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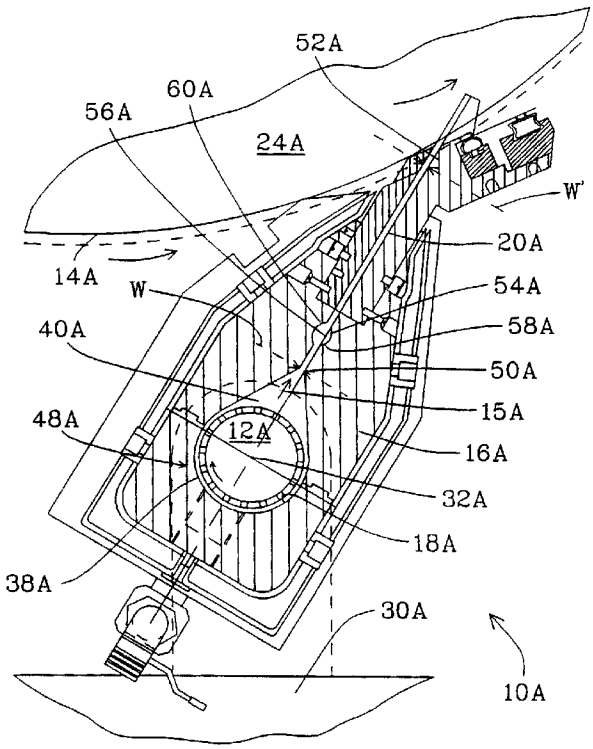

(57) Abrégé/Abstract:
A coating apparatus is disclosed for applying coating material onto a moving surface. The apparatus includes a housing (16A) which defines a chamber (18A) for the reception therein of the coating material (12A). The housing (16A) also defines an exit slot (20A) for the passage therethrough of the coating material (12A) from the chamber (18A). A shear applying device (28 A-G) is disposed within the chamber for applying shear to the coating material prior to application of the coating material onto the surface (14A). The shear reduces the viscosity of the coating material and maintains a reduced viscosity of the coating material prior to application of the coating material onto the surface so that uniform flow of the coating through the exit slot taken in a cross-machine direction is facilitated.

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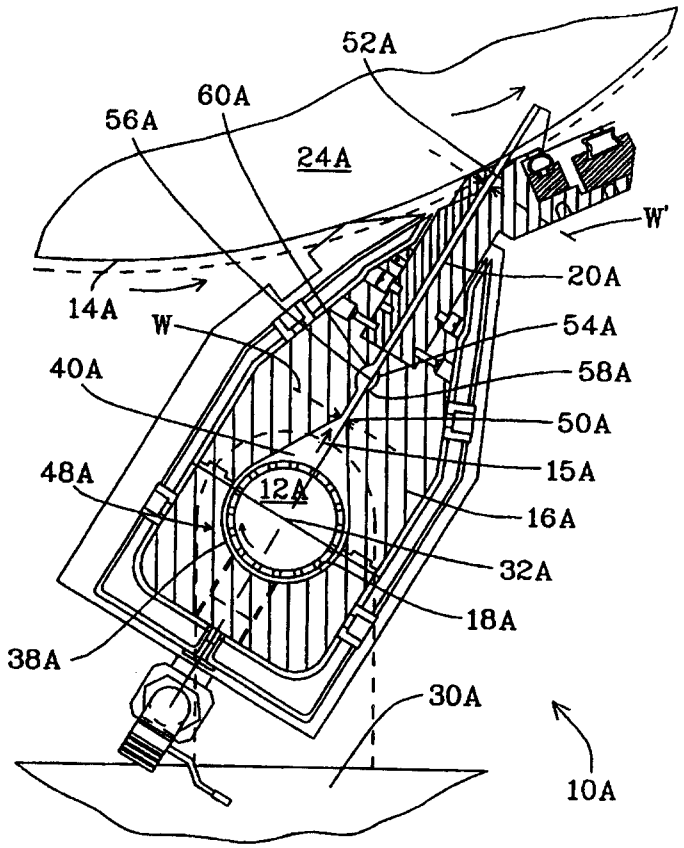
(54) Title: A COATING APPARATUS FOR APPLYING COATING MATERIAL

(57) Abstract

A coating apparatus is disclosed for applying coating material onto a moving surface. The apparatus includes a housing (16A) which defines a chamber (18A) for the reception therein of the coating material (12A). The housing (16A) also defines an exit slot (20A) for the passage therethrough of the coating material (12A) from the chamber (18A). A shear applying device (28 A–G) is disposed within the chamber for applying shear to the coating material prior to application of the coating material onto the surface (14A). The shear reduces the viscosity of the coating material and maintains a reduced viscosity of the coating material prior to application of the coating material onto the surface so that uniform flow of the coating through the exit slot taken in a cross–machine direction is facilitated.



