(12) UK Patent Application (19) GB (11) 2 046 133 A

(21) Application No 7918324
(22) Date of filing 25 May 1979
(30) Priority data
(31) 2915289
(32) 14 Apr 1979
(33) Fed. Rep. of Germany (DE)
(43) Application published 12 Nov 1980
(51) INT CL³ B05C 5/00
(52) Domestic classification B2L 101 126 135 B
(56) Documents cited None
(58) Field of search B2L
(71) Applicant Eduard Kusters, Gustav-Funders-Weg 18, 4150 Krefeld, Federal Republic of Germany
(72) Inventors Johannes Kutz, Walter Keller, Max Kruger, Eduard Kusters
(74) Agent Forrester, Ketley & Co.

(54) **Apparatus for Applying Foam to a Moving Web**

(57) A container 15 for foam extends above a moving web 1. A roller 11 protrudes into the open bottom of the container 15 and entrains foam to flow through a tapering passage 27 defined by a plate 22. A doctor 13 touches the down-going part of the roller 11 at a point 14 just above the axis of the roller. Foam slides down the doctor 13 onto the web 1.

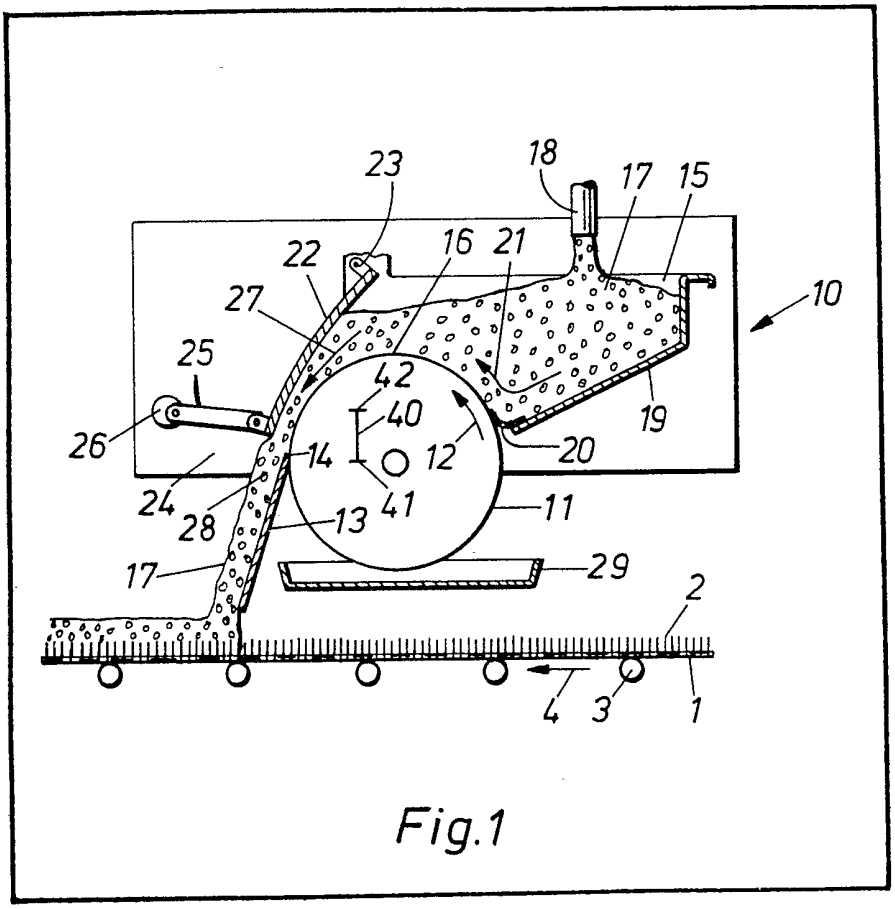
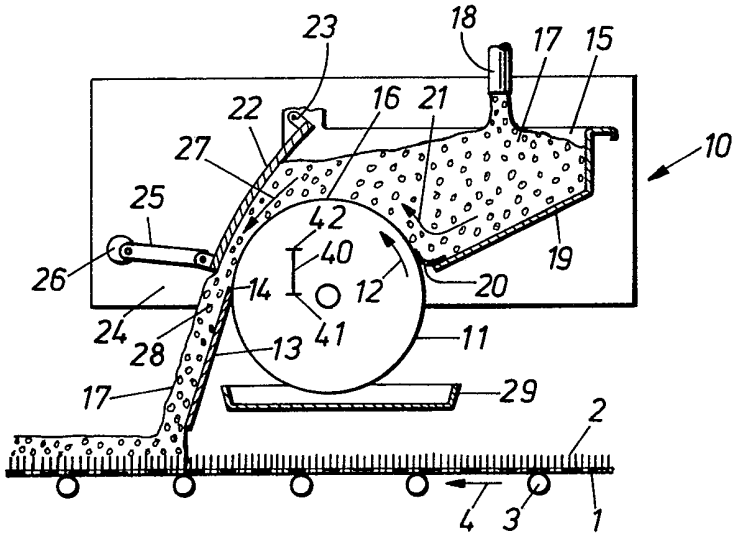


