INVENTORS
TIBOR GEORGES PATO
ERNST AMMON
ERWIN GRAF
HANS HEINRICH WYMANN

By [Signature] and [Signature]
HEAT TRANSFER ROLLER HAVING FLUID CIRCULATING MEANS THEREIN

Tibor Georges Pato, Erlangen, Germany, and Ernst Ammon, Bern, Erwin Graf, Zurich, and Hans Heinrich Wymann, Luzelfof, Switzerland, assignors to Winkler, Fallert & Co., Ltd., Bern, Switzerland

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ABSTRACT OF THE DISCLOSURE

A rotatable heat transfer roller is disclosed as including an outer cylinder having a pair of end walls closing respectively opposite ends thereof and each formed with an axially outwardly extending tubular pivot. Bearing means rotatably support the tubular pivots, and a cylindrical directing pipe extends coaxially within the cylinder and has at least partially open axially opposite ends. This pipe, together with the cylinder, defines an annular passage for a heat transfer fluid, the passage communicating with the interior of the pipe through the opposite ends of the latter.

A vane-type pump is disposed within the directing pipe and includes a rotor on a shaft which is rotatably mounted in bearings in the tubular pivot of one end plate, a driving means being connected to the shaft exteriorly of the roller. In one embodiment of the invention, the heat transfer fluid is admitted through one tubular pivot and is exhausted through orifice means associated with the other tubular pivot.

In the second embodiment of the invention, the roller is essentially sealed, with one end plate being formed with a filling opening and a pressure relief opening. In this case, a conducting pipe extends concentrically of the directing pipe and encloses a bellows compensating for expansion and contraction of the heat transfer fluid with variations in temperature. Electric heating means are associated with the wall of the directing pipe and supplied with current by leads extending through one of the tubular pivots.

Background of the invention

This invention relates to heat transfer rollers, such as cooling or heating rollers, and more particularly to an improved heat transfer roller having a high heat transmission efficiency.

In some known cooling or heating rollers, the liquid heat transfer agent flows from the interior of the roller through flow passages or apertures against the circumferential or cylindrical wall of the roller. In other known devices of this type, the heat transfer liquid flows along the inner surface of the roller's circumferential or cylindrical wall through oppositely directed helical channels. However, in both of these known embodiments, there is no assurance of a constant temperature distribution over the entire axial width of the roller.

It is also known to provide a cooling roller wherein the inner surface of the circumferential or cylindrical wall of the roller is sprayed with a liquid cooling agent by means of spray jets. An increased cooling effect is attained by the provision and arrangement of special air jets through which air, introduced from outside the hollow space of the roller, is sucked in by a jet pump and is directed against the inside surface of the cylindrical wall together with the cooling liquid. However, the use of air as an additional cooling agent requires a complicated construction of the cooling roller and, with respect to heating rollers having a closed circulation of the heat transmitting fluid, such as special oils, it is not possible to use air as an additional agent.

An object of the present invention is to provide a heat transfer roller which is not subject to the disadvantages of known types of heat transfer rollers.

Another object of the invention is to provide a heat transfer roller having a heat transfer fluid-directing pipe arranged concentrically therein.

A further object of the invention is to provide a heat transfer roller having a heat transfer fluid-directing pipe arranged concentrically therein and having a heating fluid circulating pump positioned in the fluid directing pipe.

Still another object of the invention is to provide a heat transfer roller, of the type just mentioned, including external driving means for the pump.

A further object of the invention is to provide a heat transfer roller, of the type just mentioned, in which there is a closed circulation of heat transfer liquid, and including an expansion compensating bellows within the roller.

For an understanding of the principles of the invention, reference is made to the following description of typical embodiments thereof as illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is an axial sectional view through a heating or cooling roller in accordance with one embodiment of the invention; and

FIG. 2 is an axial sectional view through a heating or cooling roller in accordance with another embodiment of the invention.

