United States Patent

[11] 3,633,663

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[21] Appl. No. **44,177**
[22] Filed **June 8, 1970**
[45] Patented **Jan. 11, 1972**
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[54] **COOLING ROLL**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **165/89,**
34/124, 138/38, 165/109, 165/177
[51] **Int. Cl.** **F28d 11/02,**
F28f 5/02
[50] **Field of Search** 165/89, 90,
177, 109, 174; 138/38; 110/97 D; 122/44 A, 155
A; 34/119, 124, 125; 126/410; 62/346

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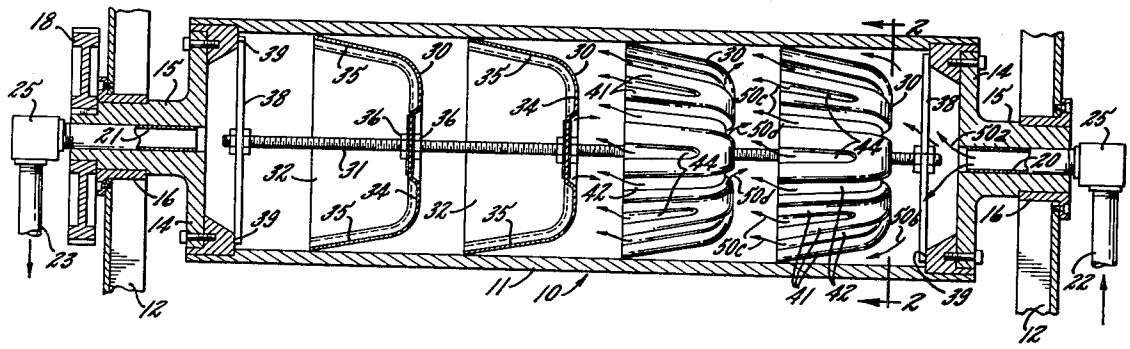
ABSTRACT: A cooling roll for a printing press having a hollow cylindrical roll body and a series of axially spaced baffle members mounted within said body for thoroughly mixing cooling fluid as it passes through the roll body and for directing the flowing fluid against the cylinder walls of the roll body. Each baffle is cup shaped and is disposed within the roll body with the open end of the cup directed downstream of the fluid flow. The end portion and tapered side portions of each cup-shaped baffle are formed with a plurality of flutes which facilitate mixing and directing of the fluid.



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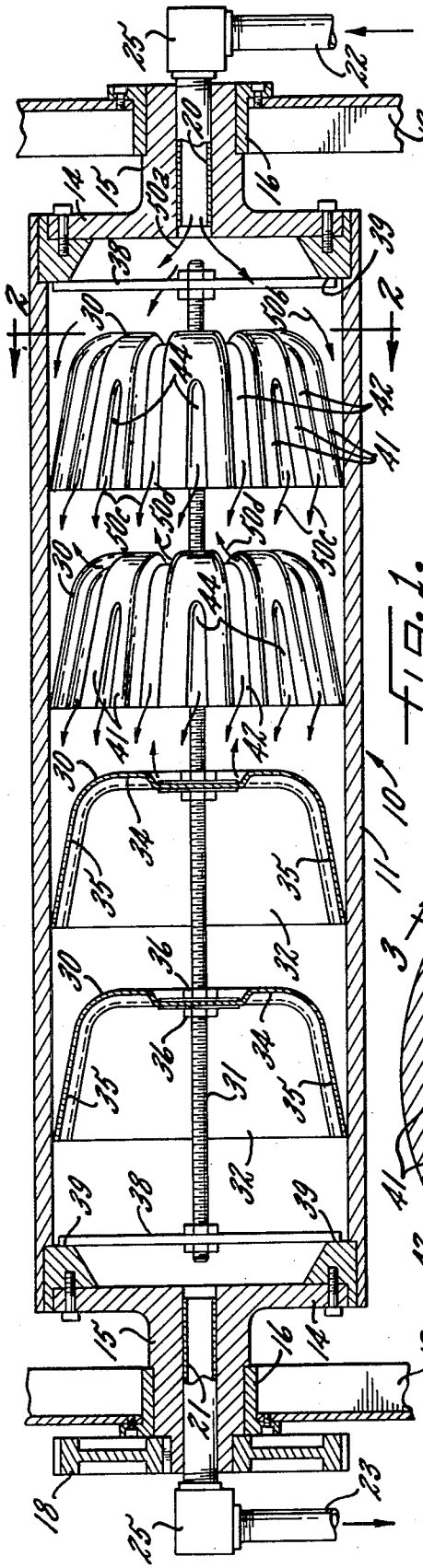

FIG. 1.

