gears 39 are in meshing relation with a ring gear 41 which is mounted on a ring 40 attached to the sleeve 28 such that the gear 41, ring 40, and sleeve 28 with cylinder 29 all rotate together. At this time it should also be noticed that the roller 12 includes a shaft 42 which extends axially therethrough to be rotatably supported by the ball bearings 43 disposed between the sleeve 28 and the shaft 42 such that the sleeve and the shaft can rotate independent of each other. Also, the end of the shaft 42 has a sun gear 44 mounted thereon for rotation with the shaft, and for meshing engagement with the planetary gears 39. The opposite end of the shaft 42 has a spur gear 46 attached thereto to be in meshing relation with a pinion gear 47 driven by a constant torque motor 48.

The main drive of the printing press or the cylinders 10 thus is transmitted through the bevel gears and the planetary gearing described to the roller cylinder 29 while the energy of the constant torque motor 48 is transmitted to the shaft 42 through the gears described. The two sources of power are such that the ring gear 41 is driven in the direction of the arrow shown outside of Fig. 3, and the sun gear 44 is driven in the direction of the arrow shown on it in Fig. 3. With this arrangement and with the output of the motor 48 being a constant amount, the tension placed on the web of paper as it is trained between the rollers 12 and 17 is a constant amount as desired. The motor 48 is preferably an electric motor of a constant torque type which does inherently produce a constant output torque irregardless of speed. To produce and maintain a constant tension in the web of paper, the roller 12 is rotated at a certain speed which will result in the desired tension in the web. If the web tension decreases momentarily, the roller will be rotated faster as the motor 48 rotates the sun gear to increase the rotation of the planet gears on their individual axes in the spider 38. Normally the sun gear and the constant torque motor will not move as the motor merely exerts a constant force on the sun gear to provide the reaction for the rotation of the roller 12 at the desired speed according to the tension desired in the web. Since the motor 48 is an electric motor, electrical controls for the motor permit the torque of the latter to be set as desired.

Fig. 1 shows that there is a constant torque motor on both the incoming and the outgoing press sides of the web or paper, and of course, these motors are arranged

to place tension in the web of paper in that the motors urge the paper in opposite directions to place the paper under tension through the printing press, as mentioned. The motor 48 on the incoming press side will operate to place a retarding force on the web so that constant tension is maintained. In this arrangement, both of the planetary gearings are variable speed or differential drive means having two-power input connections, namely, the sun gear 44 and the spider 38.

Fig. 7 shows another arrangement of what is termed a printing press which includes the master cylinder 51 which is rotatably mounted and has a plurality of printing or impression cylinders 52 disposed therearound with the web of paper 11 trained between the cylinder 51 and the cylinders 52 as shown. Here, also, the web of paper is shown to be coming from a cylinder and trained about a first guide roller 53 and the roller 12 to continue on to the guide roller 54 and into the press between the press cylinders mentioned. Also, the companion roller 17 is employed with the roller 12 to hold the paper between the rollers 12 and 17 as previously described. Again, the drive of the press is connected to the roller 12 to rotate the latter in the forward direction of paper feed shown by the arrows on the paper. Here, also, the constant torque motor 48 with its spur gear 47 is shown to be in driving relation with the gear 46 on the roller 12. It will also be understood that the gearing of the planetary type, as described in connection with Figs. 2 and 3, can be applied on the roller 12 in the same manner as previously described. In the Fig. 7 arrangement, it will then be understood that the printing cylinders 52 will at all times have one thereof in contact with the cylinder 51 so that the paper 11 will be positively held between the cylinder 51 and any one or more of the cylinders 52. Thus, the only requirement for controlling the tension of the paper is the provision of one constant torque motor 48 and one combination of the rollers 12 and 17, and this provision is shown on the incoming side of the press. This arrangement permits the constant torque motor and the rollers 12 and 17 to control the speed of the paper and the tension of the paper as the web of paper is passing to the printing press, and thus the desired result of controlled tension and the maximum in registration of multi-color printing is achieved by having the motor 48 operate in a direction to urge the web in a retarded direction as it urges the cylinder 12 in reverse of the direction of rotation induced by the drive off the press.

Figs. 4, 5 and 6 show another means of holding the web of paper to the roller 12 so that the web can be properly tensioned as desired. In this arrangement, it will be seen that the roller 12 has an air chamber 56 disposed along the length of the roller and partially around the circumference of the roller to be in close proximity to the roller at a point where the web of paper is also wrapped around the circumference of the roller 12. When air is introduced into the chamber 56 by means of a pipe or hose 57, the interior of the chamber 56 is pressurized such that the air pressure is exposed to the paper 11 to press the latter in firm contact with the cylinder 12 so that the friction between the paper and the cylinder is at a desired amount so that the paper will always be in rolling contact with the cylinder even though the paper will be placed under tension as mentioned. In order that the air pressure within the chamber 56 be fully or virtually fully effective on the paper 11, it is shown that there be provided pressure bars 58 along the length of the chamber 56 and throughout the width of the paper 11. The bars 58 are shown to be urged downwardly toward the paper by means of a compression spring 59 which is controlled in its tension by a pressure bar 61 and a screw 62 threaded into the vessel 56 by the nut 63 shown in the top of the vessel 56. Also, a retained bolt 64 is shown to project through the side of the vessel 56 and engage a slot 66 in the side of the pres-