In the embodiment of the invention shown in FIG. 1, a heating or cooling roller is illustrated as including an axially relatively elongated cylindrical wall or cylinder 1 having end plates 2 and 3, which also constitute support pivots for cylinder 1 whereby the roller may be rotatably mounted. End plates 2 and 3 are formed with axial bores 4 and 5, respectively, and are fixedly secured in cylinder or shell 1. As illustrated, these end plates have pivot extensions engaged in suitable antifriction support bearings for rotatably mounting the heat transfer roller.

In accordance with the invention, a fluid directing pipe 7, which is partially or fully open at its axially opposite ends, is disposed concentrically or coaxially within cylindrical wall 1, as by being supported from wall 1 by carriers or supports 6. Pipe 7 has an external diameter less than the internal diameter of wall or cylinder 1, so that an annular space 8 is left between cylinder 1 and pipe 7 for the circulation of the cooling or heating fluid, this space 8 communicating with the interior of pipe 7 through the at least partially open ends of the latter.

The pivot extension of end plate 3 has axially spaced bores 9 and 10 which receive antifriction bearings 11 and 12, respectively. These bearings support a vane-type pump 15 having a shaft 13 supported by bearings 11 and 12 and driven by a suitable drive means such as, for example, a motor 14. Pump 15 thus rotates within director pipe 7.

When pump 15 is in operation, all of the cooling or heating fluid in the roller is maintained in intensive circulation. Only small quantities of cooling or heating fluid need be introduced from the outside through bore 4, since higher temperatures can be used in the introduced quantities while the temperature distribution over the entire axial width of the heating or cooling roller remains constant due to the intensive circulation of the heat transfer fluid within the roller. In order to remove the fluid, three bores 16 and 17 are provided in the roller journal or tubular pivot having the passage 5, and fluid flows through these bores and the passage 5 and out through an aperture 18 in a shell 19 embracing the tubular pivot.

In the embodiment of the invention shown in FIG. 2, the heating or cooling roller is intended for a closed
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circulation of the heat transfer fluid. In FIG. 2, those parts either identical with or corresponding to the same parts in FIG. 1 have been indicated with the same reference characters primed. Thus, the heating roller includes the axially elongated cylindrical wall 1', the fluid directing pipe 7' and the axially elongated annular circulation space 9' between jacket 1' and fluid directing pipe 7'. Furthermore, a vane-type pump 15' is mounted within pipe 7' and driven from an external source, such as a motor 58.

The roller of FIG. 2 differs from that shown in FIG. 1, in the provision of a conducting pipe 24 of substantially less diameter than the fluid directing pipe 7' and arranged concentrically or coaxially with pipe 7' and cylinder 1'. A bellows 25, of metal or synthetic resin material, is positioned within cylinder 1' as by being arranged to extend axially of conducting pipe 24. Directing pipe 7' includes end wall members 20 and 21 formed with pivots rotatably supported on said end wall members 20 and 23, respectively, of cylinder 1'. Conducting pipe 24 is mounted on a cylindrical inward extension of end wall 20. Bellows 25 is a known type of bellows which serves to absorb the expansion of the heating fluid due to increased temperature.

In order to supply heating fluid to the interior of the roller, roller pivot 22, constituting an end wall fixedly secured to cylinder 1', is formed with a filling aperture selectively closed by a screw 26, and is also formed with a further aperture selectively closed by a ventilating screw 27. Instead of bellows 25, the embodiment of FIG. 2 can use a compensation vessel which, though not shown, is known per se. Electric heating elements 28 are built into the wall of fluid directing pipe 7', and these heating elements are energized through lines or conductors 29 which extend through bores 30 and 31 in end wall 20 of fluid directing pipe 7'.

