Jan. 28, 1964 T. S. JORDAN 3,119,734

STOCK INLET AND HEADBOX FOR PAPER MAKING MACHINES

Filed Nov. 30, 1960 2 Sheets-Sheet 1

FIG. 1

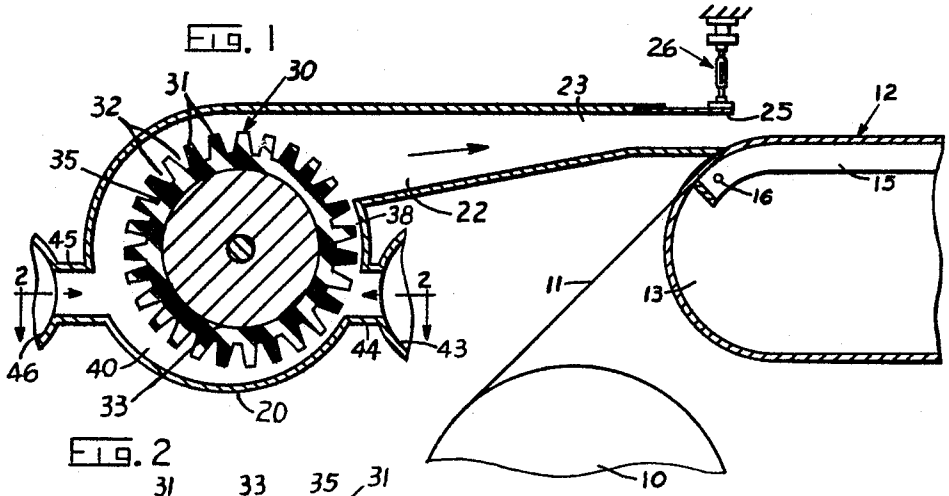


FIG. 2

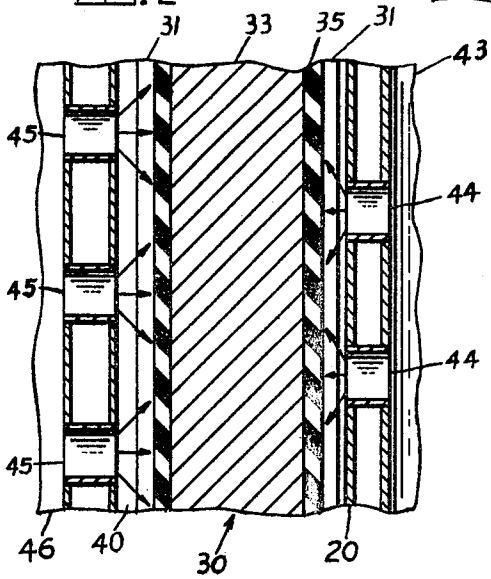


FIG. 3

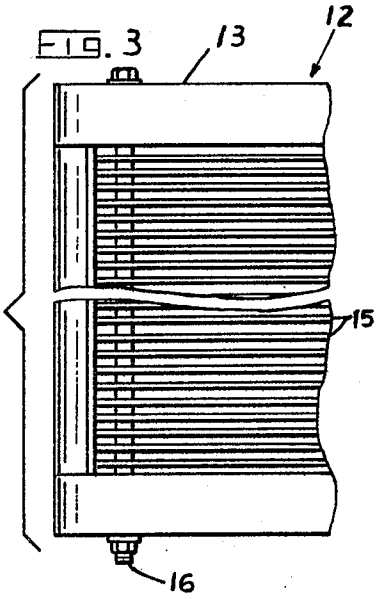
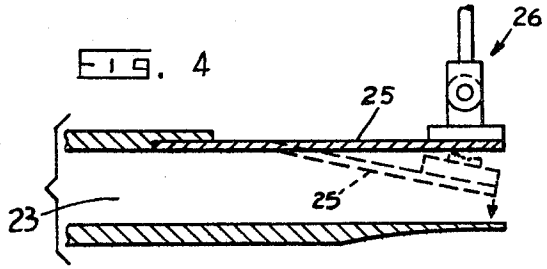


