June 10, 1958 E. A. COUDRIET 2,837,833

ROLL TEMPERATURE CONTROL SYSTEM

Filed Sept. 15, 1955 2 Sheets-Sheet 1

FIG 1.

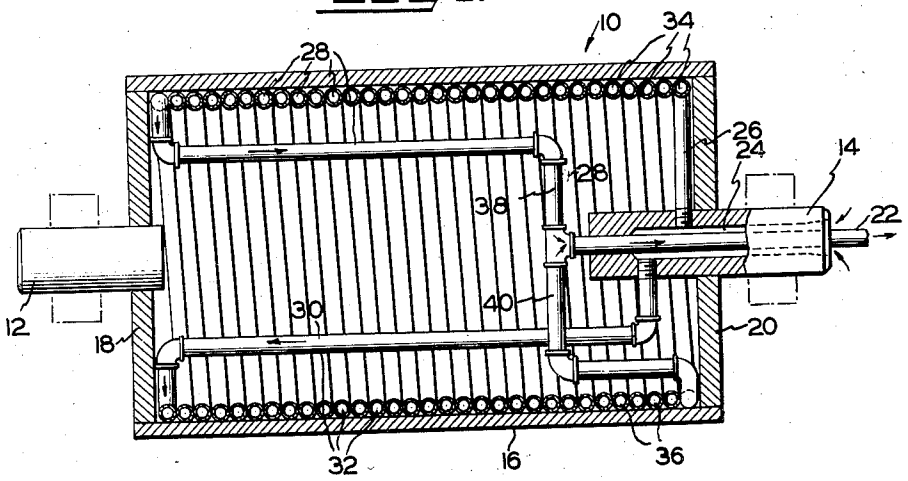
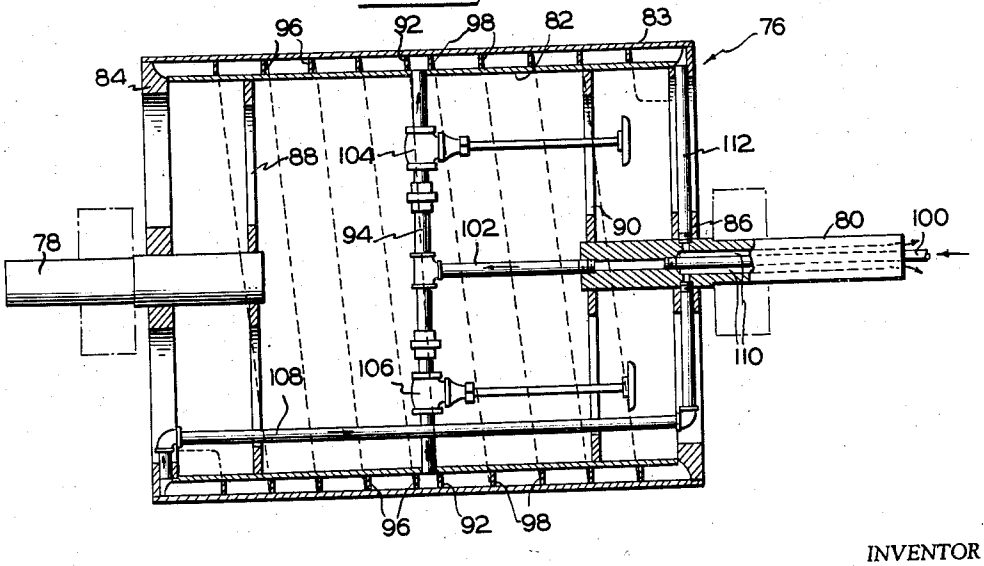


FIG 3.