PATENT APPLICATION

TITLE: A COATING APPARATUS FOR APPLYING COATING MATERIAL

Background of the Invention

Field of the Invention

The present invention relates to a coating apparatus for applying coating material onto a moving web or surface.

More specifically, the present invention relates to a coating housing which precedes the application of the coating material to the web or surface.

Information Disclosure Statement

In a typical coater apparatus such as the BA 1500* fountain type coater manufactured by Beloit Corporation, the housing defines a chamber for the reception therein of coating material.

The coating material under pressure flows from the chamber through a narrow slot which extends from the chamber to the vicinity of a web traveling around a smooth backing roll.

A thin ribbon of coating material is applied at the exit of the slot to the moving web and a metering blade or rod disposed immediately downstream relative to the slot meters and smoothes the coating material onto the moving web.

The metering or applicator blade is urged toward the coating material and web by means of at least one pneumatically inflatable tube or mechanical supports extending in a cross-machine direction.

* trade-mark

Additionally, a finishing blade is disposed downstream relative to the applicator blade such that the finishing blade is adjustably urged against the applied coating material for applying a finished coating contour to the coated web.

However, in recent years, there has been a tendency in the coating industry toward more specific or tailor-made coating compositions. Such specific coating compositions typically include an all synthetic composition as opposed to the more traditional types of coating material which include starch, or other materials as the binder, respectively, co-binder.

More specifically, in a typical coating composition utilizing starch as the binder, such compositions exhibit coating characteristics approaching that of a Newtonian liquid. More particularly, as in the case of water, such typical coating compositions display little change in viscosity when shear forces are applied thereto.

However, with the trend toward the use of the aforementioned synthetic coatings, there is a tendency for the viscosity of the coating material to decrease rapidly upon application of shear forces thereto.

Accordingly, in the prior art fountain coater when, for example, the coating material is supplied to the coating chamber from one side thereof, inherently, more shear is applied to the synthetic coating material at the inlet end of the chamber rather than at the opposite end of the coating chamber.

Consequently, the coating material flowing adjacent to the inlet end of the chamber acquires a lower viscosity leading towards splashing of the coating material adjacent to the inlet end. However, at the opposite end of

the coating chamber, the coating material is subjected to lesser shear forces and the viscosity of such coating material will remain relatively high.

Although it is possible to supply the coating material from both ends of the chamber or indeed from multiple inlets along the cross-machine direction of the coating chamber, clearly such a supply arrangement becomes extremely complicated. Such is the case, particularly in view of the fact that the coater housing must be permitted to rotate for adjustment of the exit slot relative to the moving web or surface.

The present invention overcomes the aforementioned problem of variations in the viscosity in the cross machine direction by the application of uniform viscosity to the coating material at an exit slot of the coating chamber.

More specifically, in order to accommodate various coating formulations, the present invention provides a shear imparting means which can be rotatable or stationary and which can be conveniently mounted in the coating chamber. In the case of a rotatable shear imparting means, the arrangement is such that the rotational speed of the shear imparting means may be varied to optimize the degree of shear imparted to the coating composition in order to insure uniform viscosity in a cross-machine direction flowing through the exit slot and onto the moving web or surface.

Therefore, it is the primary feature of the present invention to provide a coating apparatus which overcomes the aforementioned inadequacies of the prior art arrangements and which makes a significant contribution to the art of coating a moving web or surface.

Another feature of the present invention is the provision of a coating apparatus which imparts shear forces to the coating material so that the viscosity of the coating material in a cross-machine direction remains substantially uniform when such coating material is applied to a moving web or surface.

Another feature of the present invention is the provision of a rotatable shear imparting means which is driven at a speed commensurate with the type of coating formulation being used in order to optimize the cross-machine directional flow of such formulation onto the moving web.

Other features and advantages of the present invention will be readily apparent to those skilled in the art by a consideration of the detailed description contained hereinafter taken in conjunction with the annexed drawings.

