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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Heating method for heating a calender roll.**

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(56) References cited :
EP-A- 0 067 786
DE-A- 3 340 683
DE-A- 3 525 950
US-A- 3 365 774

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Description

This invention relates to a method for heating a calender roll. More particularly, this invention relates to a method utilizing heat supplied by induction and from a heat transfer medium.

In order to increase the printability of paper and paperboard produced by a papermaking machine, various calenders have been employed to smooth the surfaces of the dried web.

Essentially, a calender includes at least one pair of cooperating rolls which define therebetween, a calendering nip for smoothing and finishing the surfaces of the dried web. According to the type of surface required, the calender rolls may be of polished metal finish or, a combination of one polished metal roll and a soft backing roll. Soft rolls include elastomeric-covered rolls and so-called filled rolls which may include a plurality of compressed cotton discs.

When a polished metal roll is utilized in combination with a soft roll, it has been found, in practice, that an improved gloss may be imparted to the surfaces of the paper by heating the surface of the metal roll such that heat is transferred from the surface of this roll to the surface of the web extending between the metal and soft roll.

Many proposals have been disclosed in which a heating medium such as heated oil has been caused to flow through a plurality of channels, or ducts, extending through the roll. Heat from the oil is transferred to the roll so that such heat is transferred to the surface of the roll for heating the web passing therepast.

In certain applications, it is desirable to heat the surfaces of the roll above 149°C (300 degrees F.) and sometimes as high as 510°C (950 degrees F). However, in order to heat the surfaces of such calender rolls to these high temperatures, oil or the like heat transfer medium must be supplied at temperatures greatly exceeding these required surface temperatures -- thereby allowing for various heat losses and a significant temperature drop through the shell.

Two main problems are presented by the utilization of a heat transfer medium operating at such elevated temperatures. First, the shell of the calender roll is subjected to excessive stress and, secondly, handling oil or the like transfer medium at such elevated temperatures can be extremely hazardous.

US-A-3,489,344 to Keyes and assigned to Beloit Corporation addresses the problem of controlling the heat profile of a roll along with the cross-machine direction, but does not disclose means for overcoming the aforementioned problems.

In DE-A-35 25 950 there is described a method of heating a calender roll according to the preamble of claim 1. More specifically, DE-A-35 25 950 teaches the provision of channels defined by the roll and extending through the roll and utilizes heat supplied by an induction heating means disposed adjacent to the external surface of the roll, the induction heating means extending along substantially the entire length of the roll such that heat is induced in the region of the external surface of the roll. An insulating zone is provided by means of the channels to prevent dissipation of heat inwardly through the roll.

Although the provision of a heating apparatus presents relatively few problems when operating at low temperatures, such is not the case when hot calendering at temperatures as high as 510°C. As already mentioned above, at such elevated temperatures, extremely high temperature gradients are created across the thickness of the roll shell and such temperature gradients impose unacceptable thermal stresses on the roll. Another problem is presented by the utilization of a heat transfer medium to heat the roll because handling oil or the like transfer medium at such elevated temperatures can be extremely hazardous.

The object of the present invention is to overcome the aforementioned problems by the provision of a method of heating a roll operating at such elevated temperatures while reducing the temperature gradients and thermal stresses across the thickness of the calender roll.

To achieve this, the method of the invention is characterized by the features claimed in the characterizing part of claim 1. According to the invention, a heat transfer medium is passed through the channels to supply and transmit the heat from the transfer medium through the roll towards the external surface thereof by conduction, while the induction heating means supplements the heat transmitted by the heating medium in the region of the external surface of the roll.

The heating medium is supplied to the roll at a temperature within the range of 204 to 316°C (400 to 600 degrees F.) such that the hazards associated with the use of a heating medium above this temperature range is avoided

The heating medium may be supplied at a temperature that is within the range 121-177°C (250-350°C F.) above the temperature of the roll surface.

The induction heater induces heat in the region of the external surface of the roll. The heat transferred to the roll by the heat transfer medium maintains this induced heat in the aforementioned region by inhibiting the flow of the induced heat inwardly through the roll away from such region.

The present invention relates to a method of heating a calender roll utilizing heat supplied by an induction heater and a heat transfer medium. The method includes the steps of passing the heat transfer medium through the heating channels as defined by the roll for transferring heat from the heating medium to the roll so that the roll is heated. The method also includes the step of energizing an induction heater

disposed adjacent to the external surface of the roll, the induction heater extending along the length of the roll such that heat is induced in the region of the external surface of the roll. Furthermore, the heat transfer to the roll from the heat transfer medium inhibits dissipation of the induced heat inwardly through the roll away from the external surface of the roll.