FIG. 4



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Fig. 5

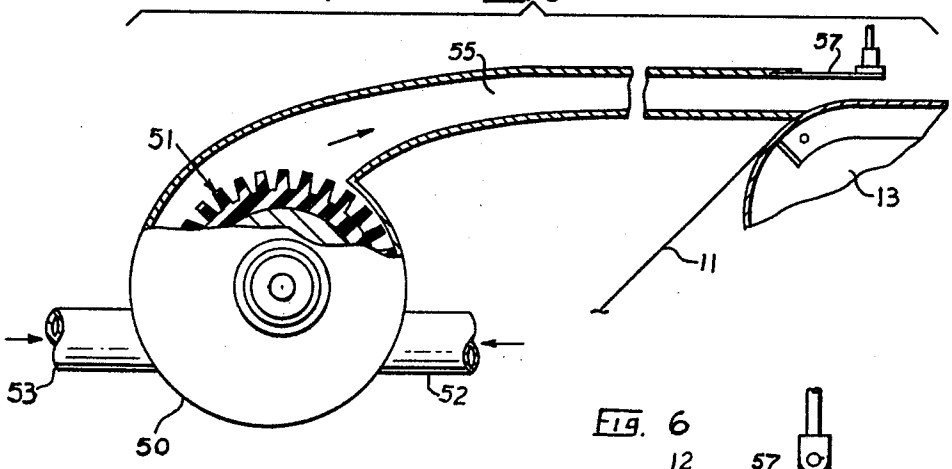


Fig. 6

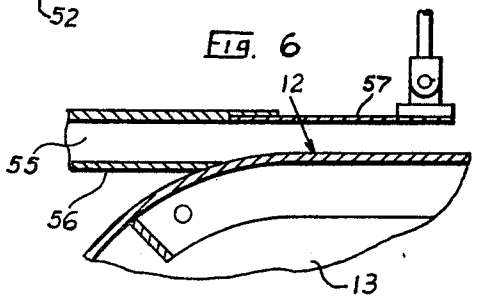
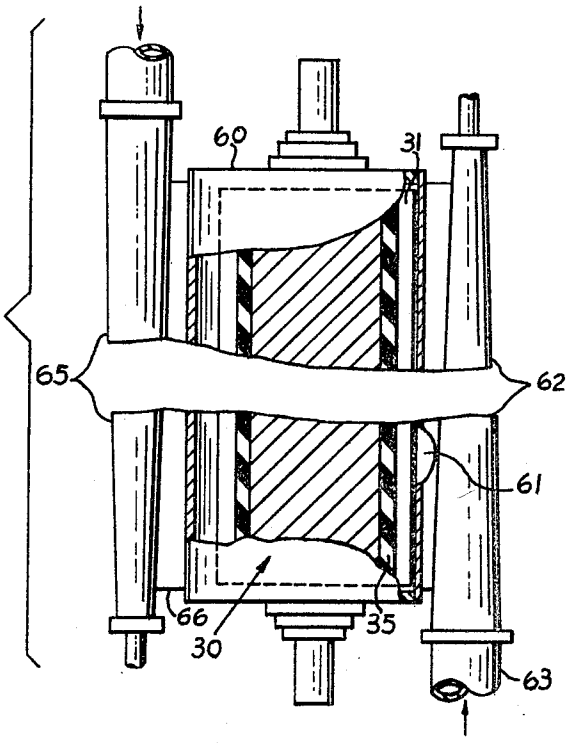


Fig. 7



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STOCK INLET AND HEADBOX FOR PAPER MAKING MACHINES

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10 Claims. (Cl. 162—342)

This invention relates to stock inlets and headboxes for fiber sheet forming machines such as paper machines.

The invention is especially directed to control of the approach flow and delivery of sheet making stock to the forming member of sheet forming machine, which involves the ultimate conversion of the flow from a single large supply pipe to a relatively flat sheet extending the full width of the machine as it is delivered to the forming member. The quality of the sheet formed on the machine depends directly upon the uniformity of flow conditions and fiber distribution which is achieved during this conversion of the stock flow, and the art has for years been seeking an inlet construction capable of effectively and efficiently carrying out this essential flow conversion without the creation of undesirable eddies, cross machine currents and other non-uniform flow conditions which tend to cause flocculation.

It is a primary object of the present invention to provide a combination stock inlet and headbox of novel and simple construction which will convert the stock flow from a single large supply pipe into a solid sheet of narrow depth for delivery to the forming member while minimizing the development of cross currents and preventing conditions of deceleration capable of permitting flocculation.

It is particularly an object of the invention to provide a stock inlet and headbox as outlined above which is of totally enclosed construction preventing contact of the stock with air prior to its delivery to the forming member.

