Sept. 20, 1971 A. G. RUSSELL 3,605,687

ADJUSTABLE ROLL MOUNTING APPARATUS

Filed Oct. 7, 1968 2 Sheets-Sheet 1

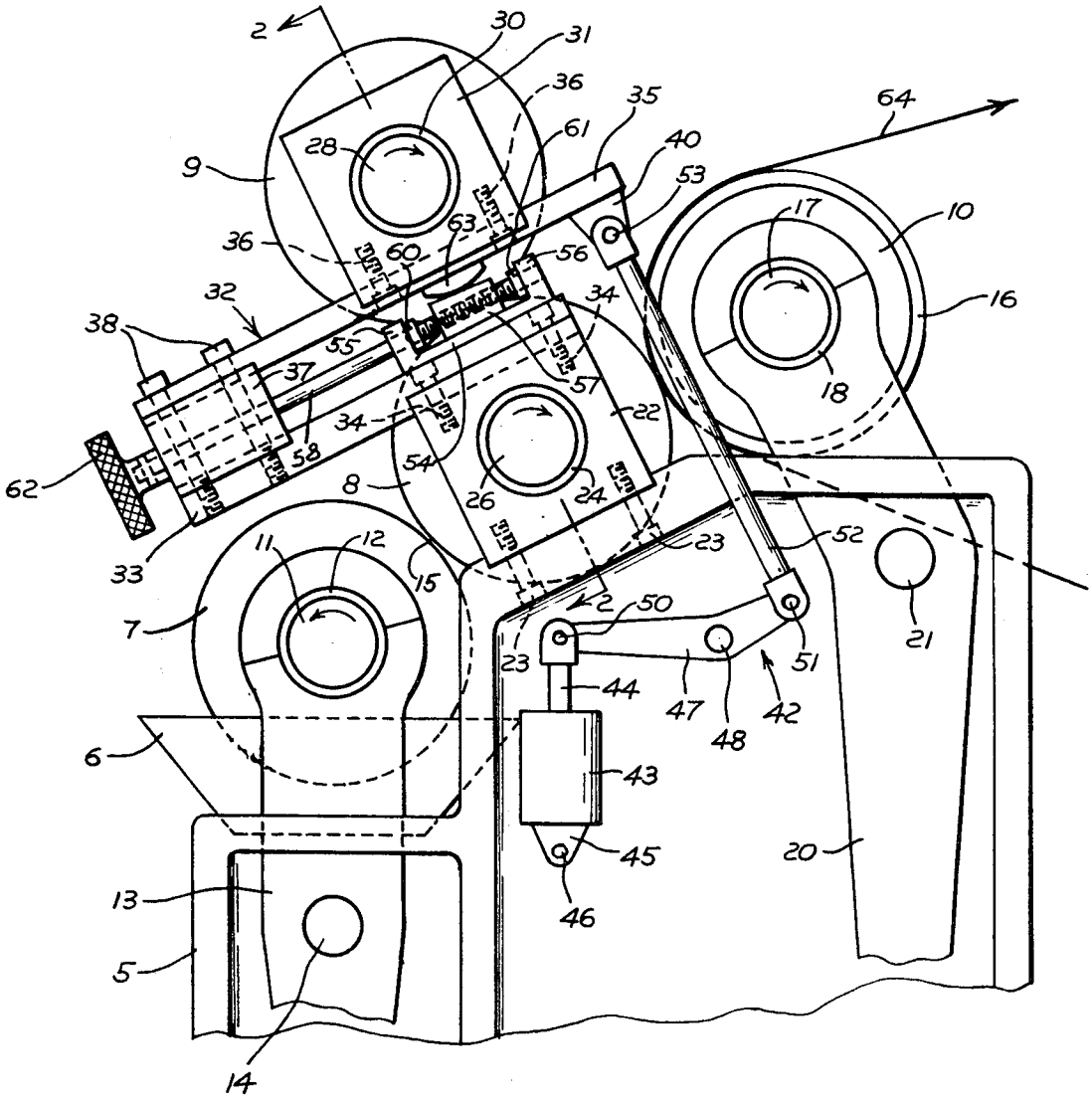



FIG. 1

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# ADJUSTABLE ROLL MOUNTING APPARATUS

