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COATING APPARATUS FOR COATING WEBS

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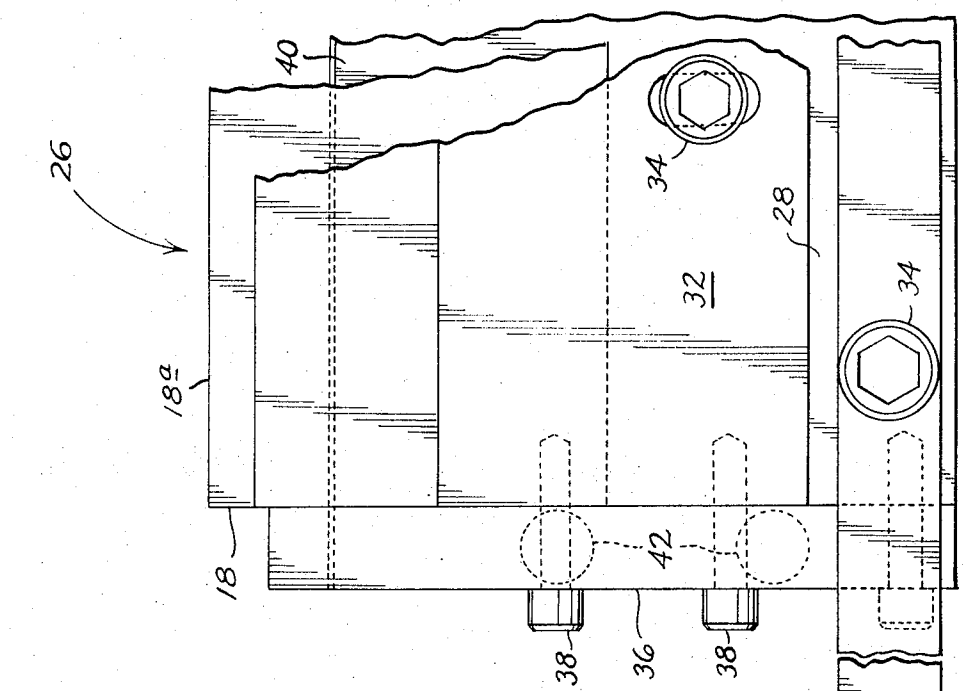


Fig. 3.

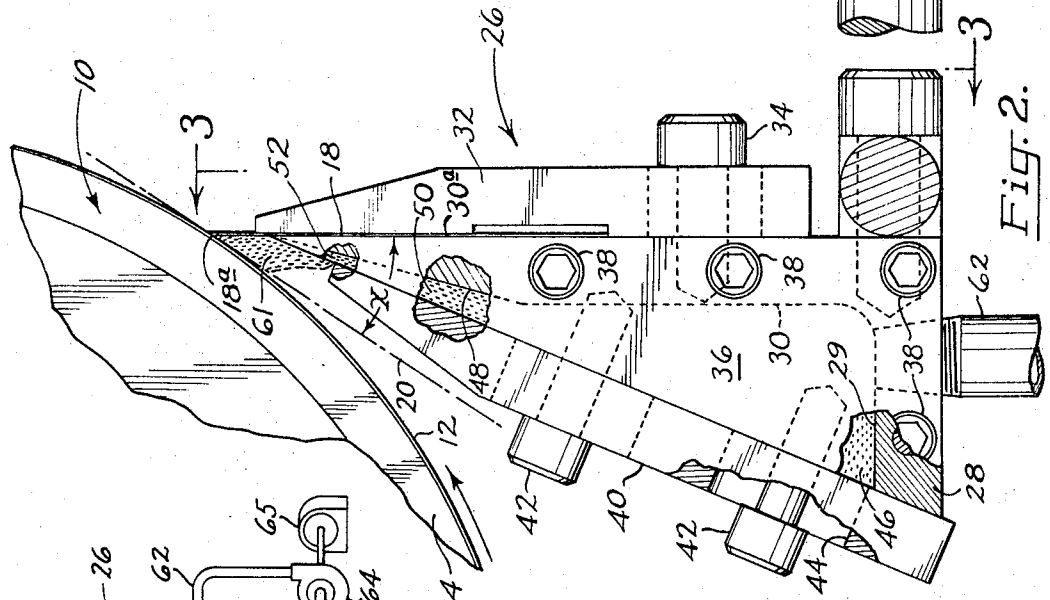


Fig. 2.

