

Nov. 10, 1959

P. HOLD

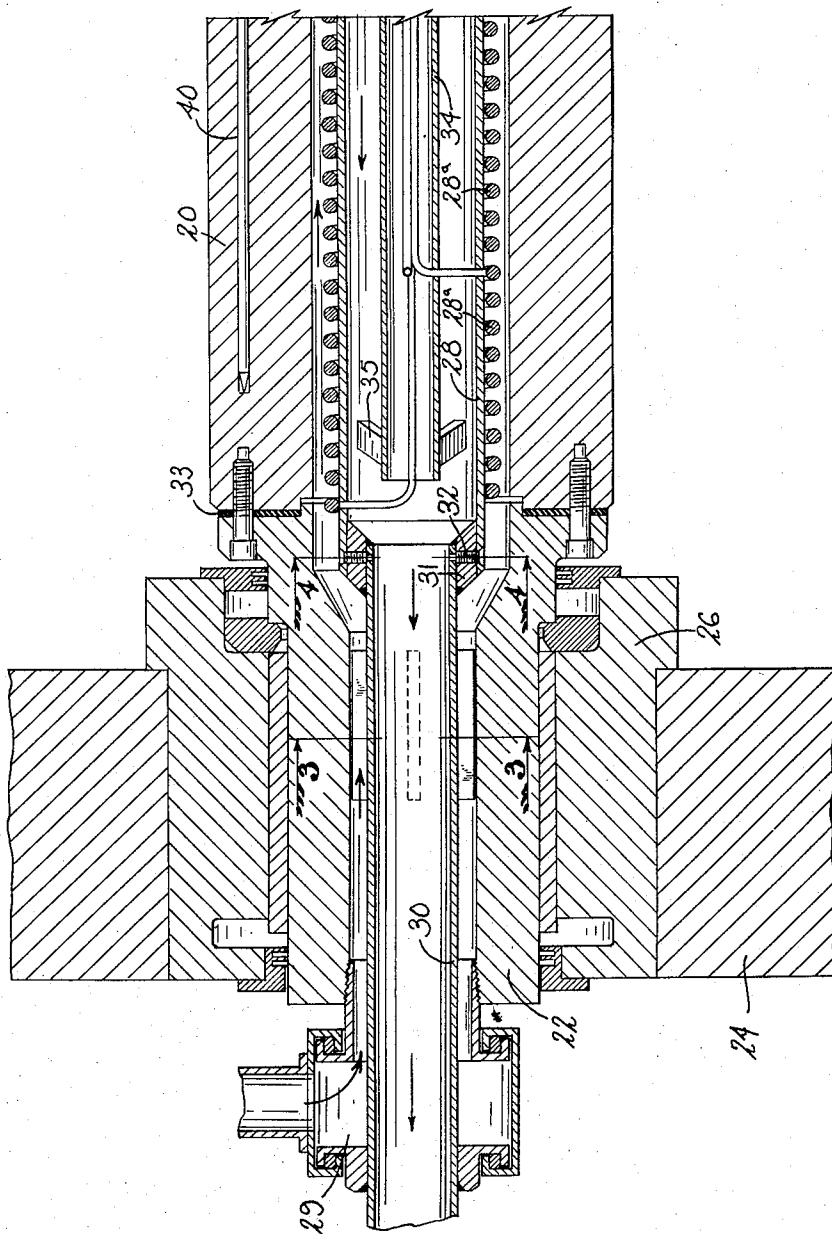
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ELECTRICALLY HEATED ROLL FOR CALENDERS OR THE LIKE

Filed May 2, 1958

4 Sheets-Sheet 1

Fig. 1.