Fig.1

GB 2 046 133 A

2046133

Fig.1



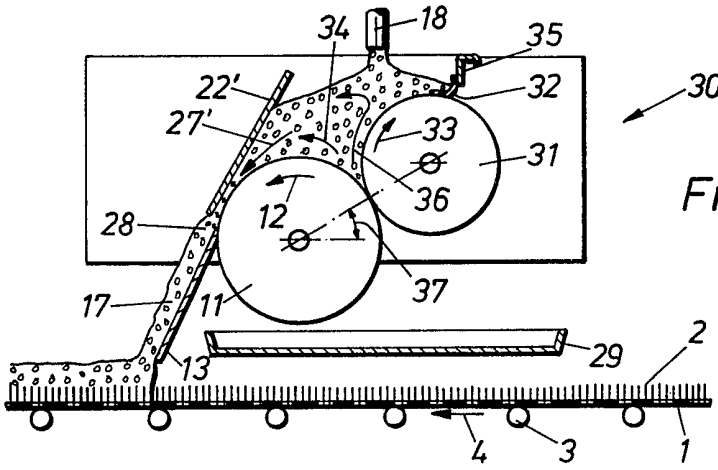


Fig.2

2046133

Fig. 3

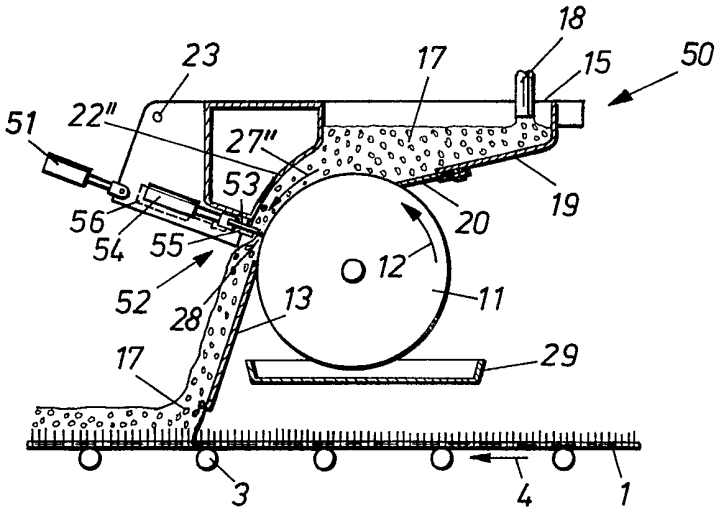


Fig. 4

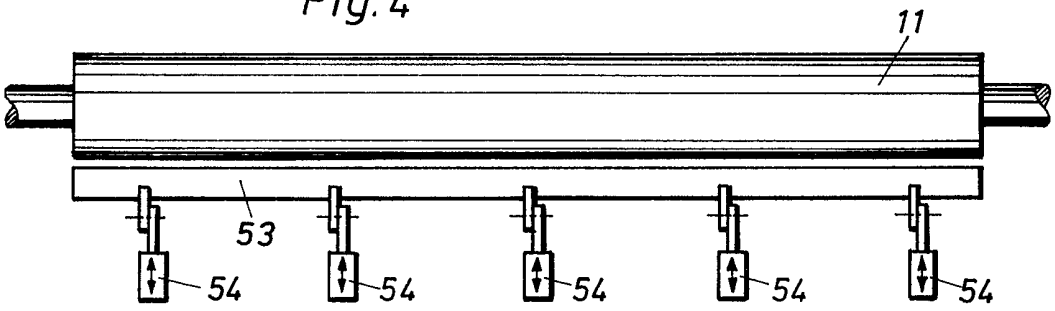


Fig. 5

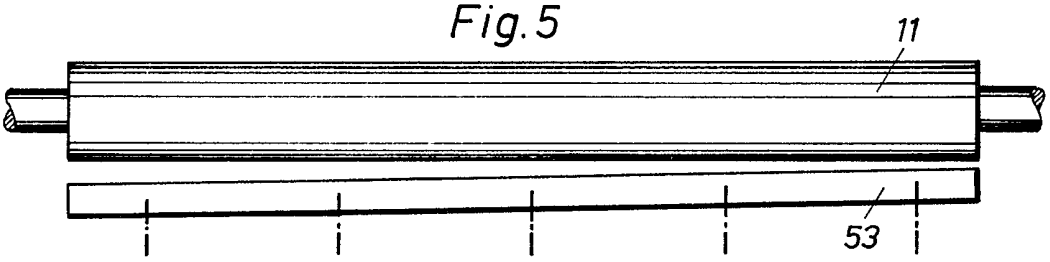


Fig. 6

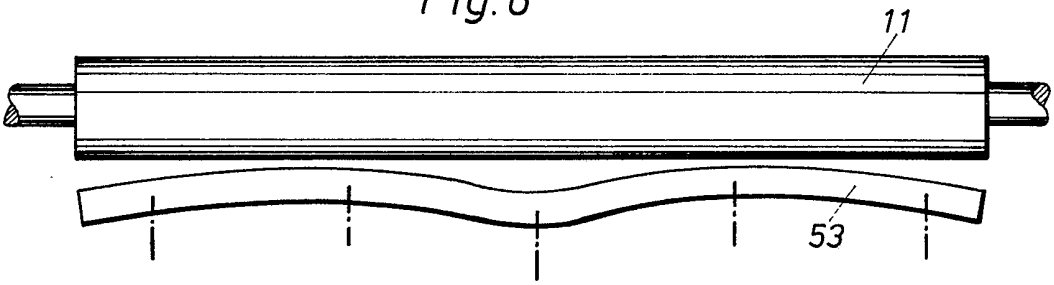
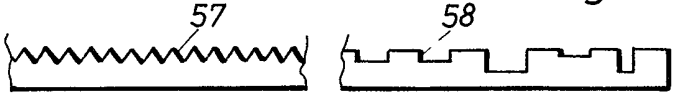


Fig. 7



SPECIFICATION

Improvements in or Relating to Apparatus for Applying Foam to a Moving Web

This invention relates to a system for applying foam to a moving web. German Offenlegungschrift 2,631,340 describes an apparatus that is used in conjunction with the production of fibre fleeces impregnated with an aqueous binder. A hopper-shaped filler box is disposed above a roller and its walls extend substantially radially thereto. Foam resting on the roller in the box is entrained on the surface of the roller and moves under the front wall as considered in the direction of rotation, and is transferred by the roller to the web, which the roller touches as the web passes beneath the roller. A doctor blade in the form of a strip is provided at the front edge of the box for adjustment of the gap between the edge of the box and the roller and this determines the thickness of the layer of foam entrained by the roller and transferred to the web. For impregnating a fleece with a binder the foam application does not have to have a high degree of uniformity, i.e. it is immaterial whether the foam entrained at the surface of the roller is or is not completely uniform or if a bead of foam forms between the roller and the web on the inlet side. With foam dyeing, on the other hand, such a lack of uniformity is not permissible, since even minor differences in the amount of dyeing liquid applied may produce different shade intensities, which are clearly visible in the finished product and which will not be acceptable for example, if the material being dyed is carpeting intended for display purposes or which can be seen when it has been laid.

The present invention seeks to provide an apparatus in which these disadvantages are obviated or reduced.

