Aug. 31, 1965 R. H. COLWILL 3,203,393

APPARATUS FOR APPLYING STRIPES OF LOW VISCOSITY COATING MATERIAL

Filed Feb. 18, 1963 2 Sheets-Sheet 1

Fig. 1.

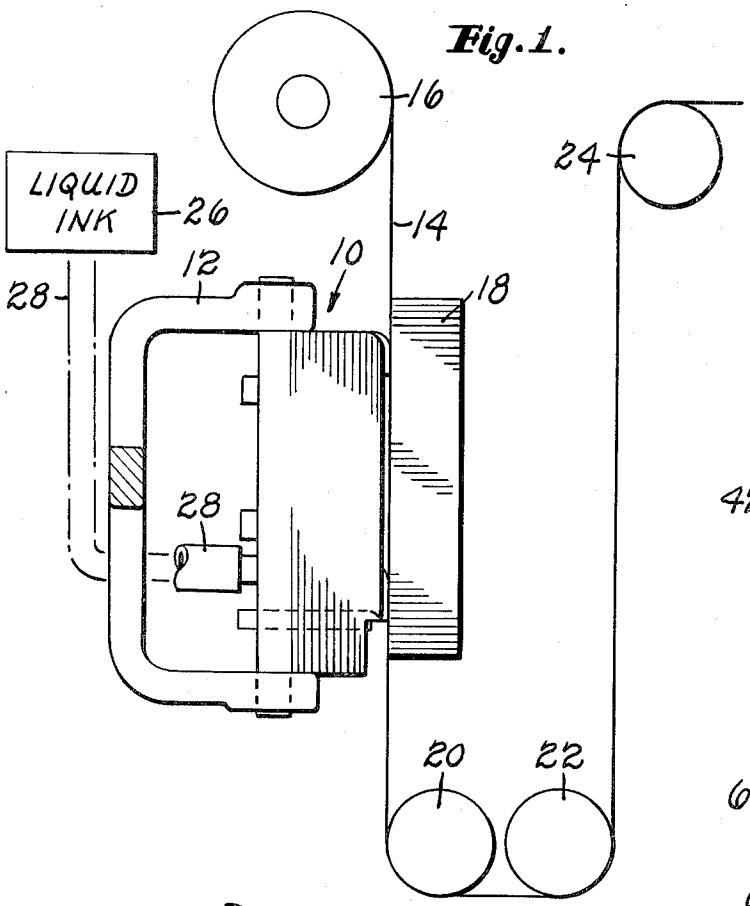


Fig. 3.

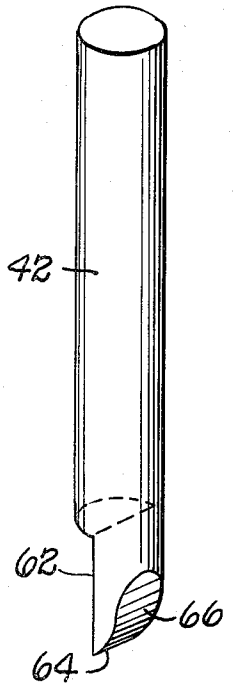
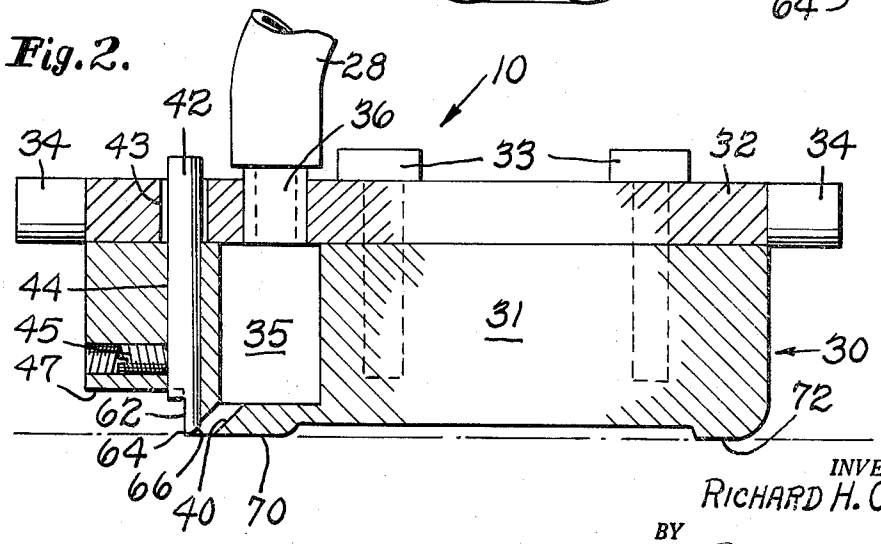


