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MAGNETIC CALENDER

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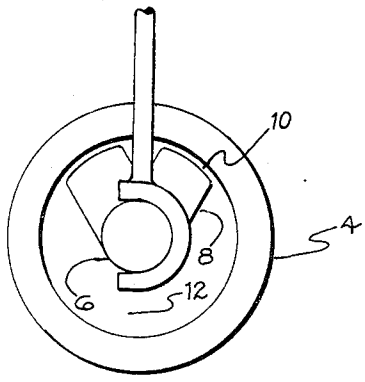


FIGURE 2.

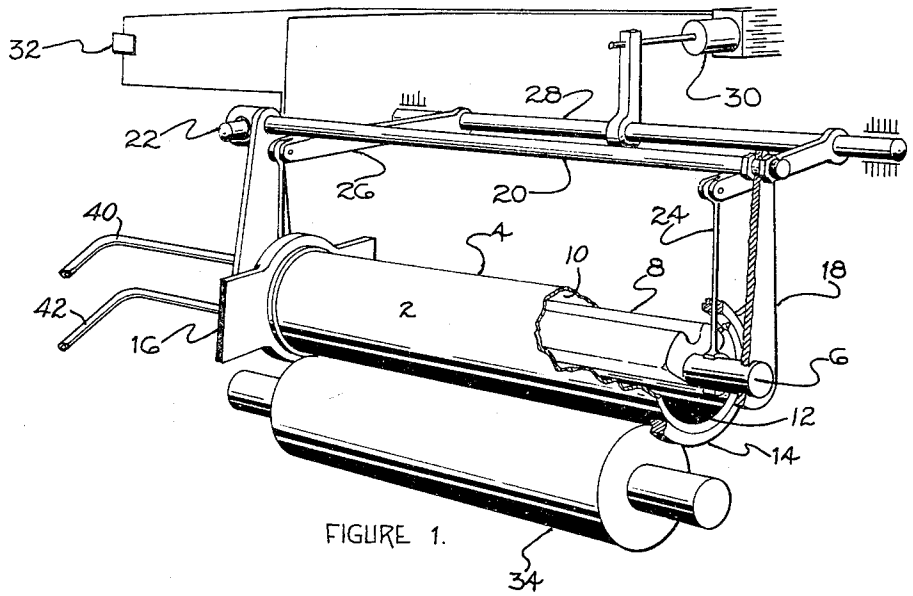


FIGURE 1.

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MAGNETIC CALENDER

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ABSTRACT OF THE DISCLOSURE

A pressure roll having a rotating shell and a fixed magnet mounted on a shaft, wherein the magnet pulls the portion of the shell nearest to the magnet towards said magnet, thereby forcing the opposite end of the shell away from the magnet and shaft to force the shell against a second roll under pressure.

BACKGROUND OF THE INVENTION

Rolls of many types are employed in a wide variety of industries. These devices are particularly important in the textile industry and in the paper industry, wherein rolls are employed to press these flexible materials such as textiles and paper to achieve certain desired results. Oftentimes, it is necessary to exert substantial amounts of pressure by means of such a roll to achieve the desired effect upon the material being processed. For this reason, pressure rolls have been developed which are capable of treating a flexible material being passed through a gap between two rolls under substantial amounts of pressure.

Normally, the pressure exerted by the roll is achieved through the use of mechanical devices which force the roll against a second roll, thereby exerting pressure on any flexible material which is passed between these two rolls. However, use of mechanical means to achieve pressure of greater than about 1,000 lbs. per linear inch involves expensive and complicated machinery. This is especially true when the linear length of the roll is long since the total tons of pressure exerted over the entire length of the roll becomes quite substantial. Mechanical rolls are normally limited in the amount of pressure measured, measured as lbs. per linear inch, since these rolls are normally fixed at both ends, and the extreme pressures developed create a deflection in the roll which is undesirable.