The present invention applies controllable or variable shear to the coating material thus decreasing its viscosity and as a result improving the flow of the coating material in the chamber.

Moreover, in a conventional coating applicator, such as a pre-metering chamber, as stated hereinbefore, the flow of coating material will be non-uniform along a cross-machine direction as there is a tendency for the coating material to stagnate at the end of the coating chamber opposite to the chamber inlet.

By way of example, in Rotogravure Printing there is a trend toward the use of specific or tailor-made formulations which typically have very shear thinning flow characteristics. Such formulations exhibit large variations in coating material flow in the coating chamber from the inlet to

the other side of the chamber. These variations result in uneven viscosities of the coating material across the width of the web or surface to be coated.

Applicant has discovered that the provision of perforate static elements within the coating chamber enhances the cross-machine directional uniformity of the applied coating.

Nevertheless, although the provision of a static triangular shaped perforate element together with a v-shaped static element between the triangular shaped element and the exit slot improved uniformity, it was also discovered that after cleaning the coating chamber with water, coating formulation was still found to be lodged within the static elements when the coating chamber was opened for inspection.

Accordingly, and as encompassed by the present invention, the provision of a rotatable shear imparting means includes a further advantage in that such rotary shear imparting means is self-cleaning without having to dismantle the coating apparatus when changing from one formulation to another.

Also, as stated hereinbefore, the provision of a rotary shear imparting means having a variable speed of rotation makes it possible for the speed of rotation and the applied shear to be adjusted to enhance the amount of shear applied to the formulation in order to optimize cross-machine directional uniformity.

Whereas, the inventive concept according to the present invention may be applied to a coating chamber of a typical BA 1500 coater or any other chamber type coater, it has been further discovered that it is

desirable to have the rotatable shear imparting means disposed as close as possible to the inlet end of the narrow exit slot, that is, as close as possible to the web or surface to be coated.

Therefore, although in the BA 1500 coater, the coating chamber is typically of a pear-shaped or tear drop shaped configuration, a more ideal shape for the coating chamber would be cylindrical so that the rotary shear imparting means can be disposed concentrically within the coating chamber for rotation therein and so that the shear imparting element is disposed close to the exit slot. However, the ideal shape may not always be desirable taking into account the abrasion characteristics of highly pigment charged coating materials.

The present invention in its preferred form provides a coating apparatus having a driven shaft which is provided with readily replaceable shear imparting rotary elements.

Also, the apparatus according to the present invention permits the feeding of coating material from one side only into the coating chamber thereby avoiding the feeding of coating material from both ends of the coating chamber or at multiple points along the length thereof as in a so-called Christmas tree type configuration. The aforementioned one sided feed arrangement is clearly the type that is preferred by the coating industry.

The variable shear imparting mechanism according to the present invention also improves the distribution of the coating material in a cross-machine direction thereby providing more uniform flow characteristics and lower viscosity of the coating material.

Additionally, as stated hereinbefore, the present invention provides a coating apparatus which avoids the problem of increased shear adjacent to the inlet end of the coating chamber. The increased shear results in improved viscosity which permits a lower operating pressure at the exit slot of the coater chamber thereby avoiding splashing at the inlet edge or inlet edges as in the case of a coating chamber fed from both sides thereof.

Moreover, coating formulations and particularly synthetic formulations unlike stock flowing through a papermachine headbox, exhibit shear thinning characteristics. Shear thinning material such as tomato ketchup and the like, tends to flow more readily when shear forces are imparted thereto. Thus, by rapidly shaking a bottle of ketchup, shear is imparted to the ketchup which enhances the uniform flow of the material through the neck of the ketchup bottle.

In an analogous manner, when shear is imparted to the coating formulation within the coating chamber as by the rotation therein of a perforate cylindrical wall disposed within the coating chamber, such shear has an affect on the shear thinning characteristics of the coating formulation thereby enhancing the uniform flow thereof through the exit slot.

More particularly, the imparting of shear forces to the coating material provides a more homogenous coating material having a uniform viscosity and flow behavior at the exit of the slot and at any point along the length of the slot in a cross-machine direction.

Additionally, with the rotary shear imparting means according to the present invention, it is possible to operate the coater with a lower pump pressure.

Although the rotary shear imparting means rotates at a selectable rotational speed within the coating chamber, and a certain amount of clearance between the shear imparting means and the chamber is required for practical operation, it is envisaged that the aforementioned clearance may be as little as 2-3 millimeters.