Fig. 2.



INVENTOR.
RICHARD H. COLWILL
BY
Benjamin F. Dessin
ATTORNEY

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APPARATUS FOR APPLYING STRIPES OF LOW VISCOSITY COATING MATERIAL

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Fig. 4.

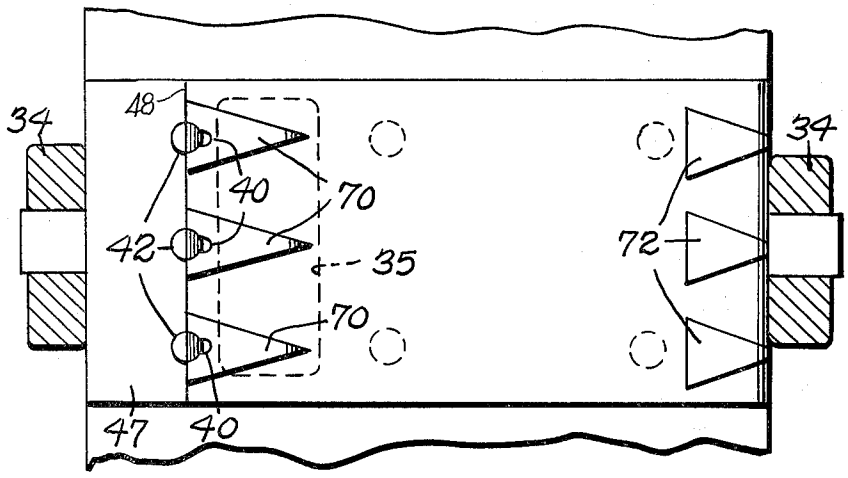


Fig. 5a. Fig. 5b. Fig. 5c. Fig. 5d.

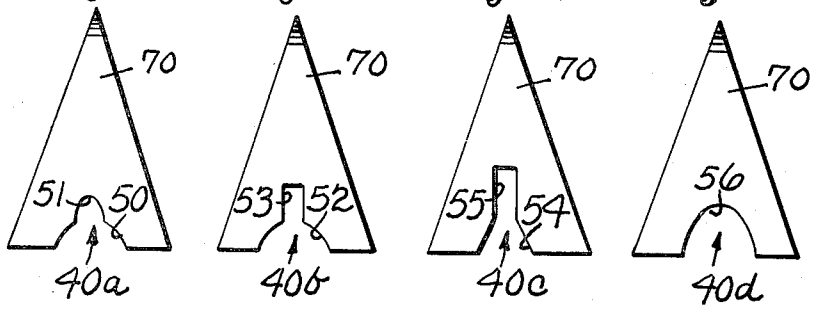
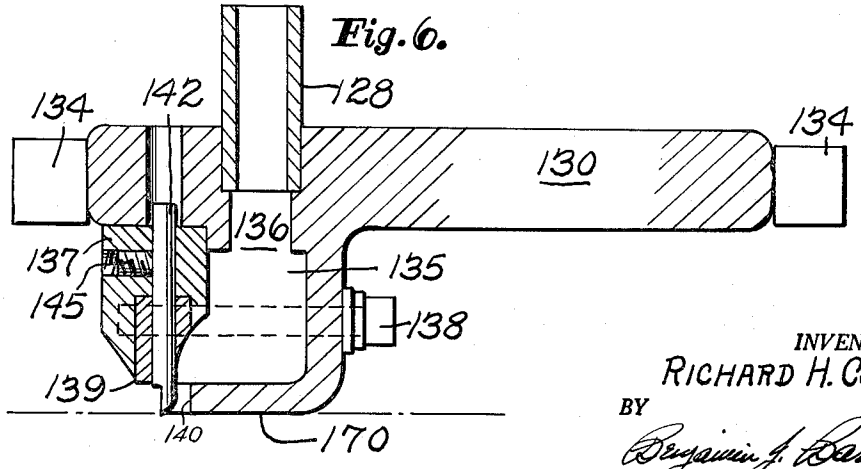