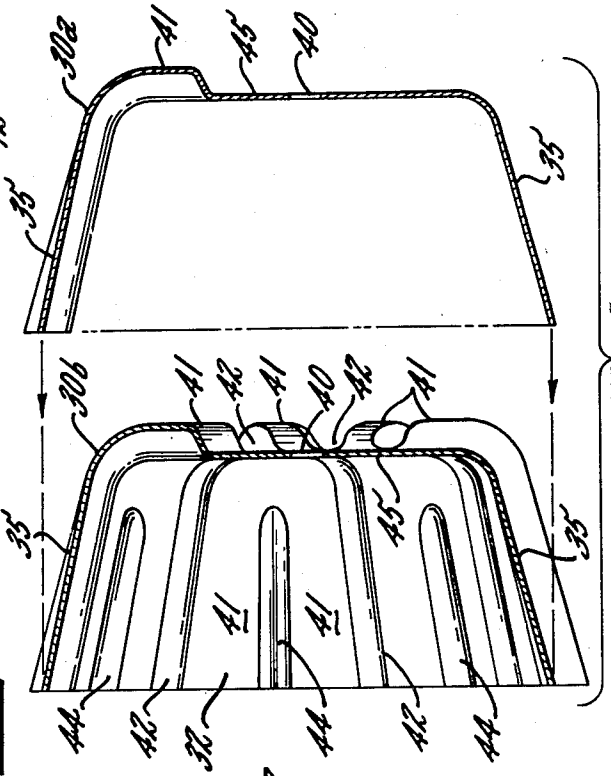

FIG. 3.

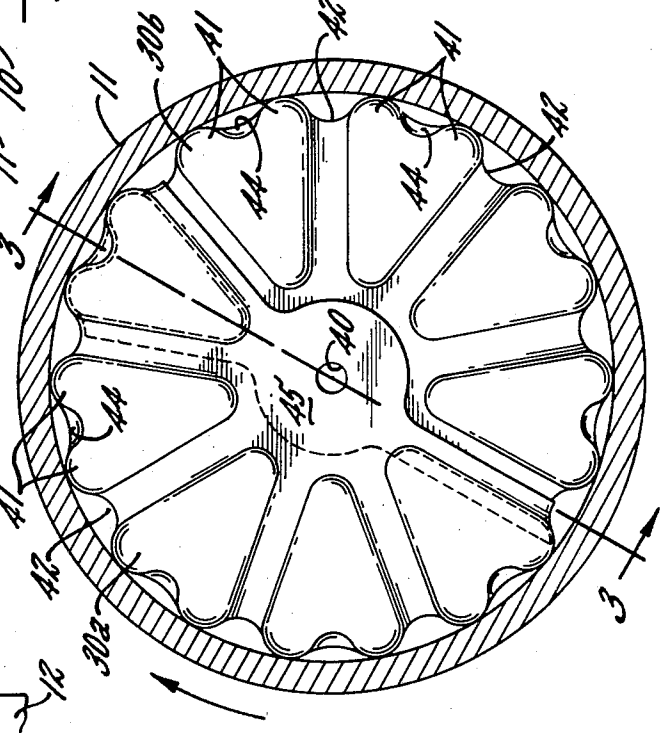

FIG. 2.

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COOLING ROLL

DESCRIPTION OF THE INVENTION

The present invention relates generally to heat exchange rolls, and more particularly, to improved cooling rolls for use with a printing press.