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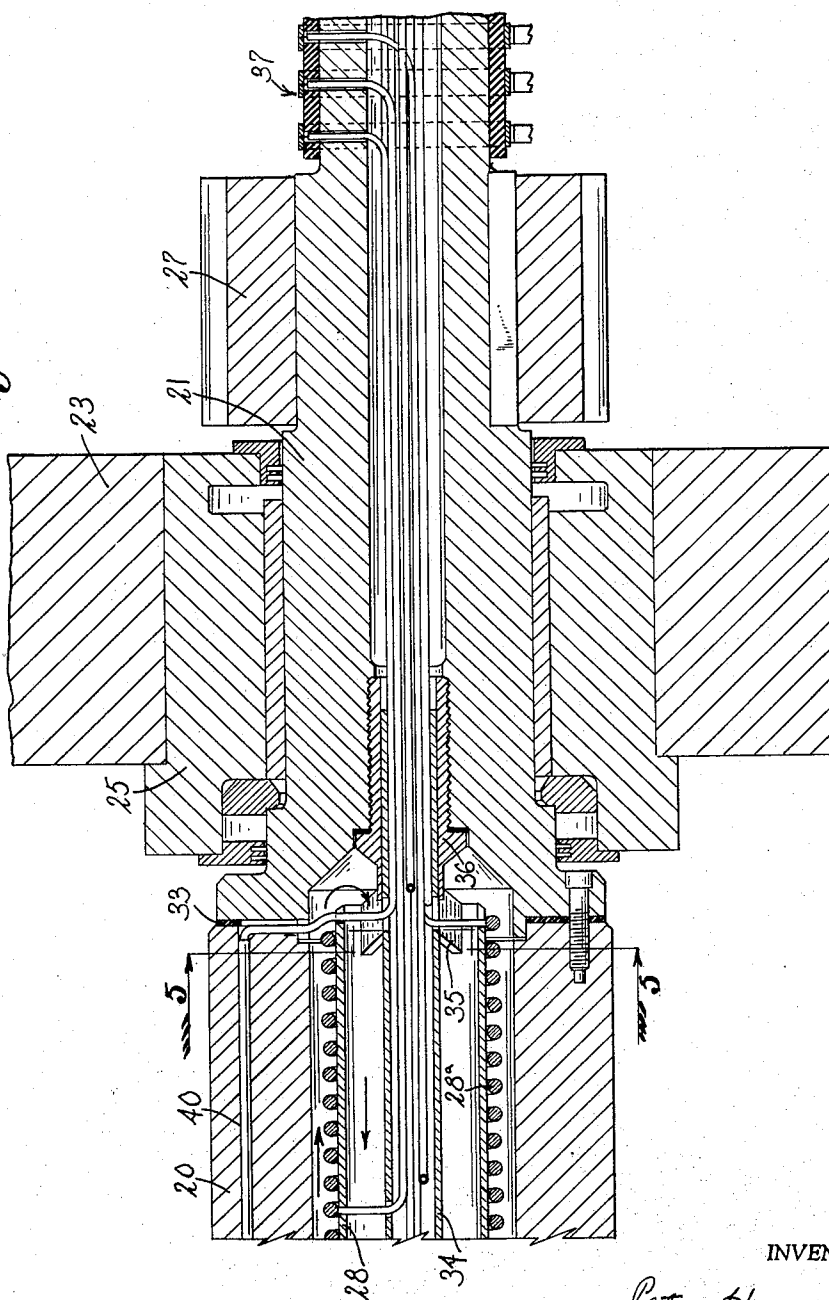
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Fig. 2.



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Fig. 3.

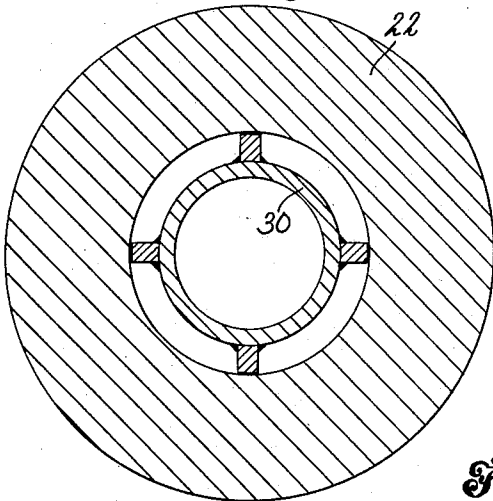


Fig. 4.