Fig. 6.



INVENTOR.
RICHARD H. COLWILL
BY
Benjamin F. Lovell
ATTORNEY

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3,203,393

APPARATUS FOR APPLYING STRIPES OF LOW VISCOSITY COATING MATERIAL

Richard H. Colwill, Victor, N.Y., assignor to Burroughs Corporation, Detroit, Mich., a corporation of Michigan

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13 Claims. (Cl. 118—412)

The present invention relates to apparatus for applying stripes of a liquid onto a web member. It is herein described for illustrative purposes with respect to apparatus for applying three spaced stripes of magnetic material on a paper web, the paper web serving as a record medium wherein the magnetic stripes are used for magnetically storing data read into and out of the paper web by a machine.

Paper webs or sheets carrying magnetic stripes have heretofore been used for purposes of storing data. Such magnetic stripes have been applied by several types of applicators. The previously used applicators, however, have generally suffered from a number of drawbacks, among which are: they are subject to wear for which it is difficult to compensate; they are difficult to adjust for different stripe thickness; they have a tendency to form ragged or unsharp edges and streaked surfaces particularly after experiencing some wear; and they are expensive to produce and maintain.

An object of the present invention is to provide an applicator which is particularly suitable, but not solely useful, for applying magnetic ink stripes and which produces improved results in one or more of the above respects.

A further object of the invention is to improved striping applicators for achieving stripes of uniform width, thickness, and texture in the application of liquids or fluids to moving webs.

In accordance with one aspect of the invention, there is provided an applicator for applying a stripe of a liquid material, supplied from a liquid source, onto a web member having relative movement in a predetermined direction with respect to a web-engaging surface of the applicator, the applicator comprising a body member formed with a passageway connected at one end to the source of liquid, the body member being further formed on the web-engaging surface with a striping orifice connected to the other end of the passageway; characterized in that the striping orifice is defined by at least first and second connecting cut-outs and is wider at the trailing edge than at the leading edge thereof with respect to the direction of relative movement of the web applicator.

In accordance with another aspect of the invention, an applicator as defined above is provided with a metering pin extending into one of said cut-outs and having a doctoring edge disposed in the striping orifice and defining the trailing edge of the orifice.

In accordance with a further aspect of the invention, an applicator is provided for applying a stripe of a liquid material, supplied from a liquid source, onto a web member having relative movement in a predetermined direction with respect to a web-engaging surface of the applicator, the applicator comprising a body member formed with a passageway therethrough connected at one end to the source of liquid; the body member being also formed on the web-engaging surface with a flat surface projecting from the body member and engageable with the web; the flat surface being wider at the trailing edge than at the leading edge thereof with respect to the direction of relative movement of the web and applicator; the body member further being formed in the middle of the trailing edge of the flat projecting surface with a striping orifice which also has a trailing edge wider than its leading edge.

These and other aspects of the invention will become apparent from the following description of several preferred embodiments thereof.

