ADJUSTABLE ROLL MOUNTING APPARATUS

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6 Claims

ABSTRACT OF THE DISCLOSURE

A coating machine having a frame and a pair of rolls that are rotatable about parallel axes and that are spaced apart to define a gap, one of the rolls being supported at its ends by the machine frame while the other roll is supported at each end by a corresponding beam unit arm that is directly or indirectly anchored at one end to the machine frame. An actuating mechanism is connected to the other end of each arm to effect predetermined bending in some where by to adjustably vary and set the size of the gap, as desired.

BACKGROUND OF THE INVENTION

This invention relates to a machine that utilizes a pair of rolls which are rotatable about parallel axes and which are spaced apart to define a gap, and, more particularly, to improved apparatus for mounting one of the rolls in a manner to permit accurate and positive adjustment of the position of such roll relative to the other roll so as to readily vary the size of the gap, as required.

This invention is adapted to be advantageously employed in various environments including coating machines, laminating machines and other types of machines in which a gap between a pair of rotatable rolls must be readily and positively adjusted and maintained within the design limits of the machine. The invention is especially useful in web coating machines and, for this reason, the ensuing discussion and the embodiments of the invention disclosed herein are directed to web coating machines, by way of example.

In certain known types of coating machines that are used to apply a coating composition to a moving web of a flexible material, such as paper, plastic, fabric or the like, the thickness or weight of the applied coating is determined by the size of the gap opening between two rotating rolls. In order to maintain uniformity of coating thickness within acceptable tolerances both in the direction of web travel and across the web, it is necessary that the gap between the rolls remain substantially constant. However, due to unavoidable changes in operating conditions, such as temperature changes, coating viscosity changes, web speed variations and the like, it is essential that suitable means be provided to permit adjustments of the gap size during the coating operation in order to obtain a constant and uniform coating thickness.

In some instances these adjustments are automatically made by beta gauge control or other types of monitoring devices known to the art.

The precision required in the roll gap setting will be appreciated by noting that a 0.0001 inch variation in a roll gap setting of 0.002 inch may result in approximately 5% variation in applied coating weight. It is possible at present to obtain coating rolls ground to a concentricity of less than 0.0001 inch total indicated runout; and bearings for the rolls are available with eccentricities of outer to inner race of 0.000075 inch or less, thus providing means to attain required accuracy of the roll gap.

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In coating machines of the character indicated, one of the rolls is usually mounted for rotation in the machine frame about a fixed axis while the other roll is mounted for rotation by a means which allows movement toward and away from the first roll to vary the size of the gap, when required. The mounting means for the movable roll constitutes a critical part of the coating system. It has generally been the practice heretofore to provide mounting means including slides or pivot arms to support the movable roll. Such means have not been entirely satisfactory in operation due to the close tolerance requirements.

SUMMARY OF THE INVENTION

As will be apparent from the detailed description that follows, the roll mounting of the present invention affords a number of worthwhile advantages over conventional slidable or pivotal roll mountings. For one thing, the subject mounting is devoid of objectionable friction, which may cause binding or sticking, since requisite movement is attained by simple bending. Since there is no cocking of slides or shifting of pivots, the gap setting is reproducible after opening or reclosing the gap. Another advantage resides in the fact that the mounting does not require the expensive machining to close tolerances which is necessary in slide or pivot mountings. The present invention affords an important operational advantage for the reason that it permits the use of a low main frame, thereby allowing ready and convenient access to various parts for purposes of inspection, cleaning, repairs, replacement and the like, without disturbing other parts.

The primary object of this invention is to provide an improved and simplified movable roll mounting.

Another object of the invention is to provide movable roll mounting apparatus that is adapted to be readily adjusted by mere bending to desired position.

A further object of the invention is to provide a movable roll mounting unit that is less expensive and superior in performance as compared to known slidable or pivotal mounting constructions.

The invention has for a still further object the provision of apparatus of the character indicated that is simple in design; that is rugged and durable in construction; that is reasonable in manufacturing, installation and maintenance costs; and that is capable of performing its intended functions in an efficient and trouble-free manner.

The enumerated objects and advantages will be readily understood by persons trained in the art from the following detailed description and the accompanying drawings which respectively describe and illustrate two embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, wherein like reference numerals denote corresponding parts throughout the several views:

FIG. 1 is a view in side elevation of a portion of one type of coating machine that is equipped with one form of adjustable roll mounting apparatus according to this invention;

FIG. 2 is a view taken along line 2—2 of FIG. 1; and

FIG. 3 corresponds to FIG. 1 and illustrates a portion of another type of coating machine that is equipped with a modified form of adjustable roll mounting apparatus of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is first had to FIGS. 1 and 2 which illustrate the upper portion of a reverse roll coating machine em-
bodily the invention and including a rigid, upright, first side frame 5. The machine also includes a complementary second side frame (not shown) which is substantially symmetrical to the first side frame and is laterally spaced therefrom. Supported by the side frames and positioned in the vertically extended space between the side frames are a removable pan 6 for containing a supply of a web-coating liquid composition and a total of four horizontal rolls, namely a furnish roll 7, a casting roll 8, a metering roll 9 and a backing roll 10. Essentially, counter parts of all of the remaining devices and elements shown in FIG. 1 are carried by the second side frame. Accordingly, the ensuing identification and description of such devices and elements appearing in FIG. 1 apply to corresponding like devices and elements (not shown) which are carried by the second side frame.