The coating apparatus according to the present invention provides means for even and uniform application of coating material while providing rapid setting of the coating formulation upon application thereof to the web.

Summary of the Invention

The present invention relates to a coating apparatus and a method for applying coating material onto a moving web. The apparatus includes a housing which defines a chamber for the reception therein of the coating material. The housing also defines an exit slot for the passage therethrough of the coating material from the chamber.

Shear means are disposed within the chamber for applying shear to the coating material prior to application of the coating material onto the web or surface. The shear reduces the viscosity of the coating material and maintains a reduced viscosity of the coating material prior to application thereof onto the web or surface so that uniform flow of the coating material through the exit slot taken in a cross-machine direction is facilitated.

In a preferred embodiment of the present invention, the shear means includes a member of preferably cylindrical configuration. More specifically, the shear means includes a cylindrical member which has a peripheral perforate wall rotatably disposed within the chamber about a rotational axis

disposed substantially parallel to the cross-machine direction of the moving web. The arrangement is such that during operation of the apparatus, the coating material flows into the member and through the perforate wall thereof toward the exit slot so that shear is applied to the coating material during passage through the perforate wall for facilitating the application of a uniform flow of coating material onto the moving web or surface.

More specifically, the shear means is rotatably disposed within the chamber. The coating apparatus also includes a variable speed drive means drivingly connected to the shear means for varying the rotational speed of the shear means within the chamber commensurate with the type of coating material being applied to the moving web in order to optimize the uniform flow of the coating material through the exit slot.

Many variations and modifications of the present invention will be readily apparent to those skilled in the art by a consideration of the detailed description contained hereinafter taken in conjunction with the annexed drawings. However, such modifications and variations fall within the spirit and scope of the present invention as defined by the appended claims.

Brief Description of the Drawings

Fig. 1 is a sectional view of a typical prior art fountain type coater.

Fig. 1A is a side elevational view of another prior art coater.

Fig. 1B is a side elevational view of yet another prior art coater.

Fig. 2 is a cross-sectional view of a coater apparatus according to one embodiment of the present invention.

Fig. 3 is a reduced bottom view partially in section of the apparatus shown in Fig. 2.

Fig. 4 is a cross-sectional view of a coater apparatus according to another embodiment of the present invention.

Fig. 5 is an enlarged sectional view of a preferred embodiment of the coating apparatus according to the present invention.

Fig. 6 is a bottom view partially in section of the apparatus shown in Fig. 5.

Fig. 7 is a sectional view of yet another embodiment of the present invention.

Fig. 8 is a sectional view taken on the line of 8-8 of Fig. 7.

Fig. 9 is a sectional view taken on the line of 9-9 of Fig. 7.

Fig. 10 is a sectional view of yet a further embodiment of the present invention.

Fig. 11 is a sectional view of still another embodiment of the present invention; and

Fig. 12 is a sectional view of yet another embodiment of the present invention.

Similar reference characters refer to similar parts throughout the various embodiments of the present invention.

Detailed Description of the Drawings

Fig. 1 is a cross-sectional view of a typical fountain coater of the type known as the BA 1500 coater manufactured by Beloit Corporation.

The coating apparatus generally designated **10** applies coating material **12** on to a moving web **14**. The apparatus includes a housing **16** which defines a chamber **18** for the reception therein of the coating material **12**. The housing **16** also defines an exit slot **20** for the passage therethrough of the coating material **12** from the chamber **18**.

The enlarged inset shown in Fig. 1 shows a metering or applicator blade **22** which is disposed immediately downstream relative to the exit slot **20** for metering or applying the coating **12** onto the moving web **14** supported by a rotatable backing roll **24**.

A finishing blade **26** is disposed downstream relative to the applicator blade **22** for applying a finished configuration to the coating material **12**.

Fig. 1A is a side elevational view of a coater according to U.S. Patent No. 5,104,697 assigned to Valmet.

Fig. 1B is a side elevational view of a coater according to U.S. Patent No. 4,869,933 assigned to Voith.

The concept of the present invention may be applied as a retrofit to any of the coaters shown in Figs. 1, 1A or 1B.