In the usual continuous printing operation of the type used for printing on nonabsorbent paper in which a heat setting ink must be used, freshly printed paper is fed from the press through a dryer where it is heated and then over one or more cooling rolls. These rolls usually consist of hollow cylindrical metal shells with rotary unions at each end to permit the passage of a liquid cooling medium such as water through the shell. The water absorbs heat from the roll which, in turn, cools the paper and completes setting of the ink.

In modern high-speed printing equipment some difficulty has been experienced with the efficiency in which the cooling rolls can absorb heat from the moving web of paper. In some cooling rolls, a hot relatively inactive layer of water tends to build up along the wall of the cylinder and cool water from the inlet passes through the cylinder with very little mixing with the hot layer so that the cylinder wall is not greatly cooled. In such systems the inefficiency is shown by the fact that the temperature differential of the water entering the cylinder and that leaving the cylinder is relatively small. In other cooling rolls the cooling fluid is directed along narrow channels or passages adjacent the wall of the cylinder so that all water must pass in close proximity to the cylinder wall. In such apparatus, since the channels through which the fluid is directed make up only a small portion of the internal volume of the cylinder the volume of fluid contained in the cylinder at one time is relatively small. The smaller volume of fluid tends to reach a temperature approaching that of the cylinder before it has passed completely through the cylinder. A nonuniform temperature gradient is thereby created along the cylinder length.

Accordingly, it is an object of the present invention to provide an improved cooling roll for a printing press which more efficiently cools a moving web of heated paper.

Another object is to provide a cooling roll of the above kind whereby large quantities of cooling fluid may be contained in and passed through the roll without creating an excessively warm relatively stagnant outer layer of fluid adjacent the cylinder wall. More particularly, it is an object to provide a cooling roll which may be nearly completely filled with a cooling fluid and which thoroughly mixes the fluid as it passes through the cylinder so that a steady flow of cool fluid passes along the entire length of the cylinder wall.

A further object is to provide a cooling roll as characterized above which tends to bleed out air from within the cylinder as it is operated so that the cylinder fills completely with cooling fluid.

Still another object is to provide a cooling roll of the foregoing type which has a simple and economical design and construction.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

FIG. 1 is a longitudinal section through the axis of a heat exchange roll embodying the present invention with two of the fluid baffles shown in section and two baffles shown unsectioned;

FIG. 2 is an enlarged section taken in the plane of line 2—2 in FIG. 1;

FIG. 3 is an exploded section taken in the plane of line 3—3 in FIG. 2 showing one of the two-part cup-shaped baffles in a disassembled condition.

While the invention is susceptible of various modifications and alternative forms, a specific embodiment thereof has been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that it is not intended to limit the invention to the particular form disclosed but, on the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the invention.

Turning now to the drawings, there is shown in FIG. 1 an illustrative cooling roll assembly **10** embodying the present invention. The assembly includes a hollow cylindrical roll body **11** suitably mounted for rotation within a frame **12**. In the illustrated embodiment, an end closure head **14** having a hollow shaft extension **15** is provided at each end of the roll body **11**. The shaft extensions **15** each are rotatably disposed in a bearing **16** secured in the frame **12**.

The roll body **11** may be rotated by a suitable drive means connected with a gear **18** mounted on one of the shaft extensions **15**. The illustrated roll is shown rotating in a clockwise direction as viewed from the right-hand end of FIG. 1. As is well known in the art, a continuous web material, such as hot freshly printed paper, may be trained about a series of such cooling rolls. Since the roll is power driven the web will proceed at a uniform speed through the entire print, heating and cooling operations.

To cool the roll body, and thus a web traveling about the roll, a continuous flow of a fluid cooling medium, ordinarily water under pressure, is supplied from a suitable source to a roll inlet tube **20** contained within the hollow shaft extension **15** at one end of the roll. The cooling fluid passes from the inlet tube **20** through the roll body **11** to absorb heat from the body and then passes out an outlet tube **21** contained in the shaft extension **15** at the opposite end of the body. Since the inlet and outlet tubes **20, 21** rotate with the driven roll body **11** and end heads **14**, they are connected to supply and return lines **22, 23** respectively, through conventional rotary couplings or unions **25**. The fluid from the outlet pipe **23** may be directed to a refrigerating unit or other conventional heat exchange means and then redirected to the inlet **22**.