Furnish roll 7 is equipped at its ends with coaxial stub shafts 11, each of which is journaled for rotation in a sleeve bearing 12 that is carried in the upper part of a corresponding lever 13 which is rockable relative to its side frame about a pivot pin 14. As is indicated in FIG. 1, the lower portion of roll 7 is positioned in pan 6 and projects below the web-treating composition level which is normally maintained in the pan when the machine is in active service. Levers 13 are adapted to be actuated about their pivots by suitable known means (not shown) to adjustably vary the gap 15 between rolls 7 and 8, as required by particular conditions of use.

Backing roll 10 is provided with a cover 16 of natural or synthetic rubber or other suitable material which is generally used on this type of roll. Roll 10 is provided at its ends with coaxial stub shafts 17, each of which is journaled for rotation in a sleeve bearing 18 that is carried in the upper part of a corresponding lever 19 which is rockable relative to its side frame about a pivot pin 20. Levers 20, as in the case of levers 13, are adapted to be actuated about their pivots by suitable known means (not shown), as required by conditions of use.

A lower bearing block 22 is mounted on and secured to each side frame by bolts 23. These bearing blocks are disposed in parallel relationship and carry coaxial sleeve bearings 24.

Casting roll 8 is equipped with coaxial stub shafts 25 having end portions 26 of reduced diameter which are journaled in corresponding sleeve bearings 24. Roll 9 is preferably the same in size and configuration as casting roll 8. This roll is also equipped with coaxial stub shafts 27 having end portions 28 of reduced diameter. Each shaft end portion 28 is journaled for rotation in a sleeve bearing 30 that is carried by a corresponding upper bearing block 31.

The several rolls 7, 8, 9 and 10 are rotatable about parallel axes, their directions of rotation, when in active service, being indicated by the corresponding arrows in FIG. 1. Casting roll 8 and metering roll 9 are preferably made of chilled cast iron and are accurately ground to obtain maximum concentricity of roll face to journal.

It will be appreciated that various other types of bearings, such as ball bearings, roller bearings or tapered roller bearings, may be used in lieu of the illustrated sleeve bearings 12, 18, 24 and 30. It is important that the bearings for the casting and metering rolls be of high precision with minimum radial runout. The order of precision required of the furnish and backing rolls is not as critical as for the casting and metering rolls.

Each upper bearing block 31 is supported by and is maintained in adjustable spaced relation to a corresponding lower bearing block 22 by a U-shaped beam unit 32 which will now be described having reference to FIG. 1. Each unit 32 comprises a lower arm 33, which registers with a recess in the top of block 22 and is secured thereon. The upper arm 35, an upper arm of block 33, which registers with a recess in the bottom of block 31 and is secured thereto by bolts 36; and a spacing block 37, which is positioned between the left ends of the arms and is secured thereto by bolts 38. Block 37 is provided with bottom and top recesses to accommodate end portions of arms 33 and 35, respectively. The web or upper arm 35 extends to the right (FIG. 1) beyond lower bearing block 22 and arm 33 and is provided with a depending ear 40. Arms 33 and 35 are preferably made of a commercial grade of flat steel stock that is rectangular in cross section.

Units 32 are so configured and dimensioned that the weight of metering roll 9 and web rolls 30 and blocks 31, will cause arms 33 and 35 to bend to the extent that the size of gap 41 between rolls 8 and 9 (FIG. 2) is normally slightly greater than the maximum required in operation, for example 0.050" in a typical reverse roll coating machine. As is shown in FIG. 2, the cross sectional area of lower arm 33 is preferably greater than that of upper arm 35 whereby essentially all of the bending occurs in the upper arm.

The gap 41 between rolls 8 and 9 may be readily reduced, as required, by a pair of mechanisms 42, each of which is carried by a machine side frame and is operatively connected to a corresponding beam unit arm 35.

As is illustrated in FIG. 1, each mechanism 42 comprises a fluid power unit which includes a generally upright cylinder 43, a piston (not shown) within the cylinder and a piston rod 44 which is connected to the cylinder and extends through and beyond the upper end of the cylinder. Cylinder 43 has a depending ear which forms a pivotal connection with side frame 5 through the medium of a pin 46. A bell crank 47 is pivotally connected intermediate its ends to the side frame by a pin 48. One end of the bell crank is pivotally connected at 50 to piston rod 44. The other end of the bell crank is pivotally connected at 51 to the lower end of a link 52. The upper end of the link is pivotally connected to ear 40, as indicated at 53.