Another object of the invention is to provide a stock inlet and headbox wherein the necessary spreading of the stock flow laterally of the paper machine is effected relatively suddenly and simultaneously with delivery of the stock into the headbox and wherein the resulting sheet of stock is thereafter caused to move continuously forward at constant or increasing speed until it is delivered to the forming member.

An additional object of the invention is to provide a stock inlet and headbox having the operating characteristics outlined above which produces the desired results with a single moving part and which does not require the use of perforated rolls or other rectifying devices of the prior art.

It is also an object of the invention to provide a stock inlet and headbox unit which is especially adapted for use with a manifold of multiple small supply pipes and which is also usable in combination with a supply connection of the slotted cross-flow type.

Among other objects of the invention is the provision of a stock inlet and headbox having the operating characteristics outlined above wherein the headbox comprises a casing of generally cylindrical section having therein an imperforate roll of slightly smaller diameter and a relatively deeply corrugated surface, and wherein the stock enters this casing at points close to the surface of the roll and in such directions that impinges on the corrugated surface of the roll and is caused to spread axially thereof while being confined against forward movement and then to move forward while being confined against lateral movement, the forward movement being achieved at an increasing speed until it is delivered to the forming member.

Further objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings:

FIGURE 1 is a somewhat diagrammatic view in vertical section showing a combined stock inlet and headbox constructed in accordance with the invention and a fragment of the associated Fourdrinier paper machine;

FIGURE 2 is a fragmentary section along the line 2—2 of FIGURE 1;

FIGURE 3 is a fragmentary plan view of the differential box of FIGURE 1;

FIGURE 4 is an enlarged fragment of FIGURE 1 showing the discharge end of the stock outlet;

FIGURE 5 is a vertical section showing a modified construction of headbox in accordance with the invention;

FIGURE 6 is an enlarged fragment of FIGURE 5; and

FIGURE 7 is a view similar to FIGURE 2 showing a modified inlet construction for the headbox of the invention.

Referring to the drawings, which illustrate preferred embodiments of the invention, the fragmentary portion of the paper machine shown in FIGURE 1 includes a roll **10** from which the forming wire **11** travels to and around a forming board **12** shown as constituting a part of the cover for a differential box **13** for receiving the initial discharge of water draining through the wire. As best seen in FIGURE 3, the forming board **12** is formed of multiple slots **15** defining a grid-like structure for transmitting water to the interior of the box **13** as the stock is first discharged onto the wire, and a reinforcing bar **16** extends across the box **13** as shown.

The stock inlet and headbox unit of the invention which delivers the stock to the wire **11** at the box **13** includes a casing **20** of generally cylindrical section from which an outlet passage **22** of tapering section leads to the wire of box **13**. A section **23** adjacent the discharge end of the passage **22** is an essentially straight, constant flow area, and the upper wall of this straight section preferably terminates in an adjustable lip **25** provided with suitable adjusting means **26** for adjusting and controlling the discharge width of the resulting slot below the lip **25** through which the stock flows onto the wire.

Within the casing **13** is a roll **30** which is imperforate and is not to be confused with the perforated rolls commonly used in headboxes for paper machines. The surface of this roll **30** is provided with deep corrugations which are shown as formed by gear-like teeth **31** having complementary grooves **32** therebetween. For preferred results in the practice of the invention, at least the tooth portions **31** of the roll **30** are formed of rubber or like material. Satisfactory results have been obtained with the roll **30** constructed of a solid steel core **33** having thereon a rubber sleeve **35** integral with the teeth **31** and with these teeth one-quarter inch wide along the outer edge thereof, one inch deep and with a space of one-half inch between adjacent teeth on the circumference of the roll.

The roll **30** is of relatively slightly smaller diameter than the inner diameter of the casing, for example one inch smaller, and the roll **30** is mounted eccentrically of the casing **20** to such extent that the peripheries of the teeth **31** will form a running seal with the wall of the casing in the area **38** below the lower wall of the discharge passage **22**. As shown in FIGURE 1, this eccentric relation of the roll **30** in the casing **20** leaves a restricted space **40** of generally crescent shape which runs from the seal area **38** around the inner surface of the casing to the outlet passage **22**.