Although the present invention is described particularly relative to a calender for calendering a paper web, it should be appreciated by those skilled in the art that the present invention is not limited to paper web calenders but includes heating apparatus for heating a calender roll used in calendering any web-like material. Furthermore, although the present invention relates to a calender, it should be appreciated that the invention incudes an arrangement where one or more of the calender rolls is replaced by an extended nip provided by a shoe and cooperating blanket.

Figure 1 is a side-elevational view of the heating apparatus according to the present invention showing a calender roll and an adjacent induction heater.

Figure 2 is a sectional view taken on the line 2-2 of figure 1.

Figure 3 is a sectional view taken on the line 3-3 of figure 2, and

Figure 4 is a perspective view of the apparatus shown in figures 1 to 3.

Figure 1 is a side-elevational view of a heating apparatus generally designated 10 for heating a calender roll 12. The heating apparatus 10 utilizes heat supplied by an induction heater means generally designated 14 and from a heat transfer medium. Figure 1 shows a web of paper W extending through a calender nip 16 defined by the calender roll 12 and a cooperating soft calender roll 18. The induction heating means 14 includes a ferromagnetic core 20 having a concave surface 22 disposed adjacent to, and partially extending around, the external surface 24 of the calender roll 12. A wire coil 28 extends around the core 20 with opposed ends 30 and 32 of the coil 28 being connected to a source of alternating current 34 such that when the coil 28 is energized by the AC source 34, heat is generated within a region disposed adjacent to the external surface 24 of the calender roll 12.

Electromagnetic eddy currents are generated in the ferromagnetic core 20 by one of two methods. A copper wire coil 28 could be wound around the ferromagnetic core 20 so that when an alternating current source 34 is connected to the copper wire coil 28 the eddy currents are generated in the ferromagnetic core 20. Alternately, a liquid cooled copper tube could be run straight through a length of ferromagnetic core 20 so that when an alternating current source 34 is connected to the copper tube, eddy currents are generated in the ferromagnetic core 20. Independent of which method is used to generate the eddy currents in the ferromagnetic core 20, eddy currents will also be induced in the region of the calender roll external surface 24 which is adjacent to the ferromagnetic core 20. This region of the calender roll external surface 24 will be heated up by the induced eddy currents.

Figure 2 is sectional view taken on the line 2-2 of figure 1 and shows the disposition of the induction heater means 14 along substantially the entire length of the calender roll 12. The calender roll 12 defines a plurality of elongate channels which extend along the length of the roll 12. Each individual channel 36-50 as shown in figures 2 and 3, is connected by radial branches 52 and 53 to a central channel 54 which extends through the supportive axle 56 of the calender roll 12. A heat transfer medium such as oil or superheated water is connected to the plurality of heating channels 36 to 50 such that the heat transfer medium circulates throughout the length of the roll calender 12.

Figure 3 is a sectional view on the line 3-3 of figure 2 and shows the plurality of longitudinally-extending heating channels 36 to 50 being disposed radially inwards relative to the external surface 24 of the calender roll 12 with each of the longitudinal channels 36 to 50 being equally spaced from the external surface 24. When heated oil or the like is circulated through these channels heat is transferred from the heat transfer medium to the calender roll 12 and this heat supplied by the transfer medium inhibits dissipation of heat supplied by the induction heater means 14 inwardly from the external surface 24 and the region adjacent thereto. By this means, the heat supplied to the calender roll 12 by the heat transfer medium is supplemented by heat induced by the induction heater means 14 and the stress that would have been applied to the shell, or region of the calender roll 12 in the absence of the induction heater means 14 is avoided. Furthermore, by supplementing the heat supplied by the heat transfer medium with heat from the induction heater 14, the oil or heating medium does not need to be heated above 316°C (600 degrees F.). Therefore, the hazards associated with handling oil or the like, at such elevated temperatures above 316°C (600 degrees F.) is avoided.

Figure 4 is a perspective view of the calender roll 12 which may be a supercalender roll and the backing roll, or soft calender roll 18 with the web of paper or paperboard extending through the calender nip 16 defined by these cooperating rolls 12 and 18 respectively.

In operation of the heating apparatus 10, the heat transfer medium is passed through heating channels 36 to 50 which are defined by the calender roll 12 and heat is transferred from the heating medium to the calender roll 12 for heating the roll 12. The induction heater means 14 is energized such that the external surface 24 of the roll 12 is heated. Such induced heating heats not only the external surface 24 of the calender roll 12 but also the region in the vicinity of the

external surface 24 of the roll 12. The heat transfer to the roll 12 from the heat transfer medium inhibits dissipation of the induced heat inwardly through the roll 12 away from the external surface 24 of the roll 12.