In the drawings:

FIG. 1 is a side elevational view of a simplified system including an applicator constructed in accordance with the invention for applying stripes of a liquid onto a web member;

FIG. 2 is a longitudinal sectional view through the applicator illustrated in FIG. 1;

FIG. 3 is a perspective view of a metering pin incorporated in the applicator;

FIG. 4 is a bottom plan view, with parts in section, of the applicator of FIG. 2;

FIGS. *5a–5d* are enlarged views of several configurations of inking orifices that may be used in the applicator;

FIG. 6 is a longitudinal sectional view through a modified applicator constructed in accordance with the present invention.

With reference to FIG. 1, the applicator, generally designated **10**, is supported by a bracket **12** adjacent to the path of movement of a paper web member **14** which is to be striped by the applicator. Paper web **14** is moved from a supply reel **16** to pass between the applicator **10** and a back mandrel **18**, around idler reels **20**, **22** and **24**, to a take-up reel (not shown). The applicator is supported by bracket **12** to press against the paper web with a moderate amount of pressure, merely enough to ensure contact with the paper without significantly loading the paper or binding it between the applicator **10** and the back mandrel **18**.

The liquid to be applied to the web member **14** is supplied from a liquid source **26** connected to the applicator by conduit **28**. The applicator of the present invention is particularly useful for applying magnetic ink stripes onto web member **14**, and therefore the liquid in source **26** would be a liquid magnetic ink. A preferred form of magnetic ink composition includes magnetic particles dispersed in an aqueous medium, such as disclosed in U.S. Patent No. 3,023,123.

As seen particularly in FIG. 2, the applicator **10** includes a body member **30**, such as of steel, comprising a main section **31** and a mounting plate **32** secured together by four tie bolts **33**. Mounting plate **32** carries a pair of end pins **34** welded thereto to which is attached the bracket **12** for mounting the applicator when in use. The body member is formed with a chamber or reservoir **35** connected by a passageway **36** extending through mounting plate **32** to the conduit **28**. The opposite surface of applicator **10**, i.e., the surface which engages the web **14**, is formed with a series of striping orifices **40** connected to the reservoir **35**. As shown in FIG. 4, three spaced, parallel inking orifices **40** are formed in the body member, so that the applicator will apply three spaced, parallel inked stripes on the paper web **14**. A metering pin **42** is disposed in each of the striping orifices **40** and controls the thickness of the ink stripe applied from its respective orifice. Each pin **42** passes through an opening **43** in mounting plate **32** (FIG. 2), and through an aligned opening **44** in the main section **31** of the applicator, and is fixed in a set position by set screw **45**, so that its bottom edge is disposed at a preset distance above the web-engaging surface of the applicator in accordance with the desired thickness of the stripe to be applied.

Various configurations of inking orifices can be used as seen in FIGS. *5a–5d*. In all these configurations, the striping orifice is wider at the trailing edge than at the leading edge, with respect to the direction of relative movement of the paper web and applicator. The

views in FIGS. 5*a*–5*d* are such that the paper web is in effect moving from the top toward the bottom of the figure. Therefore, the leading edge of the orifice would be toward the top of the figure, and the trailing edge would be at the bottom. The orifices of FIGS. 5*a*–5*c* are each formed of connecting cut-outs with the openiing at the leading edge substantially narrower than the opening at the trailing edge of the orifice.

The striping orifice of FIG. 5*a* is identified as **40***a*, and as shown, it is defined by a pair of connecting cut-outs formed on the web-engaging surface of the applicator. The first cut-out includes curved sides **50** with the widest transverse dimension of the cut-out terminating at the trailing edge (bottom of FIG. 5*a*) of the orifice. The second cut-out includes curved sides **51**, but these sides are of a substantially smaller radius of curvature than those of the first cut-out. The second cut-out is connected to the first cut-out at the apex of the first cut-out, with the apex of the second cut-out defining the leading edge of the orifice **40***a*.

This orifice can be simply produced by two drilling operations, using a smaller-diameter bit for producing the cut-out defined by sides **51**. A part of the lower body member surface is cut away from a line extending through the middle of the three larger cut-outs to the trailing edge of the body member. This produces a step **47** in the lower surface of the body member **30** terminating at a wall **48** (FIG. 4) extending through the middle of the first cut-outs of all three orifices, forming a semicircular configuration for each of those cut-outs.