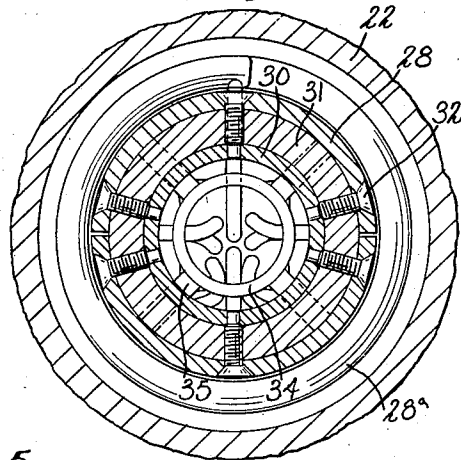
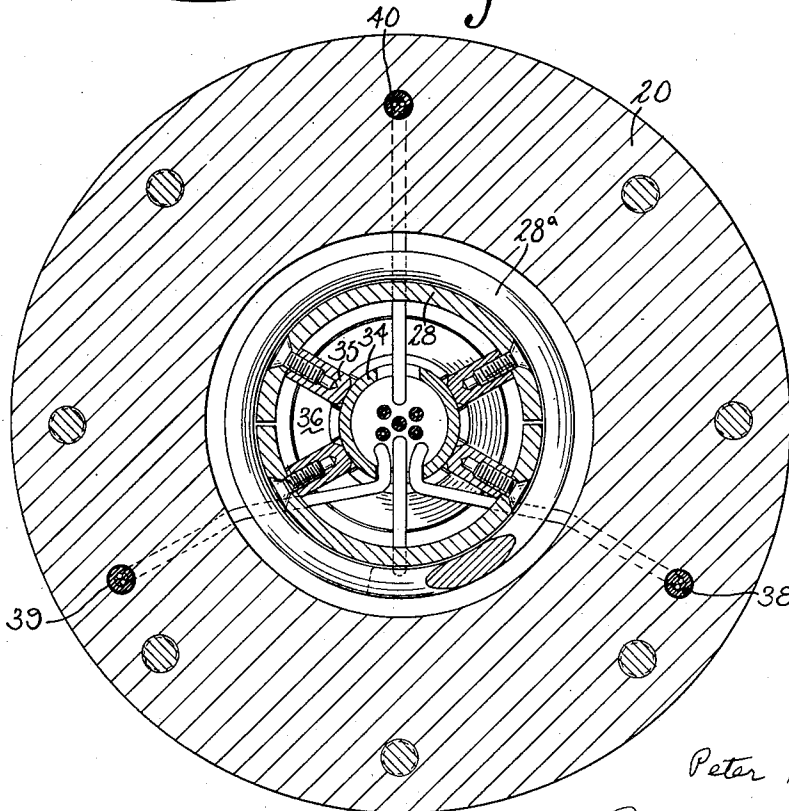


Fig. 5.



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Fig. 6.