Fig. 2 is an enlarged cross-sectional view of a coating apparatus generally designated **10A** according to one embodiment of the present invention. More specifically, Fig. 2 shows the concept of the present invention included as a retrofit to the BA 1500 coater manufactured by Beloit Corporation. The coating apparatus **10A** applies coating material **12A** onto a moving web indicated by the dashed line **14A**. The coating apparatus **10A** includes a housing **16A** defining a chamber **18A** for the reception therein of the coating material **12A**. The housing **16A** also defines an exit slot **20A** for the passage therethrough of the coating material **12A** from the chamber **18A**.

Shear means generally designated **28A** are disposed within the chamber **18A** for applying shear to the coating material **12A** prior to the application of the coating material **12A** on the web **14A**. The shear reduces the viscosity of the coating material **12A** and maintains a reduced viscosity of the coating material **12A** prior to the application of the coating material **12A** onto the web **14A**. The arrangement is such that a uniform flow as indicated by the arrow **15A** of the coating material **12A** through the exit slot **20A** taken in a cross-machine direction is facilitated.

As shown in Fig. 2, the coating apparatus **10A** also includes a frame **30A** with the housing **16A** being pivotally secured to the frame **30A** about a pivotal axis **32A** which is disposed substantially parallel to the cross-machine direction of the moving web **14A**. The arrangement is such that adjustment of the location of the exit slot **20A** relative to the moving web **14A** is permitted.

The BA 1500 coater partially shown in Fig. 2 typically includes the chamber **18A** which is of generally tear-drop shaped configuration when taken in a section perpendicular to the cross-machine direction of the moving web **14A**.

More specifically, the tear-drop sectional configuration of the chamber **18A** includes a first portion **38A** having a partially cylindrical configuration and a second portion **40A** which is disposed between the first portion **38A** and the exit slot **20A**. The second portion **40A** is of triangular sectional configuration.

Fig. 3 is a reduced bottom plan view partially in section of the arrangement shown in Fig. 2 and shows the coating apparatus as including an inlet **42A** which is disposed in fluid communication with the chamber

18A for permitting the flow as indicated by the arrow **44A** of the coating material **12A** through the inlet into the chamber **18A**.

As shown in Fig. 3, the chamber **18A** includes a first and a second end **46A** and **48A**, respectively, the inlet **42A** being connected to the first end **46A** of the chamber **18A**.

The exit slot **20A** also includes a first and a second extremity **50A** and **52A**, respectively with the first extremity **50A** extending from the chamber **18A** and the second extremity **52A** being disposed adjacent to the moving web **14A** during operation of the coating apparatus **10A**.

As shown in Fig. 2, the exit slot **20A** tapers from the first extremity **50A** toward the second extremity **52A**. The arrangement is such that the second extremity **52A** of the exit slot **20A** is more narrow than the first extremity **50A**.

More specifically, the first extremity **50A** has a width W within the range 2 to 4 millimeters and preferably 3 millimeters while the second extremity **52A** has a width W' within the range .6 to 1.9 millimeters and preferable 1.5 millimeters.

As shown in Figs. 2, the exit slot **20A** further includes an expansion chamber **54A** which is disposed between the first and the second extremity **50A** and **52A**, respectively. The expansion chamber **54A** is of generally cylindrical sectional configuration having an axis of symmetry **56A** disposed substantially parallel to the cross-machine direction of the moving web **14A**.

The expansion chamber **54A** as shown in Fig. 2 also includes an upstream portion **58A** which tapers outwardly in a direction from the first extremity **50A** toward the second extremity **52A** and a downstream portion **60A** which tapers inwardly in a direction from the first extremity **50A** toward the second extremity **52A**.

Fig. 4 is a sectional view of a further embodiment of the subject invention in which the shear means **28B** includes a perforated plate **62B** which extends along substantially the entire width of the chamber **18B** in a direction substantially parallel to the cross-machine direction of the moving web **14B**. The arrangement is such that during operation of the apparatus **10B**, when the coating material **12B** flows through the perforated triangular shaped plate **62B** toward the exit slot **20B**, a shearing action is applied to the coating material **12B** which reduces the viscosity of the coating material **12B** so that such reduced viscosity is maintained during passage of coating material **12B** through the exit slot **20B** such that uniformity of flow of coating material **12B** onto the moving web **14B** in a cross-machine direction is enhanced.

Also, as shown in Fig. 4, coating material **12B** is supplied from an inlet to the inside of the plate **62B**. The coating material has shear applied thereto as the coating flows through the perforated plate **62B** and a V-shaped perforated plate **63B** disposed between the plate **62B** and the exit slot **20B**.