The present invention provides a simple method for supplying supplementary heat to the surface region of a supercalender roll, thereby avoiding the problems of shell stress and the like. Furthermore, the present invention avoids the problems associated with handling an internal heat transfer medium at elevated temperatures.

Claims

1. A method of heating a calender roll, the method including the steps of:

providing channels (36-50) defined by the roll (12), said channels (36-50) extending through the roll (12),

energizing an induction heating means (14) disposed adjacent to the external surface (24) of the roll (12), the induction heating means (14) extending along substantially the entire length of the roll (12) such that heat is induced in the region of the external surface (24) of the roll (12),

characterized by the steps of passing a heat transfer medium through the channels (36-50) to transfer heat supplied from the transfer medium to the roll (12) and transmit the heat from the transfer medium through the roll (12) towards the external surface (24) thereof by conduction,

and supplementing the amount of heat transferred from the heating medium by the heat from the induction heating means (14) so that the temperature of the external surface (24) of the roll (12) is increased to a temperature level which, in the absence of said heating means (14), would cause excessive shell stress, said temperature level being attainable without the hazards associated with the use of a heat transfer medium operating at least at such temperature level.

2. A method as set forth in claim 1, characterized in that the heat transferred to the roll (12) from the heat transfer medium inhibits dissipation of the induced heat inwardly through the roll (12) away from the external surface (24) of the roll (12).

Patentansprüche

1. Verfahren zum Beheizen einer Kalanderwalze, wobei das Verfahren die Schritte beinhaltet:

Vorsehen von durch die Walze (12) begrenzten Kanälen (3650), wobei sich die Kanäle (36-50) durch die Walze (12) erstrecken,

Erregen einer Induktionsheizeinrichtung (14), die benachbart zu der äußeren Oberfläche (24) der Walze (12) angeordnet ist, wobei sich die Induktionsheizeinrichtung (14) über im wesentlichen die gesamte Länge der Walze (12) erstreckt, so daß Wärme in dem Gebiet der äußeren Oberfläche (24) der Walze (12) induziert wird,

gekennzeichnet durch die Schritte Hindurchleiten eines Wärmeübertragungsmediums durch die Kanäle (36-50), um von dem Wärmeübertragungsmedium gelieferte Wärme auf die Walze (12) zu übertragen und die Wärme aus dem Übertragungsmedium durch die Walze (12) hindurch durch Leitung zu der äußeren Oberfläche (24) zu übertragen, und

Ergänzen der Wärmemenge, die aus dem Wärmemedium übertragen wird, durch die Wärme aus der Induktionsheizeinrichtung (14), so daß die Temperatur der äußeren Oberfläche (24) der Walze (12) auf einen Temperaturwert erhöht wird, der bei Abwesenheit der Heizeinrichtung (14) übermäßige Mantelspannung verursachen würde, wobei der Temperaturwert ohne die Gefahren erreichbar ist, die mit der Verwendung eines Wärmeübertragunsmediums verbunden sind, das wenigstens auf diesem Temperaturwert arbeitet.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Wärme, die aus dem Wärmeübertragungsmedium auf die Walze (12) übertragen wird, die Ableitung der induzierten Wärme einwärts durch die Walze (12) hindurch weg von der äußeren Oberfläche (24) der Walze (12) verhindert.

Revendications

1. Procédé destiné à chauffer un cylindre de calandrage, le procédé comprenant les étapes consistant à:

procurer des canaux (36-50) définis par le cylindre (12), lesdits canaux (36-50) s'étendant à travers le cylindre (12);

exciter un moyen de chauffage à haute fréquence (14) disposé en position adjacente à la surface externe (24) du cylindre (12), le moyen de chauffage à haute fréquence (14) s'étendant pratiquement sur toute la longueur du cylindre (12) de telle sorte que la chaleur est induite dans la zone de la surface externe (24) du cylindre (12),

caractérisé par les étapes consistant à faire passer un milieu de transfert de chaleur à travers les canaux (36-50) dans le but de transférer de la chaleur acheminée depuis le milieu de transfert jusqu'au cylindre (12) et de transmettre la chaleur depuis le milieu de transfert à travers le cylindre (12) en direction de la surface externe (24) de ce dernier, par conduction,

et ajouter à la quantité de chaleur transférée depuis le milieu de chauffage, la chaleur provenant du moyen de chauffage à haute fréquence (14) de telle sorte que la température de la surface externe (24) du

cylindre (12) augmente jusqu'à un niveau de température qui, en l'absence dudit moyen de chauffage (14), provoquerait des contraintes excessives sur l'enveloppe, ledit niveau de température étant accessible sans les dangers associés à l'utilisation d'un milieu de transfert de chaleur mis en oeuvre à au moins un tel niveau de température.