The FIG. 5*a* orifice configuration is illustrated in the applicator of FIGS. 2 and 4. As shown particularly in FIG. 2, the first cut-out is formed by drilling the hole **44** through section **31** of the body member perpendicularly to its web-engaging surface, and the second cut-out is formed by drilling the second, smaller-diameter hole at an angle to join with chamber **35**.

The FIG. 5*b* variation of the striping orifice is generally designated as **40***b*. Like orifice **40***a* of FIG. 5*a*, orifice **40***b* is also defined by a pair of connecting cut-outs, with the first cut-out including curved sides **52** and with the widest transverse dimension of the cut-out terminating at the trailing edge of the orifice. The second cut-out in orifice **40***b* has straight parallel sides **53** and is of substantially smaller width than the widest dimension of the first cut-out. The second cut-out is connected at one end to the apex of the first cut-out with the opposite end of the second cut-out defining the leading edge of the orifice. This orifice can also be produced in a simple manner, by drilling a hole as in FIG. 5*a* to form the sides **52**, then saw-cutting the hole to form the sides **53**, and then forming the step **47** as described above.

The FIG. 5*c* variation of the striping orifice is generally designated as **40***c*. It too is defined by a pair of connecting cut-outs formed on the web-engaging surface of the applicator. The first cut-out, however, has straight sides **54** which converge toward each other, the widest transverse dimension of the cut-out terminating at the trailing edge of the orifice. The second cut-out is similar to that in orifice **40***b* (FIG. 5*b*) in that it includes straight parallel sides **55** of substantially smaller width than the widest dimension of the first cut-out. The second cut-out is connected at one end of the smaller-width end of the first cut-out with the opposite end of the second cut-out defining the leading edge of the orifice.

A further variation of the striping orifice is illustrated in FIG. 5*d*. This orifice, generally identified by the reference numeral **40***d*, is defined by but a single cut-out. This cut-out, however, is of a continuously curved configuration having its widest dimension terminating at the trailing edge of the orifice and its apex defining the leading edge of the orifice. Actually, the cut-out in FIG. 5*d* is half an ellipse.

During coating, the paper moves from the right side toward the left side, in the FIGS. 2 and 4 views, and accordingly the right side of the applicator would be the leading section, and the left side of the applicator would be the trailing section. Metering pins **42** are disposed in the striping orifices at the trailing (left) edges thereof. As seen in FIG. 4, pin **42** is of substantially the same diameter as hole **44**, so that it snugly fits in the larger-diameter first cut-out (defined by sides **50** in FIG. 5*a*) of the striping orifice.

All of the orifices shown in FIGS. 5*a*–5*c* are operated with a shaped metering pin disposed within the cut-out formed opening at the orifice trailing edge, thus leaving unobstructed the smaller opening at the leading edge of the orifices through wihch the coating material first contacts the moving web. The leading edge opening is made narrower than both the metering pin and trailing edge opening to provide a controlled lateral or transverse spreading of the coating material for over-riding the effect of uncontrolled spreading or flaring in the striping of many liquid materials.

FIG. 3 illustrates the structure of one metering pin. The bottom end is notched at one side to form a flat wall **62** and a straight edge **64**. The other side of the bottom end is formed with a rounded surace **66**. Each pin is placed in openings **43** and **44** of the applicator body member **30** and is secured in position by set screw **45**. Each pin is disposed so that its rounded surface **66** faces the leading side of the applicator, and its straight edge **64** faces the trailing side with straight wall **62** being substantially coplanar with the wall **48** of step **47**. Actually, straight edge **64** defines the trailing edge of the inking orifices **40**. Straight edge **64** of each of the pins is positioned at a level slightly above the paper-engaging surface of the applicator, so that it constitutes the doctoring edge and controls the thickness of the ink stripe applied to the paper from its respective orifice. Set screw **45** for each pin permits this doctoring edge to be individually adjusted for varying the thickness of the ink stripe.