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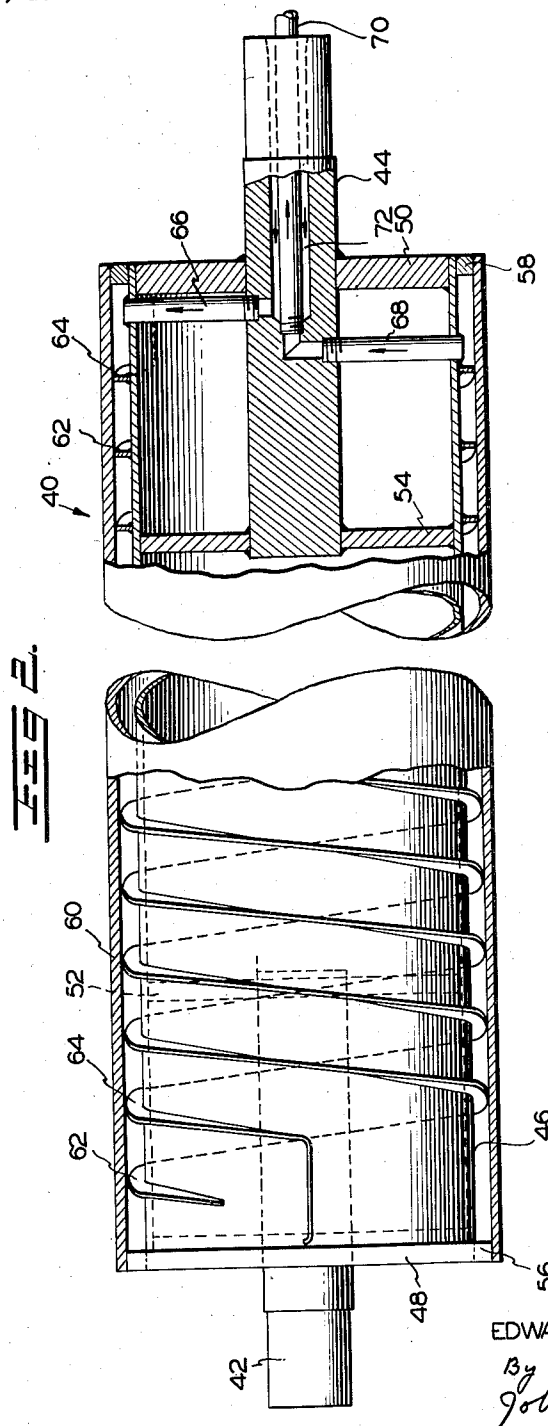


FIG 2.

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ROLL TEMPERATURE CONTROL SYSTEM

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7 Claims. (Cl. 34—124)

Drier rolls are used to heat webs of paper and other materials as they pass over the rolls, in order to dry ink on the paper, for example, or for other purposes of heat treatment. The rolls should be heated uniformly across their heating surfaces so that they will impart heat uniformly to the webs passing around them, and that has long presented a difficult problem where a heated fluid is circulated through the interior of the roll for purposes of supplying the necessary heat. The present invention relates to so arranging such circulation that it will improve control and uniformity of distribution of heat across the working surfaces of a drier roll or the like. The invention utilizes multiple streams of fluid moving in opposite rotational directions around the roll, which offsets any interference by the moving fluid with the rotation of the roll. While the invention is primarily concerned with heated drier rolls, it is also applicable to cooling rolls.

For a better understanding of the invention, reference is made to the accompanying drawings, in which present preferred embodiments of the invention are illustrated. In the drawings:

Figure 1 shows a section through the axis of a roll embodying the invention;

Figure 2 shows a like section of a second species of roll embodying the invention.

Figure 3 shows a like section of a third species of roll embodying the invention.

Referring now more particularly to the drawing, and initially to Figure 1, a heater roll **10** is journaled on axles **12** and **14** at its opposite ends. The body of the roll consists of a hollow cylindrical metal cover **16** secured around a pair of end plates **18** and **20** which are welded around the axles **12** and **14** respectively. The outer surface of the cover **16** supports and heats a web of paper or the like trained around the roll.

The axle **14** has an axial opening therethrough, and a tube **22** extends through the opening from the inside to the outside of the roll. The outer end of the axle **14** is counterbored to provide an annular passage **24** around the outside of the tube **22**, extending from the outside of the roll to the inlet end **26** of a tube **28** and to the inlet end **30** of a tube **32**. The tubes **28** and **32** are mounted within the roll body and have helical portions **34** and **36** which are wound side-by-side in a double helix against the inside of the cover **16** across the space between the end plates **18** and **20**. The respective tubes **28** and **32** have outlet ends **38** and **40** connected to the inner end of the tube **22**. In order to cause opposite flow through the helical portions **34** and **36** of the tubes **28** and **32**, the helical portion **34** has its inlet end adjacent end plate **20** and its outlet end adjacent end plate **18**, while the helical portion **36** has its inlet end adjacent end plate **18** and its outlet end adjacent end plate **20**.