The stock is delivered to the casing **20** by inlet means shown as a manifold of relatively small pipes **44** which lead from a header **43** and are connected with the casing **20** in spaced and aligned relation axially of the roll and are arranged to deliver the stock into the inlet end of the space **40** in directions parallel with a plane transverse to

the axis of the roll. This arrangement of inlets in combination with the close spacing of the roll **30** to the casing adjacent the inlets **44** causes the stock to impinge on the corrugated surface of the roll as it enters the casing. The grooves **32** between the teeth **31** therefore receive this directly impinging stock, and since they temporarily confine it against forward movement, it is forced to spread suddenly along the length of these grooves. The number and spacing of the inlet pipes **44** is preferably two inches in diameter and spaced on 5½ inch centers, with the laterally spreading stock from each pipe meeting the stock spreading laterally from the pipes on either side thereof.

The roll **30** is continuously rotated to present a fresh surface to the incoming stock from the inlet pipes **44**, but the rotation of the roll is not to be confused with the action of a pump impeller or metering wheel. On the contrary, the stock supply pressure and volume are controlled to produce the desired volume and rate of stock discharge from the passage **22—23**, and the roll **30** is preferably rotated only at a rate such that the surface speed of the teeth **31** will substantially match the flow rate of the stock through the crescent-shaped space **40**. Rotation of the roll **30** also aids in preventing the possibility of temporary deceleration of the stock as it approaches the inner end of the discharge passage **22**, and the forward flow of the stock is therefore at substantially constant or increasing velocity until it reaches the wire.

It is possible and practical in accordance with the invention to provide additional inlet means spaced angularly around the outer wall of the casing **20** from the inlet pipes **44**, and FIGURES 1 and 2 show a separate series of inlet pipes **45** leading from a header **46** and connected to the casing approximately opposite the pipes **44**. The incoming stock from the pipes **45** impinges on the corrugated surface of the roll **30** similarly to the stock from the inlet pipes **44** and is therefore similarly spread laterally of the machine. Also, preferred results are obtained with the individual pipes **45** staggered with respect to the pipes **44** as shown in FIGURE 2, this arrangement having been found to promote optimum intermixing of the separate streams of stock with minimum development of cross currents following the initial lateral spreading of the incoming streams of stock.

The stock inlet and headbox shown in FIGURE 5 is similar to the construction already described in connection with FIGURES 1–3 and includes a similarly substantially cylindrical casing **50**, corrugated roll **51** and inlet manifolds **52** and **53**. The discharge passage **55**, however, is curved as contrasted with the straight walled passage **22**, and this arrangement is preferred for high speed operation as minimizing abrupt changes in the direction of flow of the stock toward the wire. Otherwise, the unit of FIGURE 5 provides the same advantageous results as already described in connection with the unit of FIGURES 1–3.

The discharge lip construction of FIGURE 5 is shown in enlarged detail in FIGURE 6 and has proved especially advantageous in the practice of the invention. As shown, the bottom lip **56** is located slightly below the top of the board **12**, for example ¼ inch, while the flexible top lip **57** extends substantially further, for example 6 inches beyond the bottom lip. This lip arrangement appears to facilitate absorption of the explosive condition accompanying initial exposure of the stock to atmospheric pressure, with a large part of this force being dissipated by passage through the wire into the box **13**. It should also be understood that the invention is not limited to the use of the differential box **13** and that a conventional breast roll may be substituted therefor in the same relation to the discharge lips in FIGURES 1 and 5.

FIGURE 7 illustrates the combination of the headbox of the invention with stock inlet means of the cross-flow type. Thus the casing **60** corresponds to the casings **20** and **50**, but instead of the manifold pipes **44** of FIGURES 1 and 2, or **52** of FIGURE 5, the casing **60** is connected by a slotted passage **61** with an inlet pipe or header **62** of tapered section having a connection for the incoming stock at its larger end **63**. This type of inlet connection decreases the necessity for initial lateral spreading of the incoming stock by the corrugated roll of the invention, but there is still a tendency for the development of oblique currents which is effectively suppressed as the stock impinges on the surface of the corrugated roll. If the casing **60** is provided with a second inlet connection corresponding to the manifold pipes **45** and **53**, it may advantageously include a header **65** tapered in the opposite direction from the pipe **62** and a slotted connecting passage **66**. This arrangement of one or more tapered cross flow headers can also be used to supply the manifold pipes as shown in FIGURES 1, 2 and 5.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A stock inlet comprising a casing of generally cylindrical section, an imperforate roll rotatably mounted in said casing and extending lengthwise within said casing and of a diameter relatively slightly less than the inner diameter of said casing to leave a restricted space between the surface of said roll and said casing, said roll having corrugations extending axially of the surface thereof, a plurality of inlets connected to said casing from outside thereof in spaced relation axially of said roll and arranged to deliver stock into said space in directions parallel with a plane perpendicular to the axis of said roll to cause stock entering said casing therethrough to impinge on the surface of said roll and to spread axially thereof along said corrugations, means forming an outlet projecting generally tangentially from said casing and extending continuously along the full length thereof, means for supplying stock to said inlets at a volumetric rate and pressure sufficient to cause the stock to discharge from said outlet at a predetermined speed while maintaining said casing full of stock to exclude air therefrom, and means for rotating said roll to present a continuously fresh portion of the surface thereof to the separate streams of stock impinging thereon from said inlets.