Fig. 5 is a sectional view of a preferred embodiment of the present invention, in which the chamber **18C** is of cylindrical configuration. The chamber **18C** has an axis of symmetry **36C** which is disposed substantially parallel to the cross-machine direction of the moving web **14C**.

In the preferred embodiment of the present invention as shown in Fig. 5, the shear means **28C** includes a member **64C** of substantially cylindrical configuration. The cylindrical member **64C** has a peripheral perforate wall **66C** which is rotatable disposed within the chamber **18C** about rotational axis **36C** disposed substantially parallel to the cross-machine direction of the moving web **14C**. The arrangement is such that during operation of the apparatus **10C**, the coating material **12C** flows into a stationary perforated distribution tube **62C** extending in a cross machine direction from the inlet. Thereafter, the coating **12C** flows through the member **64C** and through the perforate wall **66C** thereof toward the exit slot **20C** so that a shear force is applied to the coating material **12C** during passage thereof through the wall **66C** for facilitating the application of a uniform flow of coating material **12C** onto the moving web **14C**.

In the preferred embodiment of the present invention, the shear means **28C** is rotatably disposed within the chamber **18C** as indicated by arrow **19C**.

Fig. 6 is a bottom view of the apparatus **10C** shown in Fig. 5. As shown in Fig. 6, the coating apparatus **10C** also includes a variable speed drive means **70C** drivingly connected to the shear means **28C** for varying the rotational speed of the shear means **28C** within the chamber **18C** commensurate with the type of coating material **12C** being applied to the moving web **14C** in order to optimize the uniform flow of the coating material through the exit slot **20C** as shown in Fig. 5.

As shown in Figs. 2-6 coating apparatus **10A-10C** applies a shear thinning coating material **12A-C** onto a moving web **14A-C**. The apparatus **10A-C** includes a housing **16A-C** defining a chamber **18A-C** for the reception therein of the coating material **12A-C**. The housing **16A-C** also

defines an exit slot **20A-C** for the flow therethrough of the coating material **12A-C** from the chamber **18A-C**.

Shear means **28A-C** are disposed within the flow for imparting shear to the coating material **12A-C** prior to application of the coating material **12A-C** on the web **14A-C**. Such shear alters the shear thinning characteristics of the coating material **12A-C** so that uniform flow of the coating material **12A-C** through the exit slot **20A-C** when taken in a cross-machine direction is maintained.

The present invention also encompasses a method of applying a coating **12A-C** on a web **14A-C**. The method comprises the steps of feeding the coating **12A-C** into a chamber **18A-C** defined by the coater housing **16A-C**. The coater housing **16A-C** also defines an outlet slot **20A-C** which extends from the chamber **18A-C** toward the web **14A-C**.

The method includes the step of applying shear to the coating so that the viscosity of the coating flowing from the chamber **18A-C** through the slot **20A-C** is reduced such that taken in a cross-machine direction, a uniform flow rate of the coating is maintained as the coating flows through the slot **20A-C** for application onto the web.

Fig. 7 is a sectional view of a further embodiment of the present invention. Fig. 7 shows a coating apparatus **10D** having a shear means generally designated **28D**. The shear means **28D** includes a plurality of disks **72D, 73D** and **74D** of various diameters.

Fig. 8 is a sectional view taken on the line 8-8 of Fig. 7 and shows that each of the disks **72-74D** and as shown in Fig. 8 the disk **74D** as

having a plurality of peripheral cutting edges **76D**, **77D** and **78D** for imparting shear to the coating material **12D**.

Fig. 9 is a sectional view taken on the line 9-9 of Fig. 7 and shows the plurality of disks of various diameters including disks **72D-74D**. The drive means **70D** drives the longitudinal shaft **71D** to which all of the disks **72-74D** are rigidly secured.

Fig. 10 shows yet another embodiment of the present invention which is similar to the embodiment shown in Figs. 5 and 6. However, in the arrangement shown in Fig. 10, the apparatus **10E** includes a cylindrical shear imparting means **28E** in which the spacing of the shear imparting holes such as **80E** and **81E** is greater at the inlet **42E** than at the opposite end **48E** of the chamber **18E**. In the aforementioned manner, the amount of shear imparted to the coating can be varied from the first end **46E** to the second end **48E** of the chamber **18E**.