Methods have been developed to eliminate the problem of deflection in mechanical pressure rolls. For example, it is possible to grind a crown on a mechanical roll which operates to reverse the deflection, thereby permitting the roll to operate at a fixed pressure compensating for deflection. However, these devices are limited to operation at pressures in the range approximating that for which the crown was ground on the roll, thereby substantially limiting the versatility of these rolls.

It would be a great advantage to the state of the art if a pressure roll could be developed which would not be limited in load pressure, and which would be usable over a wide range of pressures.

Accordingly, it is an object of this invention to provide a new type of pressure roll, which is economical and simple to construct.

It is a further object of this invention to provide a novel roll employing magnetic means.

It is a still further object of this invention to provide a pressure roll in which the deflection or crown on said roll may be controlled.

Yet another object of this invention is to provide a roll which is capable of maintaining constant pressure on flexible materials being passed through the roll even though the flexible material may have variations in thickness or density.

Other objects will become apparent upon a reading of the detailed description of the invention hereinafter set forth.

DESCRIPTION OF THE INVENTION

It has now been discovered that the above and other objects of this invention may be accomplished in the following manner. Briefly, the invention comprises the use of a pressure roll having a rotating shell and a fixed magnet means mounted on a shaft in the interior of the shell, wherein the magnetic force attracts the portion of the shell nearest to the magnet, thereby forcing the opposite portion of the shell away from the magnet and onto a second roll under substantial amounts of pressure. The present invention permits the use of pressure rolls having lengths as long as 160" or longer while simultaneously allowing control over the deflection, whether a uniform nip may be desired or a positive or negative crown may be the operator's goals. The present invention is adaptable to be self-regulatory in maintaining a constant pressure on any flexible material being passed through said roll even though the flexible material contains substantial variations in the thickness or density thereof. Finally, the roll of this invention permits the use of pressure rolls having lengths as means to adjust the normal operating temperature of the roll to a more desirable temperature, whether that be higher or lower than the normal operating temperature of the roll.

To more fully describe a particular embodiment of the present invention, reference is now made to the drawings, in which:

FIGURE 1 is a diagrammatic view of a particular embodiment of the present invention containing a cutaway portion to show the interior of the roll; and

FIGURE 2 is an end view of a roll illustrating one embodiment of the present invention.

Referring first to FIGURE 1, the roll of this invention is shown generally by the number **2**. This roll contains a shell **4** which encloses a shaft **6** upon which is mounted a magnet **8**. This magnet may, depending upon an individual choice, be an electromagnet or a permanent magnet. In many cases, permanent magnets are substantially more expensive than electromagnets, and for that reason electromagnets are preferred in most instances. The electromagnet may itself be one continuous electromagnet, or it may be a plurality of electromagnets connected in series along as much of the length of the shaft as desired. It is further possible to construct the magnet and shaft as one piece, or it may be desirable to mount the magnetic means on the shaft. Various shapes of the magnetic means are also possible.

The magnet and shaft are positioned within the interior of the shell in such a manner as to create a small gap **10** shown in FIGURE 2 between the shell **4** and the portion of the magnetic means **8** furthest from the shaft **6**, thus creating a large gap **12** between the shell **4** and the portion of the magnetic means **8** closest to the shaft **6**. Such a construction permits the magnetic means **8** to exert an attractive force on the shell **4**, at gap **10** thereby pulling the shell **4** toward the magnetic means **8**. This in turn forces the shell **4** away from the shaft **6** and magnetic means **8** at the large gap **12**. Thus a second roll **34** may be positioned so as to permit contact between the shell **4** and the second roll **34** at a point near the large gap **12**, whereby the shell **4** exerts substantial pressure on the second roll **34**.