According to this invention there is provided an apparatus for applying foam to a moving web, comprising a container for containing foam and disposed across and above the web over the width thereof, the bottom of the container having an orifice which extends across the width of the web; at least one rotatable roller extending across the width of the web beneath said orifice, and being sealed with respect to the container except for an outlet for the foam the roller being located so that on rotation, the roller entrains foam from the container on the roller surface and delivers it to the web passing beneath the roller; a wall element being provided on the downgoing side of the roller as considered during rotation of the roller, said wall element together with the roller forming a duct which tapers in the peripheral direction of the roller and which terminates in a zone between a first level which is the level of the roller axis and a second level which is higher than the first level; and a doctor inclined to the web and bearing against the roller beneath the end of the duct.

In operation of an apparatus in accordance with the invention the foam is entrained into the tapering duct by the rotating roller. The resulting slight pressure that is created within the foam as it passes down the tapering duct equalizes any inhomogeneity of the foam, e.g. large bubbles are broken down into a number of small ones or else they are retained until they divide up into a number of small bubbles. The uniform layer of foam slides down the doctor on to the web without any further action on the foam. The transfer to the web is effected by gravity without the roller or the doctor touching the web, this being particularly important for the treatment of webs with a pile, e.g. carpets.

Systems comprises a rotating roller which entrains a material as its surface, from which the material is stripped off by a doctor and guided down to a web passing therebeneath are known for example from German Patent Specification No. 703,930. The known systems, however, are provided for applying liquids or fibre suspensions to a web, rather than for applying a foam. In the known systems the roller dips, from above, into a liquid-containing trough underneath the roller and entrains the liquid in a thin layer by adhesion on the surface of the roller. A foam, however, has quite a different behaviour and does not spread out over a surface, but retains a certain configuration even without being confined. Thus while a liquid automatically assumes a uniform distribution, the delivery of foam requires the additional wall element which is provided according to the invention and which forms the tapering duct, so that the foam having its own configuration can be given a uniform distribution.

Preferably the wall element is curved convexly to correspond with the convex curvature of the periphery of the roller and with the roller it forms a curved and tapering duct.

Advantageously the wall element is adjustable with respect to the roller near the outlet orifice in order to adjust the size of the outlet orifice formed between the roller and the wall element which allows the system to be adjusted to different deliveries as required or to different foam properties.

Conveniently the wall element is mounted pivotally above the roller and means are provided for adjusting the position of wall element with respect to the roller.

Advantageously two parallel rollers are provided on the underside of the foam container. Preferably the said two rollers roll on one another. Alternatively the rollers have different circumferential speeds and are sealed from one another by means of a seal.

Preferably the roller which is most remote from the duct is disposed at a higher level than the roller adjoining the duct.

Advantageously a restrictor is provided at the end of said duct said restrictor extending along the roller and being adjustable with respect to the roller transversely of the duct.

Experiments have shown that the passage cross-section at the outlet orifice must be very

small in certain cases, e.g. for dyeing carpets by means of foam, down to about 1 mm. The foam passing through this narrow cross-section expands to a greater layer thickness immediately after leaving the duct and reaches the web in that form. Without a disproportionate expenditure in terms of construction it is not a simple matter to maintain exactly a gap width of about 1 mm over a length of about 5 metres, as is the current conventional wording width for carpet dyeing. Even a deviation of 1 mm to 1.3 mm means an increase of 30% and accordingly also a 30% local difference in the amount of foam applied, resulting in a completely different shade of colour in the carpet in the zones concerned, so that the carpet has to be rejected. It is precisely because the gap is so narrow in absolute terms that even relatively small deviations have such an effect. Since it is practically impossible, with tolerable expenditure, to make and support a 5 metre long wall element with such accuracy as to enable tolerances of the required order to be maintained, the problem has been solved by providing in preferred embodiments of the invention an additional restrictor at the bottom end of the duct. The wall element can thus be manufactured and supported without special tolerances, while the actual restriction of the flow cross-section at the duct outlet is provided by the restrictor, which also has the additional advantage of projecting like a knife edge into the path of the foam and destroying large foam bubbles so that the foam structure is made substantially uniform.

Conveniently the resistor is adjustable to provide different passage cross-sections at different points along the length of the roller. The restrictor edge may be substantially straight or have recesses to form patterns, so that a patterned effect can be obtained by using different quantities in the form of stripes or the like.