2. Procédé selon la revendication 1, caractérisé en ce que la chaleur transférée au cylindre (12) depuis le milieu de transfert de chaleur, inhibe la dissipation de la chaleur induite, vers l'intérieur à travers le cylindre (12), à l'écart de la surface externe (24) du cylindre (12).

FIG. 2

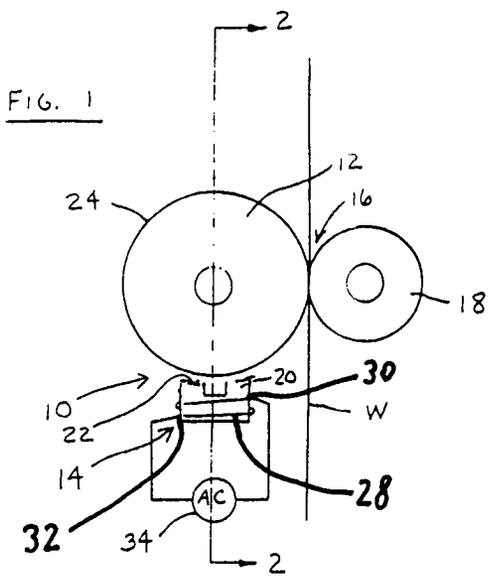
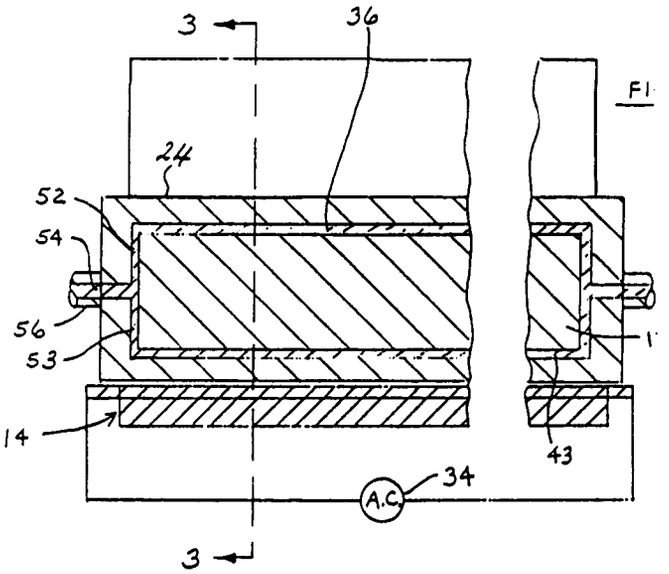


FIG. 1



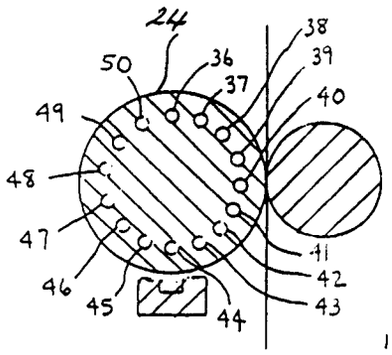


FIG. 3

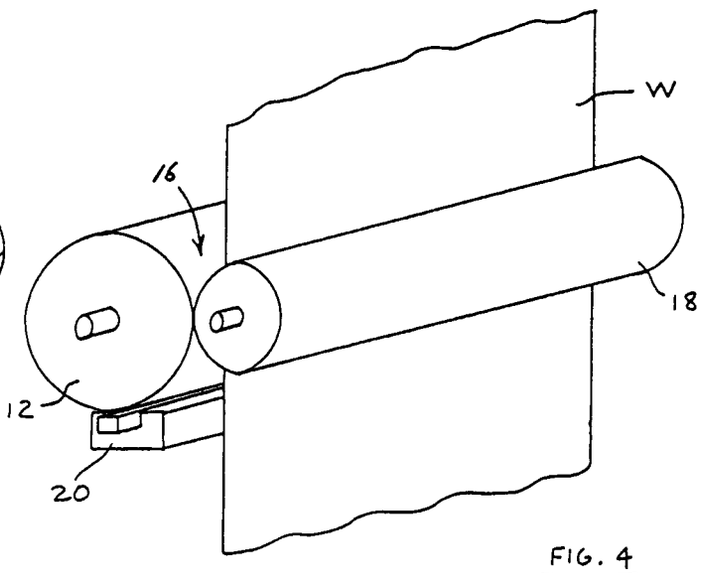


FIG. 4