In accordance with the present invention, a series of axially spaced baffle members are mounted within the roll body for thoroughly mixing the cooling fluid as it passes through the body and for directing the fluid against the inner cylindrical surface of the roll body. In the illustrated embodiment, four cup-shaped baffles **30** are disposed in axially spaced relation along a threaded tie rod **31** with an open end **32** of each cup directed downstream of the fluid flow. Each baffle in this case has an end portion **34** and outwardly tapered side portions **35** extending therefrom. In FIG. 1, for the purpose of illustration, the two baffles at the outlet side of the roll body are shown in section, while the two baffles at the inlet side are not sectioned.

In order to secure the baffles **30** to the tie rod **31** and maintain their spacing, a pair of threaded nuts **36** are provided on opposite sides of each baffle. To prevent the series of baffles from moving longitudinally within the roll body, a narrow cross rod **38** is secured in perpendicular relation to the tie rod **31** at each end thereof and abuts an internal shoulder **39** formed within the roll body **11**. The cross rods **38** and tie rod **31** are thereby interposed between the roll body shoulders **39**. Since the cross rods **38** are relatively narrow, they do not obstruct the fluid flow.

To facilitate the assembly of the baffles **30** within the roll body **11**, the illustrated baffles each are made of a two part construction with each part **30*a***, **30*b*** being approximately a one-half sector of the baffle cup. As best shown in FIGS. 2 and 3, each part or sector **30*a***, **30*b***, has an axial aperture **40** which permits the sector to be placed on the tie rod **31** during assembly of the cooling roll. The proportions of the sector are such that they are in slightly overlapping relationship when assembled, as shown in FIG. 2. In this case, the baffle part **30*a*** overlaps part **30*b***. The two-part baffle construction allows the baffle to be assembled into the roll body through an opening which is smaller than the diameter of the assembled baffle, such as the opening defined by the shoulders **39** of the illustrated roll body. It will be appreciated that the baffle parts **30*a*, 30*b***, may be readily molded to the desired proportion and shape. The baffles preferably are molded of a plastic material so that the walls of the finished baffle have a slight resiliency.

The baffles may thereby be formed somewhat larger than the internal diameter of the roll body so that the outer edges of the baffle side portions **35** are biased into firm engagement with the inner cylindrical surface of the roll body **11**.

In keeping with the invention, to permit the passage of cooling fluid between the baffles and the inner wall surface of the roll body and to facilitate mixing of the fluid as it passes through the roll, the baffles are formed with a plurality of flutes **41** which extend radially outward along the end portion **34** of each baffle and then longitudinally along the baffle side portion **35**. The flutes **41** define a series of uninterrupted passages **42** about the outer surface of the baffle back and side portions. In addition, each flute **41** forms a supplement passageway **44** in the baffle side portion **35** between each of the primary passages **42**. In addition, the flutes **41** in the end portion **34** of the baffle create a recessed central area **45**.

The provision of the fluted cup-shaped baffles within the cooling roll has resulted in a significant and unexpected improvement in the efficiency of the cooling roll. Tests have found that the addition of such baffles into a conventional cooling roll, with no other changes being made to the system, resulted in a 60° web temperature drop rather than a 42° drop as observed with the former construction.

While the explanation for this phenomena is not completely understood, tests have indicated that the flow of the fluid through the roll is such as illustrated in FIG. 1. Referring to FIG. 1, cooling fluid enters the roll body from the inlet tube **20** (arrows **50***a*) and is forced out around the first baffle **30** so that the fluid is in maximum contact with the cylindrical wall of the roll body (arrows **50***b*). The passages **42, 44** defined by the baffle flutes **41** permit the fluid to flow between the inner surface of the roll body and the outer baffle surface. At the same time, since the roll **11** is rotating, the flutes **41** create a sufficient resistance as to impart a lateral movement in the fluid in the direction of rotation so that the fluid in effect has a helical flow pattern (arrows **50***c*). In addition, as the fluid passes the outermost edge of the baffle **30**, it has been found that it then tends to flow toward the center of the roll body in a tightening helical manner (arrows **50***c*) and towards the central recessed area **45** of the next downstream baffle. The flow of the fluid into the recessed area **45** creates a counterflow or back turbulence which thoroughly mixes the fluid (arrows **50***d*). The fluid will then continue its flow past the next baffle. Thus, it will be seen that the fluid is thoroughly mixed as it passes through the roll so that a hot relatively inactive layer of fluid cannot build up along the inner wall of the cylinder.