Advantageously at least two superimposed restrictor blades may be provided which either project selectively or simultaneously into the duct cross-section to influence the passage cross-section.

Preferably the bottom edge of the doctor should be disposed immediately above the web so that the uniform foam layer on the doctor is transferred as directly as possible to the web and is not dispersed and, thus rendered non-uniform again, by falling freely over a considerable height.

To avoid the formation of a bead of foam on the doctor (since this would also result in lack of uniformity) it is preferable so to arrange the system that the doctor side bearing the foam points in the direction of web movement.

Consequently, the foam is not carried along beneath the doctor, but is carried from the top of the doctor immediately away so that no foam accumulation can form.

According to another aspect of this invention there is provided a method of applying foam to a moving web comprising the steps of supplying foam to a container disposed across and above the web over the width thereof, the bottom of the container having an orifice which extends across the width of the web, there being at least one rotatable roller extending across the width of the web beneath said orifice and being sealed with respect to the container except for an outlet for the foam, the roller being located so that on rotation the roller entrains foam from the container on the roller surface and delivers it to the web passing beneath the roller; a wall element being provided on the downgoing side of the roller as considered during rotation of the roller, said wall element together with the roller forming a duct, which tapers in the peripheral direction of the roller and which terminates in a zone between a first level which is the level of the roller axis and a second level which is higher than the first level; and a doctor beneath the end of the duct, and comprising the steps of moving said web and rotating said roller.

This invention also relates to a web treated by such a method.

In order that the invention may be more readily understood and so that further features thereof may be appreciated the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a vertical longitudinal section through a foam applicator system for applying foam to carpets, comprising one roller,

Figure 2 is a corresponding view of a foam applicator system comprising two rollers,

Figure 3 is a corresponding view of a foam applicator system with a restrictor, and

Figures 4 to 7 show different embodiments of the restrictor arrangement.

The foam applicator apparatus shown in the accompanying drawings is intended for dyeing carpets, but the invention is not restricted to apparatus solely of this type. A carpet 1 to be located is conveyed substantially horizontally over rollers 3 in the direction of arrow 4 with the pile 2 upwards in each embodiment.

In the foam applicator having the general reference 10 in Figure 1, a roller 11 is provided at a distance above, and extending transversely of, the carpet web 1 and roller 11 rotates in the direction of arrow 12. A doctor 13 bears against the roller 11 at a point of contact 14 on that side of roller 11 which moves downwards during rotation of the roller and doctor 13 is inclined to the carpet from the point of contact 14 in the direction of advance 4 of the carpet. Roller 11 forms a part of the bottom of a foam container 15 which is kept filled with foam 17 via a feed pipe 18, the level of the foam extending above the apex or uppermost part 16 of the roller 11. The foam container 15 comprises a base 19 which is inclined at an angle to the roller 11 and which is sealed to the latter by a flexible seal 20. The foam 17 slides down the base 19 towards the roller 11 and is entrained by the roller 11 so that the foam movement in the direction of arrow 21 occurs when roller 11 rotates in the direction of arrow 12.

An outwardly or convexly curved wall element 22 is disposed opposite the roller 11 on the downgoing side of the roller as considered during rotation of the roller, and the radius of curvature of wall element 22 is larger than the radius of the roller 11 and the element 22 is mounted pivotally at the top at 23. The wall element 22 terminates, at the bottom substantially level with the point of contact 14 of the doctor 13. A link 25 is pivotally connected to the bottom edge of the wall element 22 at 24 and is adjustable by means of an eccentric 26 so that the free space formed between the roller 11 and the wall element 22, which constitutes a curved duct 27 can be adjusted in the region of the outlet orifice 28 of the duct 27. The configuration and arrangement of the wall element 22 opposite the roller 11 gives a duct 27 which tapers like a funnel towards the outlet orifice 28. The wall element 22 and the duct 27 terminate in a zone 40 between the level 41 of the axis of the roller 11 and a level 42 which is half the roller radius above the level 41.

The form 17 emerging at the outlet orifice 28 and slides in a uniform layer down the doctor 13 and reaches the carpet web 1 passing close beneath the bottom edge of the doctor 13 in the direction of the arrow 4, i.e. towards the side of the doctor 13 bearing the foam 17.