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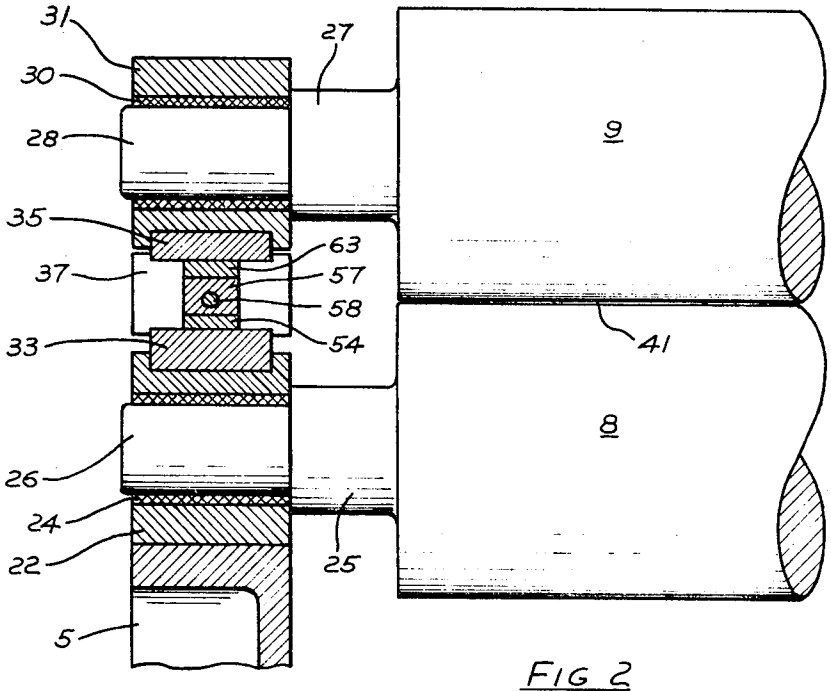



FIG 2

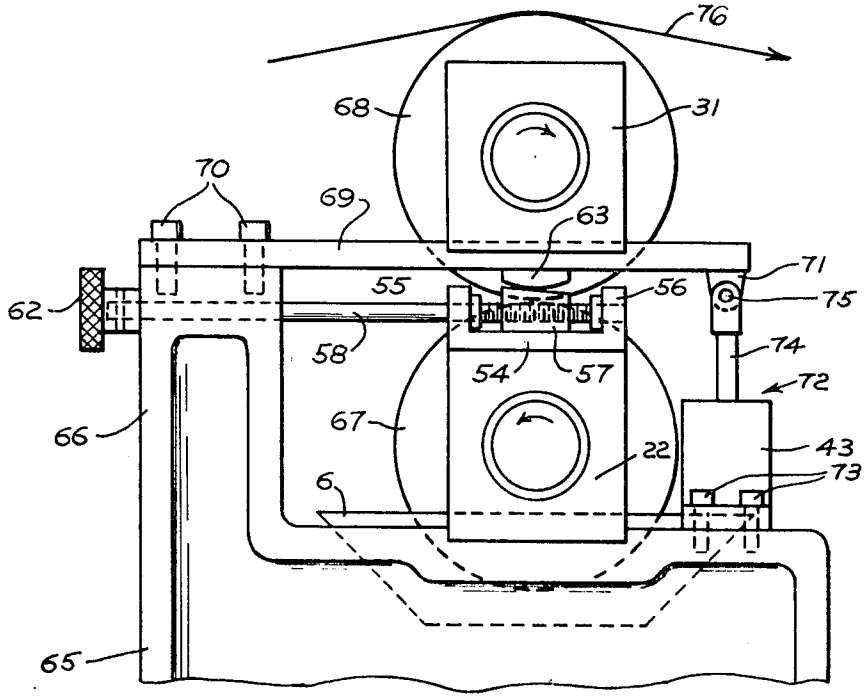



FIG 3

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3,605,687

# ADJUSTABLE ROLL MOUNTING APPARATUS

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## 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 thereof whereby 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.