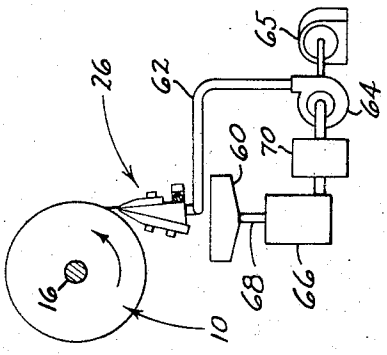


Fig. 1.

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COATING APPARATUS FOR COATING WEBS

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This invention relates to coating apparatus, for applying a coating to an elongated web of material, such as paper and the like. The apparatus makes possible the practicing of a unique and improved method for applying a coating composition to a web of material.

The coating of webs, such as paper, paperboard, woven and nonwoven fabrics, etc., has been carried out in the past employing a variety of different mechanisms and procedures. One form of coater which has been relatively widely used comprises a roll or other backup device, which supports the web as the same travels through the apparatus, and a knife or blade mounted with its working edge pressed against the web where the web passes over the roll. The knife functions to spread the coating composition applied to the web, and at the same time meter the material, whereby a uniform film results. With coaters of this general type, coating compositions in the past generally have been applied by applying them to the moving web, using a "kiss" or applicator roll. Coating compositions which may be applied with such a coater comprise the usual pigmented, water-borne coatings, as well as other coatings including "clear" or solvent-type coatings.

A general object of this invention is to provide improved coating apparatus, for coating webs of material, featuring a knife or blade, and novel means for supplying a coating composition into a region acted upon by the knife, whereby superior coatings may be produced.

More specifically, this invention contemplates, as an object of the invention, the provision in a coater of a blade and extrusion means, for extruding a coating composition into a region directly behind the blade, adjacent where the working edge of the blade defines a nip in the coater, with the action of the moving web and knife being operable to produce a smooth coating from the extruded material.

In a specific embodiment of the invention, a backup roll is provided in the coater, preferably one with a resilient covering, and an inverted blade or knife is mounted in the coater beside the backup roll, with its working edge and the surface of the roll defining a nip in the coater. The blade defines an acute angle on the feed side of the nip with respect to a plane passing tangentially of the surface of the roll at the nip. An extrusion device is mounted in the coater, in a position where it is operable to extrude a ribbon of coating material continuously onto the blade, adjacent its working edge and the nip defined thereby. The coating material on being deposited on the blade is displaced upwardly along the blade and into the nip by the coating material being continuously extruded from the extrusion device. As the backup roll is rotated, and the web advanced through the nip, the coating material which fills the nip is spread out in a smooth film on the web being treated. Ordinarily enough coating material is extruded so as to produce an excess of coating material at the nip, and the excess material is troweled off by the blade during the coating operation, then to be caught in a pan or other container, whence the material may be recirculated to the extrusion device.

With apparatus of the type described a number of advantages are realized. For one thing, the amount of time the coating material is on the web or sheet prior to being spread and troweled off by the blade, and thus the amount of time allowed for the coating material to penetrate the sheet, is considerably less with apparatus according to the invention than with conventional structures. This results in a low "soak time," i.e., the time that the coating material has to soak into the web being processed before being smoothed in a film. Because of this low soak time, using the apparatus of the invention, less coating material is needed to cover a given area. Further, with many coating materials or compositions, better coatings result.