2. A stock inlet comprising a casing of generally cylindrical section, an imperforate roll rotatably mounted in said casing and extending lengthwise within said casing and of a diameter relatively slightly less than the inner diameter of said casing to leave a restricted space between the surfaces of said roll and said casing, said roll having corrugations extending axially of the surface thereof, said roll being located in eccentric relation in said casing and with the surface thereof in close relation with a portion of the surface of said casing to impart a crescent-shape to said space, a plurality of inlets connected to said casing from outside thereof in spaced relation axially of said roll and arranged to deliver stock into said crescent-shaped space adjacent one end thereof in directions parallel with a plane perpendicular to the axis of said roll to cause stock entering said casing therethrough to impinge on the surface of said roll and to spread axially thereof along said corrugations, means forming an outlet projecting generally tangentially from said casing adjacent the other end of said crescent-shaped space and extending continuously along the full length thereof, means for supplying stock to said inlets at a volumetric rate and pressure sufficient to cause the stock to discharge from said outlet at a predetermined speed while maintaining said casing full of stock to exclude air therefrom, and means for rotating said roll in the direction to cause the surface thereof to travel through said space from said inlets to said outlet.

3. A stock inlet comprising a casing of generally cylindrical section, an imperforate roll rotatably mounted in said casing and extending lengthwise within said casing

and of a diameter relatively slightly less than the inner diameter of said casing to leave a restricted space between the surfaces of said roll and said casing, said roll having corrugations extending axially of the surface thereof, said roll being located with the surface thereof forming a running seal with a portion of the inner surface of said casing, a plurality of inlets connected to said casing from outside thereof adjacent said seal, said inlets being spaced axially of said roll and arranged to deliver stock into said space in directions parallel with a plane perpendicular to the axis of said roll to cause stock entering said casing therethrough to impinge on the surface of said roll and to spread axially thereof along said corrugations, means forming an outlet projecting generally tangentially from said casing adjacent the opposite side of said seal from said inlets and extending continuously along the full length of said casing, means for supplying stock to said inlets at a volumetric rate and pressure sufficient to cause the stock to discharge from said outlet at a predetermined speed while maintaining said casing full of stock to exclude air therefrom, and means for rotating said roll in the direction to cause the surface thereof to travel through said space from said inlets to said outlet.

4. A stock inlet comprising a casing of generally cylindrical section, an imperforate roll rotatably mounted in said casing and extending lengthwise within said casing and of a diameter relatively slightly less than the inner diameter of said casing to leave a restricted space between the surfaces of said roll and casing, said roll having corrugations extending axially of the surface thereof, said roll being located in eccentric relation in said casing and with the surface thereof in close relation with a portion of the surface of said casing to impart a crescent-shape to said space, inlet means connected to said casing from outside thereof and arranged to deliver stock into said crescent-shaped space adjacent one end thereof in directions parallel with a plane perpendicular to the axis of said roll to cause stock entering said casing therethrough to impinge on the surface of said roll and to spread axially thereof along said corrugations, means forming an outlet projecting generally tangentially from said casing adjacent the other end of said crescent-shaped space and extending continuously along the full length thereof, means for supplying stock to said inlet means at a volumetric rate and pressure sufficient to cause the stock to discharge from said outlet at a predetermined speed while maintaining said casing full of stock to exclude air therefrom and means for rotating said roll in the direction to cause the surface thereof to travel through said space from said inlets to said outlet.