sure bar and thereby retain the latter within the cut-out 67 in the vessel 56. Thus, by adjusting the screw 62, the spring 59 will exert more or less force downwardly on the pressure bar 58 to urge the latter toward the paper 11. Then, when air is introduced into the vessel 56, its outlet is under the pressure bars 58 which are thus slightly lifted by the escaping pressurized air, and the balance between the energy of the spring 59 and the escaping air will determine the spacing of the tips 68 of the pressure bars 58 from the surface of the paper 11. Of course, it is sometimes preferred that the pressure bar tips 68 be spaced from the paper so that there is no contact of the paper which might have been just printed. Also, to close off the ends of the vessel 56, end closures 69 are attached to the vessel to extend therefrom and down into contact with the circumference of the roller 12.

It should thus be understood that compressed air can then be disposed immediately over the surface of the paper 11 as the latter travels in rolling contact with the roller 12, and the pressure of the air will hold the paper in exact rolling contact with the roller 12 as desired. Of course, the vessel 56 and its related parts are then substituted for the member 22 which also serves the function of holding the paper to the roller 12.

Fig. 8 shows a wiring diagram for control of the motors 48, and in this diagram it is the intention that the motors 48 be controlled to produce the desired output during the period of acceleration and the period of normal run and also the period of deceleration of the printing press and the web speed mechanism described. Thus, a switch box 71 is shown with three wires 72, 73 and 74 leading therefrom to rheostats 80. Three-way switches 78 and 79 are connected across the lines 72, 73, and 74 which connect to the motor 48. Also, rheostats 80 are shown in pairs in each of the lines 72, 73, and 74. Depending upon the connections in the box 71 and the switches 78 and 79, the motor 48 will be operated during acceleration, normal running, and deceleration of the press to provide constant web tension as desired.

Figs. 9 and 10 show a torque motor 81 supported on a frame 82 and electrically operated to be in direct control of the roller 83 mounted in the frame 82. In this instance, it will be understood by one skilled in the art that the output shaft 84 of the motor 81 is coupled to the roller 83 which serves the function of the roller 12 and would have a companion roller 17 holding the web of paper to the circumference of the roller 83. Thus, the motor 81 is applied directly to the roller 83 and is electrically controlled in the manner mentioned to exert a constant tension on the web. Like in Fig. 1, a motor 81 and a roller 83 could be located on each side of the press, with the motor on the incoming side exerting a retarding force on the web, and the motor on the outgoing side exerting an advancing force.

While specific embodiments of this invention have been shown and described, it should be obvious that certain changes could be made therein, and the scope of this invention should, therefore, be limited only by the appended claims.

What is claimed is:

1. A means for controlling tension in a web of paper passing through a printing press, comprising a cylinder rotatably mounted for support of said web of paper as the latter enters said printing press, means adjacent said cylinder for pressing said web of paper into contact with said cylinder, a differential drive means connected to said cylinder and powered by the drive of said printing press for rotating said cylinder in one direction for feeding said web of paper toward said printing press, and a constant torque motor connected to said differential drive means for rotatably urging said cylinder in the other direction to an amount necessary to maintain a constant tension on said web of paper while the latter is being fed into said printing press.

2. A means for controlling tension in a web of paper

passing through a printing press, comprising a cylinder rotatably mounted for support of said web of paper as the latter enters said printing press, means adjacent said cylinder for pressing said web of paper into contact with said cylinder, a differential drive means connected to said cylinder, driving means connected between said printing press and said differential drive means for rotating said cylinder in a forward direction for feeding said web of paper toward said printing press, an electric constant torque motor in rotational driving relation with said differential drive means for rotatably urging said cylinder in the reverse direction to an amount necessary to maintain a constant tension on said web of paper while the latter is being fed into said printing press, and electric controls connected to said motor for governing the latter to produce said constant tension during acceleration and constant speed and deceleration of said motor.

3. A means for controlling tension in a web of paper passing through a printing press, comprising a cylinder rotatably mounted for support of said web of paper for movement through said printing press, means adjacent said cylinder for urging said web of paper into contact with said cylinder, planetary gear means connected between said printing press and said cylinder with the ring gear of said planetary gear means rotatable with said cylinder for rotating the latter in a direction for moving said web of paper through said printing press and with the planet gears of said planetary gear means intermeshed between said ring gear and the sun gear and being connected to and orbitally displaced by the drive to said printing press, and a constant torque motor in driving relation with the sun gear of said planetary gear means for rotatably urging the latter in the direction and to an amount necessary to maintain a constant tension on said web of paper while the latter is being moved through said printing press.