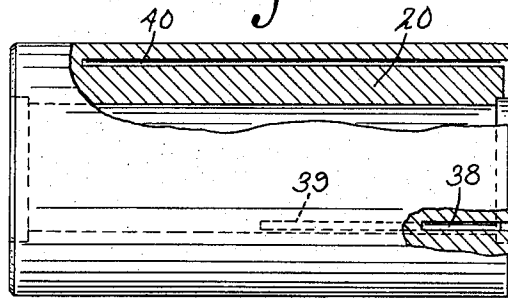
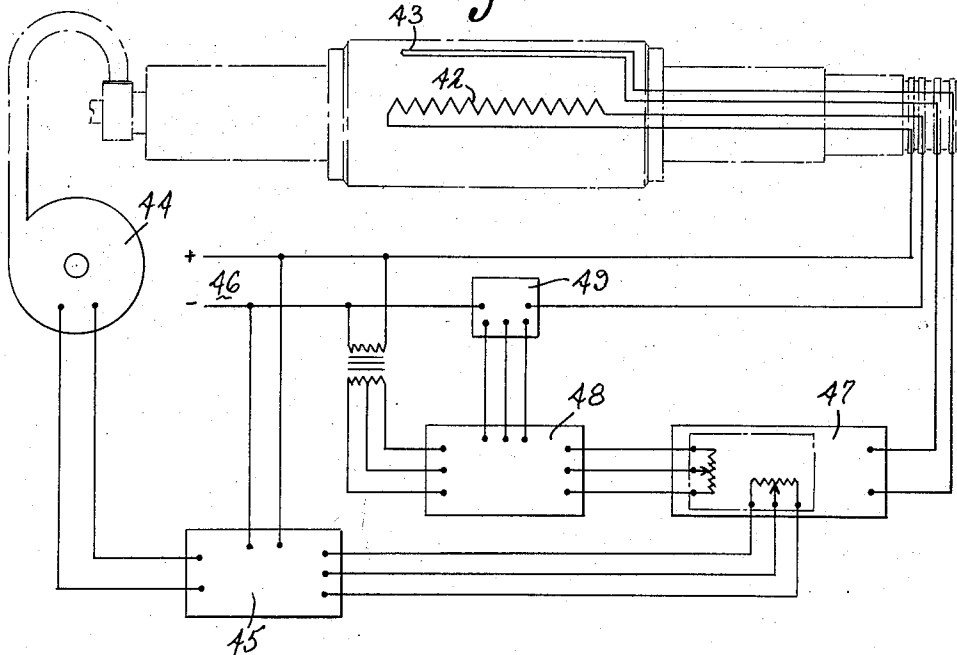


Fig. 7.



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ELECTRICALLY HEATED ROLL FOR CALENDERS OR THE LIKE

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11 Claims. (Cl. 219—19)

This invention relates to an electrically heated roll such as used in calenders or rolling mills and more particularly to a roll which is heated and subjected to temperature changes in order to meet the conditions necessary for carrying out the particular operation and facilitate and speed up the operation of the calender or mill.

In the past there have been three common methods of heating a roll and controlling its temperature. At temperatures up to about 300° or 350° F. steam has been used. Use of steam alone, however, does not fulfill the requirements of some operations, for example, that of removing heat from a roll having a temperature between 300° and 400° F. This requirement has led to a second method, namely, the use of hot water circulated through the roll and kept under pressure, the water being heated to a suitable temperature by some form of heating means. In this case, when it is desired to decrease the heat of the roll, the hot water is circulated at a lower temperature in order to cool the roll, but this is objectionable for several reasons, one of which is the length of time required for cooling. A third method comparable to that just mentioned, for use in cases where the temperature range is between 400° and 600° F., is one in which a special liquid having a high boiling point is employed, this liquid being heated to a desired temperature and circulated by means of a suitable pump. This third method is also objectionable for certain reasons, for example, the difficulties in handling the special fluid and in securing close control of the heat of the roll, especially where the roll is to be heated to a relatively high temperature.

An object of the present invention is to provide an improved heated roll intended particularly for heating to high temperatures, namely, those above 500° F., but also useful and effective at lower temperatures.

Another object of the invention is to provide an improved roll which is heated electrically and suitable for higher temperatures, that is, where the temperature is in the range of 700° to 900° F., this new roll being subject to close temperature control and also capable of prompt and effective cooling in a manner to meet the existing conditions of operation.

A still further object of the invention is to provide a heated roll having heating means and also having cooling means for cooling the roll to the desired extent when required, in a manner such that the roll temperature at different areas in the roll surface may be different as required by different conditions of operation.

It is also a purpose of the present invention to provide heating means and cooling means so arranged and organized that the roll temperature at different points in the length of the roll can be precisely, and with facility and convenience, adjusted to meet the existing conditions.