The bottom or web-engaging surface of the applicator **10** is formed with a flat projecting surface **70** which is the surface actually engageable with the web. There is such a flat projection **70** for each of the inking orifices. Since, in the embodiment illustrated, there are three inking orifices, there would be three such flat surface projections **70**, as clearly illustrated in FIG. 4.

Each of these flat surfaces has a rounded leading edge and is wider at the trailing edge than at the leading edge with respect to the direction of movement of the paper web past the applicator. Its respective inking orifice **40** is formed in the middle of the trailing edge. The metering pin **42** is disposed so that its flat wall **62** and doctoring edge **64** are substantially in alignment with the trailing edge of flat surface **70**.

As also seen in FIG. 4, the web-engaging surface of the applicator may be formed with a second group of flat projecting surfaces, these being generally identified with the reference numeral **72**. Each flat projection **72** is in alignment with a flat projection **70**, is also wider at the trailing edge than at the leading edge, and also includes a rounded surface at its leading edge.

In operation, the paper web **14** is continuously driven between applicator **10** and the back mandrel **18**. It may be operated at speeds in the order of 400 feet per minute, and higher. Ink is supplied, as by a pump, from source **26** through conduit **28** to chamber **35** of the applicator **10**. This chamber serves as an ink reservoir supplying all the inking orifices **40**, which communicate with the chamber. The ink is first deposited from the leading edges of the orifices, i.e., the narrower and completely unobstructed part of the orifices. This would be the second cut-out, defined by curve-side **51**, in the FIG. 5*a* configuration.

As the paper continues to move past the inking orifices, each metering pin 42 spreads the ink smoothly and evenly by virtue of its rounded surface 66, until the ink stripe extends completely across the widest part of the cut-out at the trailing edge of the orifice. The outward spreading of material around the leading narrower part of the orifice, which occurs when applying stripes of low viscosity liquids, is thus overlapped and covered by a wider opening at the trailing edge in which is disposed a metering pin having a doctoring edge. Straight edge 64 of the metering pin doctors the ink stripe at the trailing edge of the orifice and thereby controls its thickness in accordance with the setting of the pin. The foregoing striping action, of course, is produced at each one of the three inking orifices, so that three spaced, parallel ink stripes are formed on the paper web.

The thickness of the ink stripe applied from each orifice depends primarily upon the setting of the doctoring blade, the speed of the paper, and the rate of liquid discharge. An illustrative doctor blade setting is one that would provide a gap of between 0.003–0.005 inch. As mentioned earlier, the paper can be driven at a speed of approximately 400 feet per minute. It has been found that by maintaining the doctoring blade at the preset gap and the paper at a preset speed, the stripe thickness can be conveniently varied, within limits, by adjusting the speed of the pump (preferably, a constant displacement type) to vary the rate of flow of ink to the striping orifices.

Applicators which apply magnetic ink stripes are subject to rapid wear because of the eroding effect the magnetic particles have on the parts of the applicator. The effects of this eroding action, however, are substantially reduced in the applicator of the present invention. In this applicator, the eroding effects appear to be concentrated at the metering pins 42. However, because of the curved surface 66 forming the leading edge of the metering pin, the erosive action of the magnetic particles appears to dissipate over this gradually curved surface; also, it is spread over a relatively large surface. Moreover, the pins may be easily adjusted, through set screws 45, to compensate for wear and erosion, and once this has reached a point where a new part must be used, the metering pins may be easily removed and new pins attached. The curved configuration of the operating surface of the metering pin also greatly reduces streaking in the applied stripe since ink agglomerates and other lumps which would tend to build up in front of sharp edges are passed under the curved surface without delay.

All in all, the head is of very simple construction, is inexpensive to produce and to maintain, has been found to produce magnetic stripes having clean and sharp edges and surfaces which are practically free of streaks, can be conveniently adjusted to vary the stripe thickness, and has been found to have a long useful life.