More specifically, when coating webs with conventional type coaters, where a "kiss" or applicator roll applies the coating material onto the moving web, and using ordinary water-buoyant coatings, it has been observed that a coating material becomes higher in solids after a period of time. This means that where relatively long soak times are present, the water portion of a coating composition, and water soluble or dispersible materials migrate into the moving web at a more rapid rate than pigment and other constituents in the coating composition applied to the web. This results in an imbalance in the proportions of the various constituents at different regions in the coating. The same action is also possible in unpigmented water-borne coatings, and in solvent systems.

The apparatus contemplated enables coating materials or compositions to be used that could not be effectively handled with conventional structures because of their flow or other rheological properties.

Where an inverted blade in the coater is employed, using the extrusion device of the invention to supply coating material enables the blade to be located at any of multiple points along the backing roll's circumference, with the blade still operating properly. This is to be compared to a system, for example, where an applicator roll is provided to apply coating material. With such apparatus, often major modifications are required if the blade is to be placed at certain locations.

When coating material is extruded into the nip region, as contemplated herein, control over the rate at which the coating material is supplied is greatly facilitated. The doctor blade and the means for supplying coating material thereinto are relatively closely coupled in comparison to conventional coaters. Should a break occur in the web being processed, it is only necessary to turn off the supply to the extrusion device to clear the nip of coating material. Clean up is relatively easy. In coaters having an applicator roll or another system for supplying coating material, such as a reservoir holding a pool of material in contact with the web, a break in the web may result in a substantial shut-down time and an extensive clean-up operation.

With apparatus of the invention, where an extrusion device supplies coating material to the nip region, and the amount supplied is only slightly in excess of that used, it has also been found that streaking and other imperfections in the coated web, because of the trapping of foreign particles at the nip in the coater, are minimized. With many blade-type coaters, a reservoir containing a pool of the coating material to be applied is provided adjacent the backup roll, and the web to be coated passes through this pool on traveling to the blade. Foreign particles carried in both the coating material and the web being treated tend to collect and become more concentrated in this pool of coating material, and thence tend to be trapped or otherwise lodged in the nip region of the coater. With the extrusion supply system of the invention, any foreign particles present either on the web being processed or in the coating material, tend to be drawn quickly and directly past the blade and the nip defined thereby with the result that smooth, superior coatings are produceable.

Thus, another object is to provide novel means for applying coating material, which includes an inverted blade defining a nip region and means for supplying the

coating material, the latter means accommodating close control over the flow of coating material during the spreading thereof.

A further object is to provide a novel extrusion device for extruding coating material into the nip region of a blade-type coater. The device contemplated according to a preferred embodiment is readily adjusted to change the extrusion rate thereof.

Another object of the invention, is to provide novel means for applying coating material, characterized by a minimum of soak time, which features the extrusion of coating material onto an inverted blade, with such material working up the blade and into the nip region defined by the working edge of the blade where the same is finally applied as a film.

With the apparatus of the invention, coating compositions may be kept covered from the atmosphere until immediately prior to application to the web being processed. This inhibits tendencies for the compositions to dry, or form skins, as has been noted in some devices. Because the system is closed until the composition is delivered to the blade, the possibility of air being entrained in the compositions is reduced. Further, it has been noted that turbulence problems, as experienced in some blade-type coaters, appear to be eliminated.

These and other objects and advantages are attained by the invention, and the same is described hereinbelow in conjunction with the accompanying drawing, wherein:

FIG. 1 is a side elevational view of portions of an inverted blade-type coater, which includes an extrusion device as contemplated herein for supplying coating material, the figure also showing schematically means for feeding coating material to the extrusion device;

FIG. 2 illustrates, on a somewhat enlarged scale, the extrusion device and region around the nip defined by the blade, in the coater shown in FIG. 1, and

FIG. 3 is a view taken along the lines 3—3 in FIG. 2.