Yet another object is to provide a new and very useful calender or like roll in which heating of the roll is effected electrically and cooling is effected by circulation of air in the roll.

To these and other ends the invention consists in the

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novel features and combinations of parts to be hereinafter described and pointed out in the claims.

In the accompanying drawings:

Figs. 1 and 2 in conjunction disclose a roll in longitudinal section, showing the bearings provided for the roll and also portions of the side frames in which the roll bearings are mounted;

Fig. 3 is an enlarged section on line 3—3 of Fig. 1;

Fig. 4 is an enlarged section on line 4—4 of Fig. 1;

Fig. 5 is an enlarged section on line 5—5 of Fig. 2;

Fig. 6 is an elevational view, partly in longitudinal section, showing the roll as it appears before application of the journals and other equipment; and

Fig. 7 is a diagrammatic view showing the connection of an air blower to one of the journals and also showing electrical means adapted to control the operations of heating and cooling.

In the embodiment selected herein as an example of the new roll structure of this invention, the heating of the roll is accomplished by providing within the roll electrical heating elements located in a relatively large bore of the roll. These heating elements are in this particular case three in number. At different points in the periphery of the roll longitudinal bores are provided for enclosing thermo-couples, as hereinafter described. To each end of the roll are applied hollow journals, and these journals are adapted to be mounted in bearings in the roll stand. The electrical heaters are in the form of helical coils mounted side by side on a cylinder or sleeve provided in the roll. The heating coils are adapted to receive current from rotating slip rings on the right-hand journal, as shown in Fig. 2. In Fig. 1 there is shown at the left an inlet from an air blower, this air inlet being secured to the adjacent hollow journal, and the arrangement is such that air forced through the inlet moves to the right (Fig. 1) in a space between the adjacent hollow journal and a sleeve member mounted within the hollow journal, and this air may pass over the heating coil sections in order to cool them when cooling is desired. When the air passing over the heating member reaches the end of the latter, the air is reversed in direction, as shown by arrows in Fig. 2, and this air then moves interiorly through the sleeve member on which the heating coil is mounted and then is exhausted through the sleeve member about which the blower inlet is mounted.

In the drawings, the body of the roll is indicated at 20, the right-hand hollow journal at 21, the left-hand hollow journal at 22, portions of the side frames at 23 and 24, and the bearings for the right- and left-hand journals at 25 and 26, respectively. Keyed to the right-hand hollow journal is a gear 27 which is a part of the customary or any preferred roll-rotating means. Within the body of the roll is fixedly mounted a sleeve 28 upon which is mounted electrical heating means which, in this particular case, comprises three separate helical coils of wire 28a arranged side by side.

At the left-hand end of the roll (Fig. 1) a blower inlet 29 is provided, this inlet being mounted upon a sleeve 30 extending through the adjacent roll neck or journal and connected to the sleeve 28. It is noted that the sleeve 30 is of less diameter than sleeve 28. In the present instance, the inner end of the sleeve 30 is attached to one end of sleeve 28 by means including a filler ring 31 through which are passed fastening screws 32, as shown in Fig. 4. The external end of the sleeve 30 (not shown) is open so that air passing through the sleeve in the direction of the arrows (Fig. 1) will be discharged into the atmosphere.

It will be noted from Fig. 1 that a heat-insulating washer or gasket 33 is inserted between the left-hand journal and the adjacent end of the roll body; and at the

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opposite end of the device a similar insulating member is employed.

Fig. 3 shows how the sleeve 30 is mounted in the adjacent roll journal with spacing members interposed between the two parts, and Fig. 4 gives a further showing of the means for connecting the inner end of sleeve 30 to the sleeve 28.