A further variation of an applicator constructed in accordance with the invention is illustrated in FIG. 6. This variation is particularly useful for systems operating at higher speeds. For this purpose, it has been designed so as to have a smaller mass to thereby minimize the loading effect it produces on the web when traveling at high speed. It has also been found that the reduced mass of the applicator shortens the duration of its oscillations when the applicator engages a bump in the paper, such as a paper splice. By reducing the duration of the oscillations of the applicator, the amount of paper spoilage is also thereby reduced when the applicator intercepts a paper splice, for example.

In the FIG. 6 embodiment, the body member is identified with the reference numeral 130. It is of smaller dimension and may be made of a lighter metal, such as titanium. It includes the central chamber 135 which serves as the ink reservoir, and a passageway 136 connected to the conduit 128 for the ink supply, as in the earlier-described embodiment. However, in FIG. 6 the body member 130 does not include a mounting plate comparable to mounting plate 32 of the FIG. 2 embodiment. For purposes of minimizing its mass, the end pins, there identified as 134, are attached directly to the main section 130; also, the body member is formed with only one paper-engaging section, at the trailing end in which are disposed the inking orifices 140.

The applicator of FIG. 6 also includes metering pins 142 corresponding to those of the earlier embodiment, but these pins are mounted in a separate element 137 attached to the main section of the body member 130 by tie bolts 138. Element 137 also carries set screws 145 for fixing the positions of the metering pins 142. Element 137 is formed with an enlarged bore at the lower end, in which is disposed an insert 139 of hardened material, which can be replaced, with metering pins 142, when these parts wear out.

The body member of the applicator in FIG. 6 is formed with flat projection 170 at the trailing edge of the web-engaging surface, in a manner similar to the structure in the earlier-described embodiments. However, since the body member engages the paper web only at the trailing end, it does not include the forward section or the flat projections corresponding to projection 72 of the FIG. 2 version.

The position of the applicator in the striping system is not critical. It is shown in FIG. 1 mounted in a vertical position, but it could just as well be operated horizontally. If it is desired to apply stripes to both sides of the paper web 16, a second inking applicator, comparable to that described, could be substituted for the back mandrel 18, so that both sides of the paper will be striped in one pass through the system.

While there has been illustrated and described several embodiments of the invention, it is to be understood that these are illustrative only, and that various features of the invention, alone or in combination, may be used in other embodiments and applications.

I claim:

1. An applicator for applying a stripe of a liquid material, supplied from a liquid source, onto a web member having relative movement in a predetermined direction with respect to a web-engaging surface of the applicator, comprising a body member formed with a passageway connected at one end to the source of liquid, said body member being further formed on said web-engaging surface with a striping orifice connected to the other end of said passageway; characterized in that said striping orifice is wider at the trailing edge than at the leading edge thereof with respect to the direction of relative movement between said web and applicator and is defined by at least first and second connecting cut-outs, said second cut-out being substantially narrower than said first cut-out and being positioned for defining the leading edge of said orifice.

2. An applicator as set forth in claim 1, further including doctoring means located in said first cut-out, said doctoring means including a straight edge forming the trailing edge of said orifice and a rounded surface forward of said straight edge toward the leading edge of said orifice.

3. An applicator as set forth in claim 1 wherein the first cut-out has curved sides with its widest transverse dimension terminating at the trailing edge of said orifice, and the second cut-out has curved sides of a smaller radius of curvature than said first cut-out, said second cut-out being connected to said first cut-out at the apex of said first cut-out with the apex of said second cut-out defining the leading edge of said orifice.

4. An applicator as set forth in claim 1 wherein the first cut-out has curved sides with its widest transverse dimension terminating at the trailing edge of said orifice, and the second cut-out has straight parallel sides, said second cut-out being connected at one end to the apex

of said first cut-out with the opposite end of said second cut-out defining the leading edge of said orifice.