In order to permit the operation of the present invention over a wide range of conditions, it is possible to adapt the roll to operate at temperatures other than the normal operating temperature of the roll. This may be done simply by passing a temperature control fluid through either the pressure roll of this invention or the second roll upon

which the pressure roll is acting. This may be accomplished by providing an inlet **40**, a chamber **10** and **12** within the roll and an outlet **42** so that the fluid may flow into the interior of the roll, thereby either absorbing heat or releasing heat as the case may be. In a preferred embodiment of this invention, the temperature control fluid may be passed through the pressure roll of this invention. When the pressure roll of this invention is adapted to receive the temperature control fluid, particular advantage may be realized by introducing the temperature control fluid at a point near the small gap **10** and withdrawing the fluid at a point near the large gap **12**. It is equally possible to introduce the fluid at a point near the large gap **12** and withdraw the temperature control fluid at some point near the small gap **10**. It may be desirable to add fluid at one end of the roll and withdraw it from the other end, and it might also be suitable to add fluid at both ends while simultaneously withdrawing fluid from both ends of the roll. Thus it can be seen that the pressure roll of this invention is admirably suited to temperature control, whereby the normal operating temperature of the roll may be readily adjusted.

In a further embodiment of the present invention, the pressure roll may be adapted to provide for and take into account any deflection which might occur due to the necessity of having both ends of the roll fixedly mounted. Turning again to FIGURE 1, this control of the amount of deflection in the roll during operation may be accomplished in the following manner. The shaft **6** may be attached to a shaft mounting **18** at each end, which is in turn attached to a tension bar **20** which is provided with an adjustment **22** to regulate the tension placed by the tension bar **20** on the shaft mounting **18**. Thus the tension bar **20** exerts a force on the shaft mountings **18** in a direction reversed to the stress created by the magnet **8**. The amount of reverse stress which may be applied may be sufficient to give essentially no deflection in the shaft when the magnetic force is exerted, or it may be sufficient to give a positive or negative crown to the roll during operation. Thus the roll is adaptable for use under any circumstance which may be desirable.

In yet another embodiment of the invention, the pressure roll of this invention may be adapted to adjust for differences in thickness or density of the flexible material being passed through the roll. In the operation of the present invention, the shell **4** is pressed against the second roll **34** under a desirable amount of pressure. Depending upon the thickness and/or density of the flexible material being passed between these two rolls, a certain gap between the shell **4** and the second roll **34** will exist. To achieve the proper amount of pressure, the magnetic means **8** must be positioned such that small gap **10** is sufficient to provide the desired force. If, during the operation of the pressure roll, the density and/or thickness of the flexible material being processed changes materially, a gap between the shell **4** and the second roll **34** will change. If this phenomenon happens, the gap **10** will necessarily also be changed, thereby substantially varying the amount of pressure exerted by the shell **4** on the second roll **34**. Magnetic forces vary with the square of the distance between the magnet and the attracted object. In order to compensate for this change in pressure, the pressure roll of this invention may be adapted in the following way.

A strain gauge **32** may be attached to the roll to measure the pressure exerted by the shell **4** on the second roll **34**. This strain gauge **32** may be preset at a particular pressure, and adapted to measure changes in the pressure, thereby relaying the change to actuate a motor **30** which adjusts the bar **28** to raise or lower arms **26** and rods **24** to readjust the gap **10**. Readjustment of the gap **10** will restore the proper distance between the magnetic means and the shell, thereby causing the pressure exerted by the shell **4** on the second roll **34** to return to any preset amount. Thus, variations in the thickness or density of the flexible material will be automatically taken into account to permit a constant pressure regardless of the nature of the material being passed through the roll. Similarly, if a different pressure is desired at any time, the strain gauge **32** may be set at the new pressure, and this strain gauge **32** will then automatically actuate motor **30** to adjust the gap **10** through the bar **28**, arms **26** and rods **24**.

In an alternative embodiment of the present invention, the force exerted by the shell **4** on the second roll **34** may be varied by changing the current input to the magnetic means **8**, when said means is an electromagnet. It is well known that the force exerted by an electromagnet will vary depending upon the current input and it is a simple matter to regulate this current to achieve any desired force. Thus the pressure exerted by the roll of this invention may be controlled by regulating the current input, or the small gap **10**, or a combination of both the current and the gap **10**.