4. A means for controlling tension in a web of paper passing through a printing press, comprising a paper web supporting roller rotatably mounted on the incoming and the outgoing sides of said press for frictional engagement of said web, means adjacent each said roller for holding said web in contact with the circumference of each said roller as the latter rotates in a forward direction of feeding said web through said press, rotational drive means connected between said press and each said roller for driving the latter in said forward direction, a differential drive means connected to each said roller, a constant torque motor drivingly connected to said differential drive means of said roller located on said incoming side of said press for rotationally urging the latter said roller in a direction reverse of said forward direction, and a constant torque motor drivingly connected to said differential drive means of said roller located on said outgoing side of said press for rotationally urging the latter said roller in said forward direction, and said torque motors being of a capacity to maintain a selected tension in said web fed through said press.

5. A means for controlling tension in a web of paper passing through a printing press, comprising a paper web supporting roller rotatably mounted on the incoming and the outgoing sides of said press for frictional engagement of said web, means adjacent each said roller for holding said web in contact with the circumference of each said roller as the latter rotates in a forward direction of feeding said web through said press, planetary gear means connected between said press and each said roller for driving the latter in said forward direction with the ring gear of said planetary gear means rotationally connected to said cylinder, a constant torque motor drivingly connected to the sun gear of said planetary gear means on said roller located on said incoming side of said press for rotationally urging the latter said sun gear in said forward direction, and a constant torque motor drivingly connected to the sun gear of said planetary gear means on said roller located on said outgoing side of said

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press for rotationally urging the latter said sun gear in a direction reverse of said forward direction, planet gears intermeshed between each pair of said sun and ring gears and being geared to and orbitally displaced by the drive means of said press, and said torque motors being of a capacity to maintain a selected tension in said web fed through said press.

6. A means for controlling tension in a web of paper passing through a printing press, comprising a paper web supporting roller including a hollow cylinder and a concentric shaft extended therethrough with both of the latter independently rotatably mounted on the incoming and the outgoing sides of said press for frictional engagement of said web, means adjacent each said roller for holding said web in contact with the circumference of each said cylinder as the latter rotates in a forward direction of feeding said web through said press, planetary gearing connected to one end of each said roller with the ring gear of each said planetary gearing attached to each said cylinder to rotate the latter and with the sun gear of each said planetary gearing attached to each said shaft to rotate with the latter, rotational drive means connected between said press and each said ring gear for driving said cylinder in said forward direction, a constant torque motor drivingly connected to said sun gear on said shaft located on said incoming side of said press for rotationally urging the latter said sun gear in a direction reverse of said forward direction, and a constant torque motor drivingly connected to said sun gear on said shaft located on said outgoing side of said press for rotationally urging the latter said sun gear in said forward direction, and said torque motors being of a capacity to maintain a selected tension in said web fed through said press.

7. A means for controlling tension in a web of paper passing through a printing press, comprising a roller including a hollow cylinder and a concentric shaft extended therethrough with both of the latter independently rotatably mounted for support of said web of paper for movement through said printing press, means adjacent said cylinder for urging said web into contact with said cylinder, planetary gearing connected to one end of said roller with the ring gear of said planetary gearing attached to said cylinder to rotate the latter and with the sun gear of said planetary gearing attached to one end of said shaft to rotate with the latter, rotational drive means connected between said press and said ring gear for driving said cylinder in a direction for moving said web through said press, and a constant torque motor in driving relation with the other end of said shaft for rotationally urging said sun gear in the direction and to an amount necessary to maintain a constant tension on said web while the latter is moving through said press.

8. A means for controlling tension in a web of paper passing through a printing press, comprising a paper web supporting roller rotatably mounted for supporting said web when the latter is trained therearound, means adjacent said roller for holding said web in rolling contact with the circumference of said roller as the latter rotates in

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a forward direction of feeding said web through said press, a variable speed rotational drive means connected between said press and said roller for driving the latter in said forward direction, and a constant torque motor drivingly connected to said variable speed drive means for rotationally urging the said roller in a direction to maintain a selected tension in said web fed through said press.

9. A means for controlling tension in a web of paper which may be passed through a printing press, which has a driving means comprising a cylinder rotatably mounted for support of said web of paper to pass the latter to said printing press, means adjacent said cylinder for pressing said web of paper into contact with said cylinder, a differential drive means connected to said cylinder and powered by said driving means of said printing press for rotating said cylinder in one direction for feeding said web of paper toward said printing press, and a constant torque motor in driving relation with said differential drive means for rotatably urging said cylinder in the other direction to an amount necessary to maintain a constant tension on said web of paper while the latter is standing still and while it is being fed into said printing press.

10. A means for controlling tension in a web of paper passing through a printing press with a cylinder rotatably mounted for support of said web of paper at one side of said printing press and with means adjacent said cylinder for pressing said web of paper into contact with said cylinder and with driving means connected between said printing press and said cylinder for rotating the latter in the direction of movement of said web of paper through said printing press, the invention characterized by differential drive means connected to said cylinder, a constant torque motor in driving relation with said differential drive means for rotatably urging said cylinder in a direction and to an amount necessary to maintain a constant tension on said web of paper, and controls connected to said motor for operation of said motor while said press is both inoperative and operative with respect to the movement of said web to maintain said constant tension at all times.

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