5. An applicator as set forth in claim 1 wherein the first cut-out has straight converging sides with its widest transverse dimension terminating at the trailing edge of said orifice, and the second cut-out has straight parallel sides, said second cut-out being connected at one end to the smaller width end of the first cut-out with the opposite end of said second cut-out defining the leading edge of said orifice.

6. An applicator for applying a stripe of a liquid material, supplied from a liquid source, onto a web member having relative movement in a predetermined direction with respect to a web-engaging surface of the applicator, comprising: a body member formed with a passageway connected at one end to the source of liquid; said body member being further formed on said web-engaging surface with a striping orifice connected to the other end of said passageway; said striping orifice being defined by connecting cut-out defined openings, the opening at the trailing edge being substantially wider than the opening at the leading edge thereof with respect to the direction of relative movement of said web and applicator; and a metering pin disposed in the trailing edge opening and having a doctoring edge defining the trailing edge of said orifice.

7. An applicator as set forth in claim 6, wherein said metering pin is settably mounted so as to permit its doctoring edge to be variably positioned with respect to the web-engaging surface of the striping orifice, and means for fixing the metering pin in its set position.

8. An applicator as set forth in claim 6, wherein said metering pin is disposed in said trailing edge opening and includes a rounded surface facing the leading edge of said orifice and a straight edge defining the trailing edge of said orifice, said straight edge constituting the doctoring edge which controls the thickness of the applied stripe.

9. An applicator for applying a stripe of a liquid material, supplied from a liquid source, onto a web member having relative movement in a predetermined direction with respect to a web-engaging surface of the applicator, comprising: a body member formed with a passageway therethrough connected at one end to the source of liquid; said body member being also formed on said web-engaging surface with a flat surface projecting from said body member and engageable with said web; said flat surface being wider at the trailing edge than at the leading edge thereof with respect to the direction of relative movement of said web and applicator; said body member further being formed in the middle of the trailing edge of said flat projecting surface with a striping orifice also wider at its trailing edge than at its leading edge.

10. An applicator for applying a stripe of a liquid material, supplied from a liquid source, onto a web member having relative movement in a predetermined direction with respect to a web-engaging surface of the applicator, comprising: a body member formed with a passageway therethrough connected at one end to the source

of liquid; said body member being also formed on said web-engaging surface with a flat surface projecting from said body member and engageable with said web; said flat surface being wider at the trailing edge than at the leading edge thereof with respect to the direction of relative movement of said web and applicator; said body member being further formed with a striping orifice in the middle of the trailing edge of said flat projecting surface; said striping orifice being defined by connecting cut-outs in said web-engaging surface and being wider at the trailing edge than at the leading edge thereof with respect to the direction of relative movement of said web and applicator.

11. An applicator as defined in claim 10, said applicator further comprising a metering pin disposed in said striping orifice at its widest portion, said metering pin being formed with a straight doctoring edge substantially in alignment with the trailing edge of said flat projecting surface and defining the trailing edge of said orifice.

12. An applicator as defined in claim 10 wherein said body member is formed on said web-engaging surface with a second flat projection engageable with said web, said second flat projection being in alignment with the first flat projection and also being wider at the trailing edge than at the leading edge thereof with respect to the direction of relative movement of said web and applicator.

13. An applicator for applying stripes of a liquid material, supplied from a liquid source, onto a web member having relative movement in a predetermined direction with respect to a web-engaging surface of the applicator, comprising: a body member formed with a liquid reservoir and with a passageway connected thereto to the source of liquid; said body member being further formed on said web-engaging surface with a plurality of spaced striping orifices defined by connecting cut-outs and disposed in a line perpendicular to the direction of travel; said body member being further formed with passageways connecting said striping orifices to said liquid reservoir; all said striping orifices being wider at the trailing edges thereof than at the leading edges thereof with respect to the direction of relative movement of said web and applicator; and an adjustable metering pin having a doctoring edge disposed in each of said orifices and defining the trailing edges thereof.

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RICHARD D. NEVIUS, *Primary Examiner.*

JOSEPH B. SPENCER, *Examiner.*