It can now be seen that the pressure roll of this invention is admirably suitable for use in a process for pressing flexible material by passing the material between the pressure roll of this invention and a second roll properly positioned with respect to the pressure roll. The flexible material may be forcibly drawn through the gap between the shell **4** of the pressure roll and the second roll **34**. More often, however, the flexible material will be drawn through this gap by the rotation of the shell **4** and the second roll **34**. To accomplish this end, drive means may be attached to either shell **4** or the second roll **34** to provide this rotation. In one embodiment of this invention, it is a simple matter to provide drive means (not shown) to rotate the second roll **34**, whereby friction causes the shell **4** to rotate when the shell **4** is in contact with the second roll **34**. This rotation is suitable for pulling any flexible material being treated through the gap between the shell **4** and the second roll **34**. The flexible material may be pressed between the pressure roll and the second roll **34** under great amounts of pressure, while the normal operating temperature of this process may be varied as described hereinabove. Also, the amount of deflection in the pressure roll may be controlled to give zero deflection or a positive or negative crown on the roll as may be desired. The flexible material may be passed through without regard to changes in density and/or thickness of the material.

It can now be seen that the present invention provides a superior pressure roll adapted for use in the process of pressing flexible materials, whereby efficient and economical operation of the apparatus may be accomplished in a relatively simple manner.

Having thus described the invention, what is claimed is:

1. A calender having at least a pair of parallel contacting rolls adapted for pressing flexible material between said rolls, said calender comprising: a first roll adapted to have at least its outer surface capable of rotation; a pressure roll mounted having a shell, a shaft and magnetic means; said shell being rotably mounted on said pressure roll; said shaft being fixedly mounted on said pressure roll and positioned inside said shell such that at least a portion of said shaft is enclosed by said shell; said magnetic means being fixedly mounted on said shaft and positioned such that a small gap exists between said shell and the portion of said magnetic means furthest from said shaft and such that a large gap exists between said shell and the portion of said magnetic means nearest said shaft, said magnetic means being adapted to exert a magnetic force on said shell at said small gap to pull said shell toward said shaft, whereby said shell is forced away from said shaft at said large gap; said first roll being positioned parallel to said pressure roll such that said first roll is capable of contact with said shell of said pressure roll, said contact taking place on said shell approximately at said large gap, whereby said shell is forced against said first roll under pressure when said magnetic means exerts said magnetic force.

2. The calender of claim 1 which further contains drive means adapted to rotate said first roll, wherein said shell cooperatively rotates when said first roll and said shell are in contact.

3. The calender of claim 1 wherein said magnetic means is an electromagnet.

4. The calender of claim 3 wherein said electromagnet is one continuous electromagnet.

5. The calender of claim 3 wherein said electromagnet is a plurality of electromagnets connected together in series.

6. The calendar of claim 1 wherein said magnetic means is a permanent magnet.

7. The calender of claim 1 wherein at least one roll contains means adapted to adjust the normal operating temperature of said roll, said means comprising an inlet for a temperature adjusting fluid, a chamber in the interior of said roll wherein said temperature adjusting fluid may circulate, and outlet means for withdrawing said temperature adjusting fluid, wherein said temperature adjusting fluid may have a temperature ranging from substantially higher than the operating temperature of said roll to substantially lower than the operating temperature of said roll.

8. The calender of claim 7 wherein said means for adjusting the normal operating temperature is connected to said pressure roll, wherein said inlet is adapted to introduce said fluid into the interior of said pressure roll at a point near said small gap, wherein said chamber comprises the space between said fixedly mounted shaft and magnetic means and said rotatably mounted shell, and wherein said outlet means is adapted to withdraw fluid at a point near said large gap.