In this connection, it should be noted that the roller shown in FIG. 1 also can be provided with electrical heating means, or it may be heated by hot water. While specific embodiments of the invention have been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A rotatable heat transfer roller, for heating or cooling purposes, comprising, in combination, an axially relatively elongated outer cylinder, a pair of end walls closing respective opposite ends of said cylinder and each formed with an axially outwardly extending tubular pivot; bearing means rotatably supporting said tubular pivots; a cylindrical directing pipe extending coaxially within said cylinder and having at least partially open axially opposite ends, said pipe defining, with said cylinder, an annular passage for flow of heat transfer fluid and communicating with the interior of said pipe through said axially opposite ends of the latter; means supporting said pipe in said cylinder to direct flow of fluid through the latter; fluid circulating means within said cylinder operable to circulate fluid through said pipe and through said annular passage to maintain a uniform temperature distribution throughout the length of said cylinder; a bellows positioned within said cylinder; said roller being secured to provide for closed circulation of said heat transfer fluid; said bellows compensating for expansion and contraction of said heat transfer fluid with variations in temperature; and fluid heating means within said heat transfer roller in heat transfer contact with the fluid therein.

2. A heat transfer roller, as claimed in claim 1, including said conducting pipe supported within said directing pipe to extend concentrically thereof; said bellows being disposed within said conducting pipe.

3. A heat transfer roller, as claimed in claim 2, in which said means supporting said directing pipe comprises an apertured end wall member secured to an end of said directing pipe and having bearing support in one of said end walls; said conducting pipe being supported at one end on said end wall member.

4. A rotatable heat transfer roller, for heating or cooling purposes, comprising, in combination, an axially relatively elongated outer cylinder; a pair of end walls closing respective opposite ends of said cylinder and each formed with an axially outwardly extending tubular pivot; bearing means rotatably supporting said tubular pivots; a cylindrical directing pipe extending coaxially within said cylinder and having at least partially open axially opposite ends; said pipe defining, with said cylinder, an annular passage for flow of heat transfer fluid and communicating with the interior of said pipe through said axially opposite ends of the latter; means supporting said pipe in said cylinder to direct flow of fluid through the latter; fluid circulating means within said cylinder operable to circulate fluid through said pipe and through said annular passage to maintain a uniform temperature distribution throughout the length of said jacket; said roller being secured to provide for flow of circulation of heat transfer fluid; and heating means mounted alongside said directing pipe.

5. A heat transfer roller, as claimed in claim 4, in which said heating means are electric heating means.

6. A rotatable heat transfer roller, for heating or cooling purposes, comprising, in combination, an axially relatively elongated outer cylinder; a pair of end walls closing respective opposite ends of said cylinder and each formed with an axially outwardly extending tubular pivot; bearing means rotatably supporting said tubular pivots; a cylindrical directing pipe extending coaxially within said cylinder and having at least partially open axially opposite ends; said pipe defining, with said cylinder, an annular passage for flow of heat transfer fluid and communicating with the interior of said pipe through said axially opposite ends of the latter; means supporting said pipe in said cylinder to direct flow of fluid through the latter; fluid circulating means in the form of a vane-type pump positioned within said directing pipe; axially spaced bearings in one of said tubular pivots; a driving shaft for said vane-type pump extending through said axially spaced pivot and rotatably supported in said axially spaced bearings; driving means drivingly secured to said shaft externally of said heat transfer roller; and fluid inlet and outlet means provided in at least one of said end walls; said fluid inlet means comprising the tubular pivot on one of said end walls; said fluid outlet means comprising orifices in the tubular pivot on the other of said end walls; a shell embracing said last-named tubular pivot and communicating with said orifices, and a further orifice in said shell.

7. A heat transfer roller, as claimed in claim 6, in which said tubular pivot formed with said orifices is the one containing said axially spaced bearings supporting said shaft, said last-named tubular pivot extending inwardly from its associated end wall and said orifices means being formed in said inward extension axially outwardly of the innermost of said bearings therein.

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ROBERT A. O'LEARY, Primary Examiner.
A. W. DAVIS, Jr., Assistant Examiner.