A collecting tray 29 is disposed beneath the roller 11 and collects any liquid or foam dripping from the roller to avoid any spots of different colour intensity from being formed on the carpet web 1.

The foam applicator system having the general reference 30 shown in Figure 2 has basically the same construction as the system 10 shown in Figure 1 and like parts have like references. However, this system has a stationary wall element 22′ in the form of a substantially flat plate which, together with the roller 11, forms the tapering duct 27′. The inclined bottom 19 is replaced by a roller 31 which in the illustrated embodiment is disposed at a higher level than the roller 11, so that the plane formed by the axis of the rollers 11, 31 includes with the horizontal, an angle 37 of about 40° in the illustrated embodiment, to force the foam through the arrangement of the rollers 11, 31 and towards the duct 27. Roller 31 has substantially the same diameter as roller 11 and rolls on it, that is to say the periphery of roller 31 is in contact with the periphery of roller 11 and the rollers roll so that their peripheries have the same speed. Alternatively, the roller 31 can be driven at a different circumferential speed either in the same or in the opposite direction. In that case, of course, the rollers 11, 31 cannot touch one another and a seal must be provided between them to prevent the foam from running out between them. The foam container 35 is in any case bounded at the bottom substantially only by the rollers 11, 31. Roller 31 is sealed off from the edge of the foam container 35 by a seal 32.

Rotation of the rollers 11, 31 in the direction of the arrows 12 and 33 respectively causes the foam that has sunk into the nip between the rollers 11, 31 to be entrained upwards again at the surfaces of the rollers so that the foam flow is in the direction of the arrows 34, 36 and no "dead" or stagnant zone is formed inside the foam.

Figure 3 shows a foam applicator system having the general reference 50, of basically the same construction as that shown in Figure 1, like parts having like references.

For stability reasons, the wall element 22′ is constructed as a hollow box girder and together with the roller 11 forms the tapering duct 27″. The wall element 22″ is pivotable about a pivot point 23 by means of the hydraulic, electrical or mechanical adjustment element 51, so that the cross-section of the duct 27″ is adjustable near the outlet orifice 28.

A restrictor having the general reference 52 is provided at the bottom end of the wall element 22′ and comprises a blade 53 extending over the width of the web and projecting transversely into the duct 27″ from outside and capable of being pushed to different depths into the duct by means of actuators 54. The entire arrangement is mounted on the wall element 22′ and the position of the arrangement can be adjusted, with a corresponding adjustment of the wall element 22′, by means of the adjusting element 51. Restrictor 53 extends substantially at right angles to the duct 27″ but may alternatively extend at a slight angle in the direction of flow of the foam 17 so that no "dead" corners, where static foam can accumulate, can form in the angle between the wall element 22′ and the blade 53.

Figure 3 shows a second blade 55 with its own actuators 56 just below the blade 53 and adapted to be moved instead of or together with blade 53 into the outlet cross-section of the duct 27″.

Figure 4 is a detail of the arrangement of the roller 11 and the restrictor 53. It will be seen that a plurality of actuators 54 each controllable separately are provided over the length of the roller 11 and the blade 53.

In this way, as shown in Figures 5 and 6, the blade 53 may be moved so that the longitudinal axis is not parallel with the axis of the roller or arcuate deformation of the edge of the blade 53 may enable it to project to different depths into the duct 27″ at different points so that the cross-section of the outlet of the duct can deliberately de made non-uniform over the length of the roller 11 (or the width of the web 1) or else the blade 53 can follow an irregular roller surface to give a uniform outlet cross-section. This may apply, for example, if the roller 11 has been somewhat deformed across the width of the web because of its weight. In that case, the blade 53 would have to be bent forward somewhat in the middle. The different distances shown in Figures 5 and 6 are, of course, shown on a highly exaggerated scale. In another aspect, the arcuate deformation of the blade 53 can be used to vary the foam application for adjustment to different properties of the web across the width.

The blade 53 will normally have a straight edge at the side projecting into the duct 27", but in special cases, e.g. when strip-like patterns are required, a serrated edge 57 or stepped edge 58 may be provided as shown in Figure 7.