9. The calender of claim 7 wherein said means for adjusting the normal operating temperature is connected to said pressure roll, wherein said inlet is adapted to introduce said fluid into the interior of said pressure roll at a point near said large gap, wherein said chamber comprises the space between said fixedly mounted shaft and magnetic means and said rotatably mounted shell, and wherein said outlet means is adapted to withdraw fluid at a point near said small gap.

10. A calender having at least a pair of parallel contacting rolls mounted on a frame and adapted for pressing flexible material between said rolls, said calender comprising: a first roll rotatably mounted on said frame and equipped with driving means to rotate said roll; and a pressure roll mounted on said frame and having a shell, a shaft and magnetic means; said shell being rotatably mounted on said pressure roll; said shaft being fixedly mounted on said pressure roll and positioned inside said shell such that a portion of said shaft is enclosed by said shell; said magnetic means comprising an electromagnet and being fixedly mounted on said shaft, said electromagnet being positioned such that a small gap exists between said shell and the portion of said electromagnet furthest from said shaft and such that a large gap exists between said shell and the portion of said electromagnet nearest said shaft, said electromagnet being adapted to exert a magnetic force on said shell at said small gap to pull said shell toward said shaft, whereby said shell is forced away from said shaft at said large gap; said first roll being positioned parallel to said pressure roll such that said first roll is capable of contact with said shell of said pressure roll, said contact taking place on said shell approximately at said large gap, whereby said shell is forced against said first roll under pressure when said electromagnet exerts said magnetic force; said pressure roll being mounted by connecting means which are adjustably capable of exerting stress on said shaft in a direction reverse to stress created by said electromagnet.

11. A calender of claim 10 wherein said connecting means is adjusted to stress said shaft in said reverse direction in an amount sufficient to give essentially a uniform air gap in said pressure roll when said magnetic force is exerted.

12. The calender of claim 10 wherein said connecting means is adjusted to stress said shaft in said reverse direction in an amount sufficient to give a positive crown on said pressure roll.

13. The calender of claim 10 wherein said connecting means is adjusted to stress said shaft in said reverse direction in an amount sufficient to give a negative crown on said pressure roll.

14. The calender of claim 13 which further contains temperature control means wherein at least one roll contains means adapted to adjust the normal operating temperature of said roll, said means comprising an inlet for temperature adjusting fluid, a chamber in the interior of said roll wherein said temperature adjusting fluid may circulate, and outlet means for withdrawing said temperature adjusting fluid, wherein said temperature adjusting fluid may have a temperature ranging from substantially higher than the operating temperature of said roll to substantially lower than the operating temperature of said roll.

15. The calender of claim 14 wherein said cooling means for adjusting the normal operating temperature is connected to said pressure roll, wherein said inlet is adapted to introduce said fluid into the interior of said pressure roll at a point near said small gap, wherein said chamber comprises the space between said fixedly mounted shaft and magnetic means and said rotatably mounted shell, and wherein said outlet means is adapted to withdraw fluid at a point near said large gap.

16. The calender of claim 14 wherein said cooling means for adjusting the normal operating temperature is connected to said pressure roll, wherein said inlet is adapted to introduce said fluid into the interior of said pressure roll at a point near said large gap, wherein said chamber comprises the space between said fixedly mounted shaft and magnetic means and said rotatably mounted shell, and wherein said outlet means is adapted to withdraw fluid at a point near said small gap.

17. The calender of claim 10 which further contains control means for regulating the pressure exerted by said second roll on said first roll during operation of said electromagnet, said control means comprising sensing means adapted to detect changes in said pressure and adapted to relay said changes to operably connected adjusting means, said adjusting means being adapted to vary the size of said small gap, thereby varying the magnetic force on said shell, whereby the pressure of said shell on said first roll is capable of being regulated.

18. The calender of claim 17 wherein said sensing means is adapted to maintain a preset amount of said pressure, whereby said adjusting means is adapted to respond to said preset sensing means to adjust said small gap in an amount sufficient to maintain said preset amount of pressure.

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