Referring now to the drawing, **10** indicates an elongated web-supporting backup roll in the coater, which functions to support a web, such as paper web **12**, while the same has a coating composition applied thereto. The backup roll preferably includes a resilient covering **14** (see FIG. 2) extending about the perimeter thereof, made of rubber or other elastomer. The outer surface of covering **14** constitutes a convex backing surface which contacts the web being supported. The roll in operation ordinarily is rotated under power, in the direction indicated by the arrow in FIG. 1, through power-driven shaft **16** projecting from the ends of the roll, said shaft being supported in the coater on a suitable frame (not shown).

A flexible blade or knife **18** is provided in the coater which is mounted beside the periphery of roll **10**. The blade, during the coating operation, spreads coating material over one face of the web being processed, under the action of working edge **18***a* of the blade which resiliently presses against the outer face of the web. Working edge **18***a* and the periphery of roll **10** define a nip in the coater, and web **12** passes through this nip to have coating material spread thereover.

Blade **18** comprises what is known as an "inverted blade." The term inverted blade as used herein refers to a blade mounted so that its working edge faces upwardly and the body of the blade inclines downwardly from the working edge, which relationship is the usual relationship intended to be conveyed by those skilled in the art when reference is made to an inverted blade. Blade **18** has its working edge **18***a* facing upwardly and the remainder of the blade inclines downwardly from the working edge as so specified. The blade in a longitudinal direction extends substantially parallel to the axis of roll **10**. In a transverse direction and on the feed side of the nip, the blade defines an acute angle (shown at X) with respect to a plane such as plane **20** which passes tangentially of roll **10** at the nip.

Structure indicated generally at **26**, spaced radially outwardly from roll **10**, supports blade **18** in its position beside roll **10**, and also includes means for extruding a coating composition into the nip defined by the blade during the operation of the coater.

More specifically, structure **26**, also referred to herein as an extrusion device, comprises an elongated element **28**, including walls **29** and **30** which are joined together and define a substantially L-shaped cross section for the element. Wall **30** constitutes a blade mounting portion, and blade **18** is mounted against wall **30** with one face of the blade against face **30***a* of the wall. Upper marginal portions of blade **18** including edge **18***a* project beyond the top of wall **30**. A plate **32**, detachably connected to wall **30** as by fasteners **34**, clamps blade **18** in place.

Fastened to the ends of element **28**, one to each end, are a pair of opposed end plates such as end plate **36**. These may be secured in place on element **28** with fasteners, such as fasteners **38**. A cover plate **40**, extending between the end plates at each end of element **28**, is fastened to the edges of end plates **36** by fasteners **42**. As can be seen in FIG. 2, fasteners **42** extend through slots **44** in the cover plate. Thus, on loosening the fasteners, the cover plate may be shifted up or down relative to element **28**.

Walls **29** and **30**, and cover plate **40**, define an elongated chamber **46** for holding a coating composition, such chamber being disposed on the opposite side of wall **30** and from face **30***a*. This chamber substantially parallels working edge **18***a* of blade **18**.

It will be noted in FIG. 2 that wall **30** is bounded by an inclined surface **48** along the top margin thereof. Further, plate **40** is supported by end plates **36** a slight distance away from surface **48**. The back side or face of cover plate **40**, and surface **48** together define, between the end plates, an elongated relatively narrow extrusion passage **50** communicating with chamber **46**. An extrusion opening **52** paralleling working edge **18***a* of the blade is defined adjacent the top margin of plate **40**, through which coating material is extruded as will hereinafter be described.

At opening **52**, surface **48** and the back face of cover plate **40** converge toward each other progressing in an upward direction in FIG. 2. They also slope toward the exposed upper marginal portion of blade **18**. Thus, coating composition material, on being extruded from chamber **46**, is directed by the opening upwardly and toward the protruding edge of the blade **18**. Any material lodged on the blade will be displaced by newly extruded material upwardly and along the blade into a region directly adjacent the nip defined by edge **18***a*.