It will be evident from an examination of FIG. 1 that actuation of the piston in cylinder 43 in an upward direction, through its interconnection with piston rod 44, bell crank 47 and link 52, will cause corresponding downward movement of ear 40 and further bending of beam arm 35 and thereby decrease in the size of gap 41. Upon release of fluid pressure in the cylinder, the beam arms will return to their normal position and increase the size of gap 41.

The size of gap 41, within its design limits, is adjustable by a pair of means which will now be described. Each such means includes a U-shaped bracket that is secured to the top of arm 33 by bolts (not shown) and a pin 54 and a pair of arms 55 and 56. A wedge member 57, having an upper surface that is inclined to its lower surface and a through tap, is positioned between arms 55 and 56 and slideable along web 54. An elongated screw 58 is supported for rotation in aligned through openings in spacing block 37 and bracket arms 55 and 56.

Screw 58 also extends through and threadedly engages the tap in wedge member 57. The screw is provided with a first thrust collar 60 adjacent the inner face of bracket arm 55 and a second thrust collar 61 adjacent the inner face of bracket arm 56. These collars prevent axial movement of screw 58 while permitting rotational movement thereof. Screw 58 is equipped at its outer end with a handwheel 62 for manual turning in either direction, as desired.

Affixed to the under side of beam arm 35 is a contact block 63 having an accurate bottom face that bears against the inclined upper surface of wedge member 57. This block cooperates with the wedge member to positively set the size of gap 41. The gap size may be readily adjusted by turning handwheel 62, thereby moving wedge member 57 to the right or to the left, depending on the direction of rotation of the handwheel. Such movement of the wedge member permits corresponding bending of beam arm 35 and changes in the size of gap 41.
In this form of the invention, a web 76 of flexible material bears against the upper portion of roll 68 and is advanced in the direction indicated by the arrow.

In operation, rolls 67 and 68 are driven in opposite directions, roll 67 rotating in a counter-clockwise direction and roll 68 rotating in a clockwise direction. Coating material in pan 6 is picked up by furnish roll 67 and carried to a metering gap (corresponding to gap 41) between the rolls. The desired amount of coating material passes through this gap and is applied by roll 68 to the under surface of moving web 75. Excess coating material is returned to the pan by gravity.

Based on the foregoing, it is believed that the construction, operation, objects and advantages of the present invention will be readily comprehended by persons skilled in the art, without further description. It is to be clearly understood, however, that various changes in the constructions described above and illustrated in the drawings may be made without departing from the scope of the invention, it being intended that all matter contained in the description or shown in the drawings shall be interpreted as illustrative only and not in a limiting sense.

What is claimed is:

1. A machine for coating a moving web of flexible material comprising:
   (a) support means;
   (b) a roll coated by the support means and rotatable about a fixed first axis;
   (c) roll coating means carried by the support means and associated with the first roll, said roll coating means comprising a receptacle for containing a supply of a liquid coating material and being adapted to effect deposition of the coating material on the peripheral surface of the first roll upon rotation thereof about said first axis;
   (d) a beam unit secured to the support means;
   (e) a second roll carried by the beam unit and rotatable about a second axis which is substantially parallel to the first axis; and
   (f) a mechanism connected to the beam unit for effecting bending thereof and corresponding bodily movement of the second roll relative to the first roll, said rolls being spaced apart to define a gap and said movement of the second roll relative to the first roll correspondingly varying the size of the gap.

2. A machine according to claim 1 including:
   (a) adjustable means for limiting the size of the gap within a predetermined range.

3. A machine for coating a moving web of flexible material comprising:
   (a) support means;
   (b) a first roll carried by the support means and rotatable about a fixed first axis;
   (c) roll coating means carried by the support means and associated with the first roll, said roll coating means comprising a receptacle for containing a supply of a liquid coating material and being adapted to effect deposition of the coating material on the peripheral surface of the first roll upon rotation thereof about said first axis;
   (d) a pair of spaced beam units secured to the support means;
   (e) a second roll carried by and between the beam units and rotatable about an axis which is substantially parallel to the first axis; and
   (f) actuating means connected to the beam units for effecting simultaneous bending thereof and corresponding bodily movement of the second roll relative to the first roll, said axes remaining substantially parallel during such movement of the second roll; said rolls being spaced apart to define a gap and said movement of the second roll relative to the first roll correspondingly varying the size of the gap.
4. A machine according to claim 3 including:
   (a) adjustable means for limiting the size of the gap
       within a predetermined range.

5. A machine according to claim 3 wherein each beam
   unit is generally U-shaped and comprises:
   (a) a pair of spaced arms, one of the arms being
       anchored to the support means, the other arm carry-
       ing an end of the second roll and being connected
       at its free end to the actuating means.

6. A machine according to claim 3 wherein each beam
   unit comprises:
   (a) an arm which is anchored at one end to the sup-
       port means and connected at its other end to the
       actuating means, said arm carrying an end of the
       second roll.

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