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-

bodying 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 symmetrical counterparts 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 journalled 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 journalled for rotation in a sleeve bearing **18** that is carried in the upper part of a corresponding lever **20** which is rockable relative to its side frame about a pivot pin **21**. 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 journalled in corresponding sleeve bearings **24**.

Metering 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 journalled 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 thereto by bolts **34**; an upper arm **35**, 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 free end of 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**, bearing sleeves **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 .030" 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 piston 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 adjustably controlled 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 that consists of a web **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 slidable 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 arcuate 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**.

A web **64** of a flexible material, which is to be coated by the illustrated machine, is led under backing roll **10**, through the nip between the backing roll and casting roll **8**, over the top of the backing roll and thence to a dryer or other processing equipment (not shown).

For the purpose of outlining the operation of the embodiment of the invention shown in FIGS. 1 and 2, it is assumed that the parts are in the relative position shown in these views and that pan **6** contains a supply of a liquid coating composition. It is also assumed that the several rolls are being driven by suitable means (not shown) for rotation in the directions indicated by the corresponding arrows, casting roll **8**, metering roll **9** and backing roll **10** rotating in a clockwise direction. Furnish roll **7** rotating in a counter-clockwise direction. Furnish roll **7** picks up coating material contained in pan **6** and transfers an excess of the material to casting roll **8** which in turn transfers the material through the gap **41** between the casting and metering rolls. The material remaining on the periphery of the casting roll, after passing the gap, is deposited on web **64** in the nip between the casting roll and the backing roll. It will be evident that the amount or thickness of the coating that is deposited on the web is determined by the size of gap **41**. Excess coating material which is applied to the casting roll by the furnish roll is returned to pan **6** by appropriate means (not shown).

The amount or thickness of the coating deposited on the web may be readily varied, as required, by adjusting the size of gap **41** in the manner earlier described.

It will be evident that movement of metering roll **9** toward or away from casting roll **8** for the purpose of adjusting the size of gap **41** is devoid of critical parts having sliding or rotary movement such as those of the prior art. Moreover, the design of the linkage arrangement of mechanism **42** is not critical to the operation, it being only necessary to provide an adequate force to effect requisite bending of the beam unit arms to maintain contact block **63** in engagement with wedge member **57**. Nor is such force critical. This force should be at least sufficient to bend the beam unit arms and to prevent lifting of the metering roll due to hydraulic forces created in the roll gap. Any excess force will have no effect on the roll gap. By reversing the action of the fluid cylinders, it is possible to bend the beams in a reverse direction in order to obtain a relatively wide gap between the rolls for cleaning or other purposes.

Referring now to FIG. 3, the modification of the invention illustrated therein is the same in a number of respects as that shown in FIGS. 1 and 2. This modification is embodied in a two roll kiss coating machine which includes a pair of laterally spaced, symmetrical side frames. Illustrated side frame **65** has an integral upwardly projecting extension **66**. The machine is equipped with only two rolls, namely a furnish roll **67** and an applicator roll **68** which are preferably the same as earlier-described casting roll **8** and metering roll **9**, respectively.

Each upper bearing block **31** of the modification is supported in adjustable spaced relation to a corresponding lower bearing block **22** by a beam unit consisting of a single arm **69** which is anchored at one end to side frame extension **66** by bolts **70**. Arm **69** corresponds to arm **35** of FIG. 1 and is in the nature of a cantilever beam. This arm carries a depending ear **71** at its free end.

As in the case of the embodiment of the invention of FIGS. 1 and 2, the modification includes a pair of mechanisms **72** for decreasing the gap between rolls **67** and **68**, as required. Each mechanism **72** comprises a hydraulic power unit including a cylinder **43** which is rigidly secured to its side frame by bolts **73** and a piston rod **74** which is pivotally connected to ear **71**, as indicated at **75**. It will be observed that mechanism **72** is simpler and less expensive than mechanism **42** for the reason that it is devoid of the bell crank **47** and link **52** which are essential elements of mechanism **42**.



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 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 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 carrying 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 support means and connected at its other end to the actuating means, said arm carrying an end of the second roll.



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U.S. Cl. X.R.

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