Referring to FIG. 2, during operation of the apparatus, and as shown at **61**, sufficient coating material is maintained on the blade and in the region directly adjacent, to more than fill the nip, i.e., a slight excess is present. Normally, excess material is continually troweled off by the blade, and such material may be caught below structure **26** in a suitable container, such as the pan shown in FIG. 1 at **60**. The coater may be operated without an excess of coating material applied at the nip, and when this is done all the coating material issuing from opening **52** is troweled onto the web.

Coating material is supplied to the extruder device or means described through a conduit **62**. Material is pumped up through the conduit by a pump, preferably a variable speed positive displacement pump, such as that shown schematically at **64**, driven by motor **65**. A reservoir or tank for holding a supply of coating material is indicated at **70**. Excess material which falls away from the blade and is caught in pan **60** is returned to the reservoir, through a conduit **68**. A filter for filtering foreign particles from the coating material may be provided, to minimize streaking tendencies. Such a filter is indicated at **66**. The filter is ahead of the supply tank, to inhibit

contamination of the contents in the tank. Some operations may include a filter after pump **64**.

As mentioned earlier, cover plate **40** may be shifted up and down relative to element **28**, upon loosening fasteners **42**. Such shifting of the cover plate, also referred to herein as an adjustable part, has the effect of varying the width of extrusion opening **52**. On movement of the plate upwardly in FIG. 2, the opening is made narrower, and the ribbon of material extruded through the opening becomes narrower. On movement of the plate downwardly, the reverse is true.

From the above description, the operation of the coating apparatus should be obvious. Speaking in general terms, coating material held in reservoir **66** is pumped by the pump up into chamber **46** provided adjacent the backup roll. The material is maintained at a sufficient pressure whereby a ribbon of coating material is continuously extruded upwardly through extrusion opening **52**. This ribbon of material is directed upwardly toward upper protruding margins of the blade. As additional material is extruded, this displaces any material lodged on the blade, with such being caused to travel upwardly on the blade and into the region directly adjacent the nip. Here the material contacts the moving web which is being processed, and is spread by the blade in an even film over the expanse of this web. On the web advancing through the nip, coating material adhering to the web is withdrawn. Such coating material is always being replaced by newly extruded material.

Blade **18** together with structure **26** which supports the blade in its position beside roll **10** constitutes applicator means in the apparatus, with the blade part of this applicator means forming with the web on the roll an elongated pocket substantially paralleling the axis of the roll for receiving coating material to be applied to the web. This pocket is bounded along one longitudinally extending side by the body of the blade (the upper protruding margin of blade **18** in FIG. 2 bounds the pocket catching coating material along the side of the pocket which faces upwardly and to the right in FIG. 2). The pocket is open along a longitudinally extending side which faces the advancing web, or the side opposite the side bounded by the blade (the open side of the pocket in FIG. 2 is the side that faces toward the left or toward the advancing web).

Coating material travels over the blade to come into contact with the web being processed, and this contributes to a shorter soak time, than if the coating material were applied first to the web and then troweled off by the blade. A small rolling mass of material collects adjacent the nip on the feed side of the nip. The blade by lying at an acute angle relative to incoming untreated portions of the web, functions with such incoming web portions always to direct this rolling mass of material toward the nip of the blade.

According to the invention, as already noted, soak time of the web being processed is reduced to a minimum. A close coupled operation is contemplated, where the supply of coating material and actual application of the material to the web is carried out simultaneously. Clean up and control problems thus are simplified. The means for applying the coating material may be easily mounted at different points around the periphery of the backup roll, with little if any modification needed in the coated.

The extrusion device described features means defining a chamber for holding coating material, which is an integral part of the means that mounts the blade in place. The invention should not be limited in all cases to such a construction. An apertured pipe in the nip area, for instance, would produce extrusion of coating material although such a device would not be as flexible from an operating standpoint as the one described. It should be obvious also that other means of varying the dimensions of the extrusion orifice or orifices could be employed, than those specifically described herein.