5. A stock inlet comprising a casing of generally cylindrical section, an imperforate roll rotatably mounted in said casing and extending lengthwise within said casing and of a diameter relatively slightly less than the inner diameter of said casing to leave a restricted space between the surfaces of said roll and said casing, said roll having corrugations extending axially of the surface thereof, said roll being located with the surface thereof forming a running seal with a portion of the inner surface of said casing, inlet means connected to said casing from outside thereof adjacent said seal and arranged to deliver stock into said space in directions parallel with a plane perpendicular to the axis of said roll to cause stock entering said casing therethrough to impinge on the surface of said roll and to spread axially thereof along said corrugations, means forming an outlet projecting generally tangentially from said casing adjacent the opposite side of said seal from said inlet means and extending continuously along the full length of said casing, means for supplying stock to said inlet means at a volumetric rate and pressure sufficient to cause the stock to discharge from said outlet at a predetermined speed while maintaining said casing full of stock to exclude air therefrom, additional inlet means connected to said casing in angularly spaced relation between said seal and said outlet and arranged to deliver stock into said space in directions causing the stock to impinge on the surface of said roll, and means for rotating said roll in the direction to cause the surface thereof to move from said first named inlet means toward said additional inlet means.

6. A stock inlet comprising a casing of generally cylindrical sections, an imperforate roll rotatably mounted in said casing and extending lengthwise within said casing and of a diameter relatively slightly less than the inner diameter of said casing to leave a restricted space between the surfaces of said roll and said casing, said roll having corrugations extending axially of the surface thereof, a first plurality of inlets connected to said casing from outside thereof in spaced and aligned relation axially of said roll and arranged to deliver stock into said space in directions parallel with a plane perpendicular to the axis of said roll to cause stock entering said casing therethrough to impinge on the surface of said roll and to spread axially thereof along said corrugations, means forming an outlet projecting generally tangentially from said casing and extending continuously along the full length thereof, a second plurality of inlets connected to said casing in spaced and aligned relation axially of said roll at a position spaced angularly between said first inlets and said outlets, said inlets in said second plurality being staggered axially of said roll with respect to said first inlets, means for supplying stock to said inlets at a volumetric rate and pressure sufficient to cause the stock to discharge from said outlet at a predetermined speed while maintaining said casing full of stock to exclude air therefrom, and means for rotating said roll in the direction to cause the surface thereof to move from said first inlets to said second inlets.

7. A stock inlet and headbox for fiber sheet forming comprising a casing of generally cylindrical section, an imperforate roll extending lengthwise within said casing and of a diameter relatively slightly less than the inner diameter of said casing to leave a restricted space between the surfaces of said roll and said casing, said roll having corrugations extending axially of the surface thereof, said roll being located with the surface thereof forming a running seal with a portion of the inner surface of said casing, inlet means connected to said casing from outside thereof adjacent said seal and arranged to deliver stock into said space in directions parallel with a plane perpendicular to the axis of said roll to cause stock entering said casing therethrough to impinge on the surface of said roll and to spread axially thereof along said corrugations, means forming an outlet passage projecting generally tangentially from said casing adjacent the opposite side of said seal from said inlet means and extending continuously along the full length of said casing, said outlet passage being substantially longer than the diameter of said roll and including a first section of a decreasing flow area in the plane transverse to said roll and an exit section of substantially constant flow area, means for supplying stock to said inlet means at a volumetric rate and pressure sufficient to cause the stock to discharge from said outlet at a predetermined speed while maintaining said casing full of stock to exclude air therefrom, and means for rotating said roll in the direction to cause the surface thereof to travel through said space from said inlets to said outlet.

8. In a stock inlet:

a casing of generally cylindrical interior cross section;

an imperforate cylindrical roll rotatably mounted in said casing and extending lengthwise therein, said roll having exterior corrugations extending axially along the surface thereof, the maximum roll diameter being slightly less than the maximum distance across the casing interior through the axis of the roll;

inlet means connected to the casing in open communication with the casing interior and extending along the full length of the roll, said inlet means being adapted to deliver a plurality of streams of

stock to said corrugations in directions parallel with a plane perpendicular to the axis of the roll;

supply means operatively connected to said inlet means adapted to deliver stock thereto;

drive means operatively connected to said roll adapted to rotate said roll about its axis on said casing;

and outlet means formed on said casing in sealed communication with the casing interior and extending continuously along the full length of said roll, the circumferential width of the opening in said casing leading to said outlet means being substantially greater than the maximum radial separation between said roll and said casing.

9. A stock inlet as defined in claim 8 wherein said outlet means extends tangentially outward from said roll, the opening leading from said casing to said outlet means being progressively enlarged in the direction of rotation of said roll.

10. A stock inlet as defined in claim 8 wherein said inlet means comprises:

first and second rows of identical inlets axially spaced

an equal distance from one another, the inlets of said first row being axially interspersed between the inlets of said second row, said first and second rows of inlets being angularly spaced from one another on said casing.

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