A fluid heating medium, such as water or steam, is heated by any suitable means outside of the roll, and is then pumped through the passage **24** into the inlet ends of tubes **28** and **32**, thence in opposite directions through

the helical portions **34** and **36** of tubes **28** and **32**, and thence through the outlet ends **38** and **40** of tubes **28** and **32** into tube **22**, which discharges the fluid out of the roll. The same effect is achieved if the above-described flow is reversed.

The fluid heating arrangement for the roll **10** has the advantage of dividing the incoming heated fluid into a pair of equal streams, one of which flows in a helical path from one end of the roll body to the other, while the other stream flows in the opposite direction through an equal helical path extending side-by-side with the first helical path. A unit of area of cover **28** across both helices adjacent one end of the roll, and a corresponding area adjacent the other end of the roll, must have substantially the same average temperatures, because each is exposed to the combined heating action of one stream of fresh heating fluid entering one of the helical paths, and an equal stream of used heating fluid leaving the other helical path. The average temperature near the middle of the roll is substantially the same as at the ends of the roll, because both streams of fluid at the middle of the roll have a temperature substantially equal to the average temperatures near the ends of the roll.

In order to improve the even heating qualities of the roll **10**, the spaces between the outer surfaces of the helical portions **34** and **36** of the tubes **28** and **32**, on the one hand, and the interior surface of the metal cover **16**, on the other hand, are filled with highly heat-conductive material, such as aluminum shavings.

Another embodiment of the invention is illustrated in Figure 2, which shows a roll **40** journaled on a pair of axles **42** and **44**. An inner cylindrical shell **46** is welded around a pair of end plates **48** and **50**, which in turn are welded around the axles **42** and **44**. An interior supporting plate **52** braces the inner end of the axle **42** against the inner shell **46**, and a like plate **54** braces the inner end of the axle **44** against the shell **46**. A pair of spacer rings **56** and **58** are welded around the outside of the opposite ends of the shell **46**, and around the inside of the opposite ends of an outer cylindrical cover **60**. A pair of spaced helical strips **62** and **64** are welded between the inner shell **46** and cover **60**, forming double helical passages along the inside of the cover **60**. Each of the strips **62** and **64** has one end welded to the spacer ring **58**, so that one end of the helical passage to the right of the strip **64** terminates adjacent the spacer ring **58**, where it is connected to a radially extending tube **66**, and one end of the helical passage to the left of the strip **64** also terminates adjacent the spacer ring **58**, where it is connected to a radially extending tube **68**. A tube **70** extends axially from the outer end of axle **44** to connect with radial tube **68**, and an annular passage **72** extends from the outer end of axle **44** around the outside of tube **70** to connect with radial tube **66**. At the other end of the roll **40**, the strip **62** terminates short of the spacer ring **58**, while the corresponding end of the strip **64** is welded to the spacer ring **56**. This has the effect of connecting the helical passages to the right and left of strip **64** to each other adjacent spacer ring **56**.

When a supply of heated fluid is fed into the passage **72** around the outside of the tube **70**, such fluid passes through the tube **66** into the right end of the helical passage to the right of the strip **64**, and thence passes helically between the strips **62** and **64** along the length of the roll body until it reaches the terminal end of the strip **62** adjacent the spacer ring **56**. There the fluid passes around the end of strip **62** and starts back through the helical passage to the left of strip **64**, reversing its direction of flow accordingly. When the fluid reaches the right end of the roll body it passes into tube **68** and is withdrawn through tube **70**. The operation is substantially the same if the supply and exhaust connections

are reversed. In either case, equal streams of fluid move oppositely in a double helix along the length of the roll body, which substantially equalizes the local average temperatures of the cover 60 across the length of the roll body.