Within the sleeve 28 in the roll body, a further sleeve 34 is mounted. The sleeve 34 is of less diameter than sleeve 28, and the two sleeves are spaced apart by radial spacing members 35. Some of these spacing members 35 are located near the left-hand end (Fig. 1) of the roll body and others adjacent the right-hand end. As shown in Fig. 2, a hollow threaded member 36 that screws into a bore in the right-hand journal supports the inner sleeve 34 in proper position in the roll body. Each of the heating-coil sections has leads at the respective ends connected to slip rings on the exterior of the right-hand journal (Fig. 2), and cooperating with the slip rings are fixed contact members. The device, including the slip rings and contact members, is indicated at 37 in Fig. 2.

As shown in Fig. 6, the cylindrical roll body has a relatively large longitudinal bore or chamber adapted to receive the heating means mentioned above. In addition, the roll body is provided with receiving means for current-measuring members which, in this particular form, are thermocouples. In this particular case three thermoresponsive members in the form of thermocouples are employed, and for this purpose the roll body has a relatively short bore 38, a bore 39 for a longer thermocouple, and a bore 40 for the longest of the thermocouples. These three bores are offset from each other with respect to the axis of the roll body at angles of 120°. Within each of these bores is a thermocouple. These thermocouples enter the roll body from the right-hand end (Fig. 2), and as the thermocouples have their distal ends at different points lengthwise of the roll, there can be provided a temperature indication in any of three distinct areas of the roll. For each thermocouple there are two leads that are connected to the slip rings of the contact device 37. It will be seen, therefore, that the necessary current for the heating member and for the temperature-responsive devices, such as thermocouples, which current is received from a suitable exterior source, is supplied by way of the slip rings. The leads from the thermocouples have portions that lead radially inwardly, and in the present embodiment these leads and also the heating-element leads have portions that extend lengthwise through the right-hand journal 21 (Fig. 2) and to the contact member 37, there being in this particular case twelve leads in all, six of which are connected to the heating coils and the remaining six to the thermocouples.

Fig. 5 shows the heating and temperature-responsive leads as just mentioned. In the arrangement shown in Fig. 5, by way of example, certain of the wires or cables comprise more than one conducting element.

The air inlet 29, previously mentioned, is a fixed part for supplying cooling air, and the sleeve 30 rotates therein when the roll rotates, a suitable rotary joint being provided for this purpose which will permit relative movement of the two parts and inhibit leakage of air at this point.

Fig. 7 is a diagram showing how automatic control of the electric heater and the air cooler can be obtained, but this is by way of example only. At the upper part is a roll containing an interior heating element 42, and also provided with thermocouple means 43. At the left-hand side of the diagram is a blower 44 adapted to supply air to the roll interior in the manner described above. At the lower left-hand portion of the diagram is a control means or relay 45 controlling the operation of the blower. The control means 45 is connected to a power-supply circuit 46. At the lower right-hand part of the diagram is shown an adjustable potentiometer-type temperature-control instrument 47. This instrument 47 is connected

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to the blower control 45 and also to the thermocouple means 43. This temperature-control instrument is also connected to a reactor control 48. The reactor control 48 is in turn connected to a saturable reactor 49 associated with the power circuit 46. The blower control 45 is operable to start and stop the blower. The blower control 45 is under control of the temperature-control instrument 47. Also under the control of the temperature-control instrument 47 is the reactor control 48, which through the saturable reactor 49, determines the amount of current delivered to the heating coil 42.

The temperature-control instrument 47 through its control of the blower, for cooling, and its control of the amount of current delivered to the heating element 42, determines the temperature of the roll. This temperature, which can be varied by adjustment of the temperature-control instrument, is maintained by the thermocouple means 43. If the temperature-control instrument is set for a particular temperature and this temperature is exceeded, the thermocouple means will sense this and cause the temperature-control instrument, through the blower control 45, to energize the blower and quickly cool the roll to the adjusted temperature. If, on the other hand, the temperature falls below the desired degree, the thermocouple, through the temperature-control instrument and the reactor control, will increase the current supplied to the heating element so as to increase the temperature of the roll. In this manner the temperature of the roll can be maintained at a desired setting.