Claims

1. An apparatus for applying foam to a moving web, comprising a container for containing foam disposed across and above the web over the width thereof, the bottom of the container having an orifice which extends across the width of the web; at least one rotatable roller extending across the width of the web beneath said orifice and being sealed with resvzct to the container except for an outlet for the foam, the roller being located so that on rotation, the roller entrains foam from the container on the roller surface and delivers it to the web passing beneath the roller; a wall element being provided on the downgoing side of the roller as considered during rotation of the roller, said wall element together with the roller forming a duct which tapers in the peripheral direction of the roller and which terminates in a zone between a first level which is the level of the roller axis and a second level which is higher than the first level; and a doctor inclined to the web and bearing against the roller beneath the end of the duct.

2. An apparatus according to Claim 1, wherein the wall element is curved convexly to correspond with the convex curvature of the periphery of the roller.

3. An apparatus according to Claim 1 or 2, wherein the wall element is adjustable with respect to the roller near the outlet orifice in order to adjust the size of the outlet orifice formed between the roller and the wall element.

4. An apparatus according to Claim 3, wherein the wall element is mounted pivotally above the roller and means are provided for adjusting the position of wall element with respect to the roller.

5. An apparatus according to any one of Claims 1 to 4, wherein two parallel rollers are provided on the underside of the foam container.

6. An apparatus according to Claim 5, wherein the said two rollers roll on one another.

7. An apparatus according to Claim 5 or 6, wherein the roller which is most remote from the duct is disposed at a higher level than the roller adjoining the duct.

8. An apparatus according to Claim 5 or 7, wherein the rollers have different circumferential speeds and are sealed from one another by means of a seal.

9. An apparatus according to any one of Claims 1 to 8, wherein a restrictor is provided at the end of said duct said restrictor extending along the roller and being adjustable with respect to the roller transversely of the duct.

10. An apparatus according to Claim 9, wherein the restrictor is adjustable to provide different passage cross-sections at different points along the length of the roller.

11. An apparatus according to Claim 9 or 10, wherein the edge of the restrictor projecting into the duct (27") is subsequently straight.

12. An apparatus according to Claim 9 or 10, wherein the edge of the restrictor projecting into the duct has recesses to form patterns.

13. An apparatus according to any one of Claims 9 to 12, wherein the restrictor comprises at least two superposed blades.

14. An apparatus according to any one of Claims 1 to 13, wherein the bottom edge of the doctor (13) is disposed immediately above the web.

15. An apparatus according to any one of Claims 1 to 14, wherein the apparatus is so disposed that the side of the doctor bearing the foam points in the direction of web movement.

16. An apparatus according to any one of the preceding claims including means for producing foam and for supplying said foam to said container.

17. A method of applying foam to a moving web comprising the steps of supplying foam to a container disposed across and above the web over the width thereof, the bottom of the container having an orifice which extends across the width of the web, there being at least one rotatable roller extending across the width of the web beneath said orifice, and being sealed with respect to the container except for an outlet for the foam, the roller being located so that on rotation, the roller entrains foam from the container on the roller surface and delivers it to the web passing beneath the roller; a wall element being provided on the downgoing side of the roller as considered during rotation of the roller, said wall element together with the roller forming a duct which tapers in the peripheral direction of the roller and which terminates in a zone between a first level which is the level of the roller axis and a second level which is higher than the first level; and a doctor inclined to the web and bearing against the roller beneath the end of the duct.

18. A web wherever foam has been applied thereto by a method according to Claim 17.

19. An apparatus substantially as herein described by way of example with reference to Figure 1 of the accompanying drawings.

20. An apparatus substantially as herein described by way of example with reference to Figure 2 of the accompanying drawings.

21. An apparatus substantially as herein described by way of example with reference to Figures 3 to 5 of the accompanying drawings.

22. An apparatus substantially as herein described by way of example with reference to Figures 3 to 5 as modified by Figure 6 of the accompanying drawings.

23. An apparatus substantially as herein described by way of example with reference to Figures 3 to 5 as modified by Figure 7 of the accompanying drawings.

24. A method of applying foam to a web substantially as herein described with reference to the accompanying drawings.

25. A web to which a foam has been applied by a method substantially as herein described with reference to the accompanying drawings.

26. Any novel feature or combination of features disclosed herein.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.