Instead of having the oppositely moving spiral streams of fluid side-by-side, as shown in Figures 1 and 2, the two streams can be disposed on opposite sides of the center of the roll, as shown in Figure 3. The roll 76 shown in Figure 3 is journaled on axles 78 and 80 at its opposite ends. Inner and outer cylindrical shells 82 and 83 are welded around a pair of end plates 84 and 86, which in turn are welded around the axles 78 and 80. Interior supporting plates 88 and 90 brace the inner ends of axles 78 and 80 against the inner shell 82. A ring 92 is welded between the shells 82 and 83 to bisect the annular space therebetween. The ring 92 is canted slightly relative to the roll axis so that a central feed pipe 94 extending perpendicular to the roll axis has one end extending through the inner shell 82 on one side of ring 92, and its opposite end extending through the inner shell 82 on the other side of ring 92. Spiral strips 96 and 98 of the same hand and pitch, are welded between the shells 82 and 83 to create spiral passages of the same hand and size on opposite sides of ring 92, the opposite ends of strip 96 being welded to end plate 84 and ring 92, and the opposite ends of strip 98 being welded to end plate 86 and ring 92. An inlet tube 100 extends axially from the outer end of axle 80 and connects through a tube 102 with the center of feed pipe 94. A valve 104 controls flow through one end of pipe 94 into the inner end of the spiral passage formed by helical strip 96, and a like valve 106 similarly controls flow from the other end of pipe 94 into the inner end of the spiral passageway formed by helical strip 98. The valves 104 and 106 are adjusted to equalize the flow on opposite sides of the roll. When the flow along the helical strip 96 reaches the end plate 84 it is drawn off through an exhaust pipe 108, which connects with an annular counterbored discharge passage 110 extending through the outer end of axle 80 around the outside of tube 100. In like manner, when the flow along the helical strip 98 (rotationally and axially opposite to the direction of flow along strip 96) reaches end plate 86, it is withdrawn through an exhaust pipe 112, which also connects with the discharge passage 110. The operation is reversed if the supply and exhaust connections are reversed, because then the heat (if the fluid is heated) is greatest adjacent the ends of the rolls, and less near the center of the roll. The temperature difference between the ends and the center of the roll is limited by the fact that each spiral passageway extends only half the axial length of the roll, and that distance may be relatively small, so that the temperature drop is small.

The tubular construction of the first of the above-described embodiments of the invention is adaptable for use in the second and third of the above-described embodiments of the invention, and the double-shell construction of the second and third embodiments of the invention is similarly adaptable for use in the first of the above-described embodiments of the invention. While the illustrated embodiments of the invention are drier rolls supplied with high-temperature fluid, the principles of the invention are also applicable to cooling rolls supplied with a low-temperature fluid.

While I have illustrated and described present preferred embodiments of the invention, it will be understood that the invention is not limited thereto, but may be variously embodied and practiced within the scope of the following claims.

I claim:

1. A heat-exchange roll, comprising a roll body, means to journal the roll body for rotation about a central axis through the roll body, means forming at least a pair of helical conduits within the roll body adjacent and in heat exchange relation with its periphery, the inclination of the conduits being in the same direction, means defining an inlet fluid passageway at one end of each helical conduit and restricting fluid flow only into the respective conduit with the inlet passageway of the two conduits being located in the roll body at relative opposite ends of the respective conduits, and means defining an outlet passageway at the end of each helical conduit opposite the inlet passageway, whereby fluid is fed through one of the helical condiuts in one rotational direction and through the other of the helical conduits in an opposite rotational direction to offset frictional drag on the roll body during rotation of the roll.

2. A heat-exachnge roll as defined in claim 1, wherein the conduits are integral and rotatable with said body with the helices of said conduits in alternate side-by-side heat transfer relation.

3. An apparatus according to claim 2 in which the means for forming helical conduits comprises an inner cylindrical member coaxial with and radially spaced from said roll body and a plurality of spaced helical strips integrally fixed therebetween.

4. Apparatus according to claim 1, in which the helical conduits are disposed on opposite sides of the middle of the roll body, one fluid passageway being connected to the end of each of said helical conduits nearest the middle of the roll, and another fluid passageway is connected to the end of each of said helical conduits nearest the ends of the roll.

5. Apparatus according to claim 4 wherein said one fluid passageway connected to the end of each of said conduits at the middle of the roll constitutes the inlet, and a valve in each of said inlet fluid passageways to enable individual control of each conduit.

6. Apparatus according to claim 1, in which said means for forming helical condiuts comprise a plurality of helical tubes disposed in side-by-side relation.

7. A heat-exchange roll as defined in claim 1 wherein said conduits extend substantially the length of the roll body with the helices of said conduits in alternate side-by-side heat transfer relation, the inlet passageway for one conduit and the outlet passageway for the other conduit being at one end of the roll body and the outlet passageway of said one conduit and the inlet passageway of said other conduit being at the other end of said roll body.

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