Moreover, it has been found that when operation of the cooling roll is begun and fluid is introduced into the roll, since the baffles **30** tend to distribute the fluid to the cylinder wall of the roll body as it passes the baffles, air within the roll tends to accumulate in the center of the cylinder. This air will bleed out through the center holes **40** of the baffles **30** and exit through the outlet tube **21** until the cylinder is nearly completely filled with fluid. The fluid, however, still has the same turbulent flow pattern described above even when the cylinder is completely filled with fluid. Since such a relatively large volume of fluid may be contained within the roll and is thoroughly mixed as it passes through the roll a relatively steady flow of cool fluid is maintained in contact with the roll body walls for maximum cooling.

While the invention has been described with particular reference to a cooling roll it will be appreciated that the heat exchange roll may similarly be used as a heating roll by passing a hot fluid through the cylinder. It is also understood that although the inlet and outlet fluid tubes are disposed at opposite ends of the illustrated roll alternatively a counterflow roll could be used whereby the inlet and outlet are at the same end.

I claim:

1. A heat exchange roll for treating webs of sheet material comprising a hollow cylindrical roll body having an outer periphery, an inner surface and closed ends, means at the ends thereof for rotatably supporting said roll body, means at one end of said body defining a fluid inlet passageway, means at the other end of said body defining a fluid outlet passageway, a single series of axially spaced, substantially identical cup-shaped baffle members each having an end portion and outwardly tapered side portions mounted within the roll body, the outer edge of each baffle tapered side portion engaging said roll body inner surface, each said baffle side portion being formed with a plurality of circumferentially spaced flutes which define passageways for fluid flow between said baffle side portions and said inner body surface, said baffles being disposed with the open end of said cup directed downstream of the fluid so as to mix said fluid and repeatedly direct it against said inner surface as it passes through the length of said roll body.

2. A heat exchange roll for treating webs of sheet material comprising a hollow cylindrical roll body having an outer periphery, an inner surface and closed ends, means at the ends thereof for rotatably supporting said roll body, means at one end of said body defining a fluid inlet passageway, means at the other end of said body defining a fluid outlet passageway, a single series of axially spaced, substantially identical cup-shaped baffle members each having an end portion and outwardly tapered side portions mounted within the roll body, said end portion of each baffle being formed with a plurality of radially extending flutes and said side portion of each baffle being formed with a plurality of outwardly tapered longitudinal flutes, said baffles being disposed with the open end of said cup directed downstream of the fluid so as to mix said fluid and repeatedly direct it against said inner surface as it passes through the length of said roll body.

3. The heat exchange roll of claim **2** in which the end flutes of each baffle extend without interruption into said longitudinal side flutes to define uninterrupted passageways about the outer surface of said baffle.

4. The heat exchange roll of claim **3** in which the end flutes define an axially disposed internally recessed area in the end of each baffle.

5. The heat exchange roll of claim **1** including a rod extending axially the length of said roll body upon which said baffles are disposed, and means securing the baffles to said rod for maintaining said baffles in axially spaced relation.

6. The heat exchange roll of claim **5** in which said baffles each have a two-part construction, each said baffle part being a sector of said cup and being disposed on said tie rod in partially overlapping relation with the tie rod passing through an axially disposed aperture in each part.

7. The heat exchange roll of claim **1** in which the end portion of each baffle is formed with a plurality of radially extending flutes, said end flutes extending without interruption into said side flutes to define uninterrupted passages about the outer surface of said baffle, a rod extending axially the length of said roll body upon which said baffles are disposed and means securing said baffles to said rod for maintaining their axially spaced relation.

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