While an embodiment of the invention has been described, obviously changes and variations are possible without departing from the invention. It is desired to cover all such modifications and variations as would be apparent to one skilled in the art, and that come within the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. Apparatus for applying a coating to a moving web comprising means for advancing the web including back-up means having a backing surface for supporting the upper face of the web as the same is advanced under the backing surface;

applicator means comprising blade mounting means and an inverted blade with the latter forming with the lower face of the web, where such web is supported on the back-up means, an elongated pocket extending transversely of the web for receiving coating material to be applied to the web, which pocket is open along a longitudinally extending side of the pocket facing the web as it advances into the pocket;

said blade including a blade body bounded along one margin by working edge, said blade being mounted on said blade mounting means with the blade body extending downwardly from said working edge and with the working edge disposed adjacent the backing surface and extending transversely of the web thereby to define a nip through which the web travels while being coated;

said applicator means further comprising extrusion means defining an elongated extrusion opening spaced a short distance below and substantially parallel to said working edge and in a position where material extruded through such opening is directed as an extruded ribbon upwardly against said blade body and said web, with such ribbon supported on one face only and such support being supplied by said blade body, said extrusion means further including means defining a chamber for coating material communicating with said extrusion opening, said applicator means being devoid of support for the opposite face of such extruded ribbon in a region extending from the extrusion opening to said backing surface; and

means for supplying coating material to said chamber.

2. Apparatus for applying a coating to a moving web comprising means for advancing the web including back-up means having a backing surface for supporting the upper face of the web as the same is advanced under the backing surface;

applicator means comprising blade mounting means and an inverted blade with the latter forming with the lower face of the web where such web is supported on the back-up means, an elongated pocket extending transversely of the web for receiving coating material to be applied to the web, which pocket is open along the longitudinally extending side of the pocket which faces the web as it advances it into the pocket;

said blade including a blade body bounded on one margin by a working edge, said blade being mounted on said mounting means with the blade body extending downwardly from said working edge and with the working edge thereof disposed adjacent the backing surface and extending transversely of the web thereby to define a nip through which the web travels while being coated;

said applicator means further comprising extrusion means including an elongated cover plate adjacent said blade mounting means forming with said mounting means a chamber for coating material located between the cover plate and blade mounting means, said cover plate having an upper edge closely adjacent the mounting means and said blade body, and said upper edge forming an elongated extrusion opening disposed a short distance below and substantially

parallel to the working edge in a position where material extruded through the opening is directed as an extruded ribbon upwardly against said blade body and said web with such ribbon supported on one face only and such support being supplied by said blade body; and

means for supplying coating material to said chamber.

3. Apparatus for applying coating to a moving web comprising an elongated substantially horizontal rotatable backing roll for supporting the web with the web advancing over the roll and traveling over the base and thence over an upwardly moving side portion of the roll;

applicator means comprising blade mounting means and an inverted blade with the latter forming with the web on the upwardly moving side of the roll where the web is supported on the roll an elongated pocket substantially paralleling the axis of the roll for receiving coating material to be applied to said web, which pocket is open along a longitudinally extending side of the pocket which faces the web as it advances into the pocket;

said blade including a blade body bounded along one margin by a working edge, said blade being mounted on said blade mounting means with the blade body extending downwardly from said working edge and with the working edge substantially paralleling the axis of the roll and disposed adjacent the surface of said roll to define a nip through which the web travels while being coated;

said applicator means further comprising extrusion means including an elongated cover plate adjacent

said blade mounting means forming with said mounting means a chamber for coating material located between the cover plate and blade mounting means, said cover plate having an upper edge closely adjacent the mounting means and said blade body, and said upper edge forming an elongated extrusion opening disposed a short distance below and substantially parallel to the working edge in a position where material extruded through said opening is directed as an extruded ribbon upwardly against said blade body and said web with such ribbon supported on one face only and such support being supplied by said blade body; and

means for supplying coating material to said chamber.

4. The apparatus of claim 3, wherein said blade is disposed at an acute angle relative to portions of the web advancing over the roll into said nip.

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