The roll-heating means provided as above described will permit heating of the roll to a high temperature, say in the range of 700° to 900° F. When the heat of the roll reaches a certain limit so that cooling should take place, the volume of air passing through the roll is increased to the necessary extent. The thermocouples arranged in the manner previously described provide effective means for indicating the temperature of the roll. In the example shown herein, the thermocouples for sensing the actual roll temperature and the means for supplying heating current to the roll-heating means are arranged in a circuit providing the electrical heating current and means for effecting cooling of the roll by flow of air.

The heat-insulating washers or gaskets between the roll body and the roll journals minimize the loss of heat from the hot roll body into the cooler journal. In the case shown, the electrical heating means is divided into several sections so that the ends of the roll can be controlled in temperature differently from the center or middle portion of the roll, and the different temperatures in portions of the roll are indicated by thermocouples in the different locations.

It has been indicated above that the improved roll herein described is capable of heating the roll to a high degree, or to a lower degree if desired. Supposing that the roll were, for example, heated to, say, 800° F., and it was desired to reduce the temperature to 750° F., reduction or cutting off of the heating would, in the ordinary practice, permit cooling of the roll, but cooling would be delayed a considerable time and, moreover, according to prior practices, reduction of the heat to the exact extent desired would be difficult, if not impossible. The present roll is not open to such an objection as the cooling of the roll is prompt and exact. In many processes, prompt and exact cooling is desirable, and this is accomplished in the present roll, and the present roll meets the condition of cooling the roll promptly and rapidly whether the temperature is at a substantially high figure or at a lower figure.

As above indicated, the present disclosure is by way of example only, and it is to be understood that various modifications and changes in the details may be made without departure from the principles involved and the scope of the claims.

What I claim is:

1. In a heat-exchange roll for calendering or like

operations, the combination of a roll body, interior electrical heating means for said body, air-forcing means in the form of a blower operative to cool said body by the passage of air in said body, and journals in the form of hollow members carried by said body at opposite ends, said heating means being connected with an exterior source of current through one of said journals and the other of said journals serving to provide an air channel through which air is supplied to said roll body for cooling the same.

2. The structure of claim 1, in which said electrical heating means is in the form of a coil supported on a sleeve in the interior of said body.

3. The structure of claim 1, in which said heating means is a coil supported on a sleeve disposed in the roll body and in which a blower supplies air through a channel in one of said journals, said channel being formed between the roll body and a second sleeve, said second sleeve being of a diameter less than that of said first sleeve and said second sleeve being connected to said first sleeve.

4. The structure of claim 1, in which the blower forces air through one journal between the wall of said journal and a sleeve extended through the said journal.

5. The combination of claim 4, in which cooling air is forced through one of the journals by way of an inner sleeve in said journal, which air after passing over the heating means is reversed in direction and is forced in a reverse direction through said sleeve-provided journal.

6. In a heat-exchange roll for calendering and like operations, the combination of a hollow roll body, interior electrical heating means for said body comprising a conducting coil connected to a power source, a sleeve

spaced inwardly from the inner surface of the roll upon which the coil is mounted, and air-forcing means comprising a blower operative to cool said body by forcing air through said space over said coil in a direction axially of the roll.

7. The combination of claim 6, in which the heating means and the cooling means are placed in and out of operation automatically by means comprising a temperature-responsive element so as to maintain the roll at a temperature within a predetermined range.

8. The construction of claim 7, in which a plurality of temperature-responsive elements are associated with respective portions of a heating coil for the roll.

9. A calender or like roll in which heating of the roll body is effected by interior electrical heating means in the body and in which when a certain temperature is reached the roll is cooled by circulation of air in the roll body.

10. The device of claim 9, in which cooling air is forced into the roll body through a hollow journal at one end of said body.

11. The combination of claim 6, in which said blower forces air in one direction through a hollow journal at one end of the roll body and thence over the heating coil and in which the air stream after passage over the heating coil is reversed in direction and discharged through said hollow journal.

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