Additionally, Fig. 11 is a diagrammatic representation of yet another embodiment of the present invention. Fig. 11 shows a coating apparatus **10F** having a plurality of inlets **42F** and a shear imparting means **28F** which defines a plurality of holes **80F-81F** disposed between the first and second ends **46F** and **48F** of the chamber **18F**.

Fig. 12 is a diagrammatic representation of another embodiment of the present invention. Fig. 12 shows a coating apparatus **10G** in which the shear imparting means **28G** includes a plurality of disks **72G**, **73G** and **74G** disposed between the first and second ends **46G** and **48G** of the chamber **18G**. The arrangement is such that a uniform flow and viscosity of the coating material is attained prior to the flow of the coating material through the exit slot for application on to the web.

In both the arrangements shown in Figs. 11 and 12, the holes and disks, respectively, are dimensioned to accommodate the inlet points **100F** and **100G** respectively, where lower shear is needed.

As will be appreciated by those skilled in the art, there are many variations that fall within the spirit and scope of the inventive concept of the present invention. The configuration of the shear imparting means will in many respects depend on the type of coating material being used and the quality of the web that is to be coated.

The shear rate is influenced by the rotational speed of the motor and the number and diameter of the holes in the rotating cylinder.

In the case of the embodiment including rotating disks, the shear rate will be influenced by the diameter of the disks and the dimensions of the razor edges which may be of rectangular configuration.

Accordingly, the rate of shear will increase with the number of holes or slits provided in the rotating cylinder and will increase when the diameter of the holes or width of the slits is decreased.

Similarly, the shear rate will increase with the number and diameter of the disks and the size of the razor edges.

The shear rate can be optimized by varying the design of the rotor shear imparting means dependent on the number of inlets for the coating color.

Additionally, the rate at which the shear imparting means is rotated may be adjusted relative to the coating color pump speed in order to optimize uniformity of flow.

In general, the shear generated by the shear imparting means should ideally be higher than the shear generated by the structure following the shear generator and prior to the metering or pre-metering elements such as a blade or rod.

The concept of the present invention also includes the application thereof in connection with a blade metering size press where the coating is applied to the surface of a roll for subsequent transfer to a web moving past such coated roll.

The present invention provides a unique coating apparatus which is eminently suitable for the application of highly synthetic coating compositions in which the application of shear to the coating material causes reduced viscosity and uniform flow of the coating material onto the web to be coated.

While the invention has been described in connection with certain shear producing elements which are currently considered to be the best practical way of imparting shear to the coating mixture, it will be understood by those skilled in the art that other shear inducing elements can be readily used. For example, a smooth non-perforate cylinder will impart a certain amount of shear and can be useful for certain coating formulations. Other shear inducing devices well known to those versed in the art of preparing coating mixture can be readily adapted to practice the principles of the present invention.

CLAIMS

1. A coating apparatus for applying onto a moving surface a coating material having viscosity dependent on shear, said apparatus comprising:

a housing defining a chamber for the reception therein of the coating material, said housing also defining an exit slot for the passage therethrough of the coating material from said chamber; and

shear means disposed within said chamber for applying shear to the coating material prior to application of the coating material onto the moving surface, said shear reducing the viscosity of the coating material and maintaining a reduced viscosity of the coating material prior to application of the coating material onto the moving surface so that uniform flow of the coating material through said exit slot taken in a cross-machine direction is facilitated,

wherein said shear means includes a member of substantially cylindrical configuration, said cylindrical member having a peripheral perforate wall which is rotatably disposed within said chamber about a rotational axis disposed substantially parallel to said cross-machine direction of the moving surface, the arrangement being such that during operation of the apparatus, the coating material flows into said member and through said perforate wall thereof towards said exit slot so that said shear is applied to the coating material for facilitating the application of a uniform flow of the coating material onto the moving surface.

2. A coating apparatus as set forth in claim 1 further including:

a frame;

said housing being pivotally secured to said frame abut a pivotal axis which is disposed substantially parallel to said cross-machine direction of the moving web, the arrangement being such that adjustment of the location of said exit slot relative to the moving web is permitted.

3. A coating apparatus as set forth in claim 1 wherein said chamber is of cylindrical configuration, said chamber having an axis of symmetry disposed substantially parallel to said cross-machine direction of the moving web.

4. A coating apparatus as set forth in claim 1 wherein said chamber is of generally tear-drop shaped configuration when taken in a plane which extends along the direction of movement of the web and perpendicular to the web.

5. A coating apparatus as set forth in claim 4 wherein said chamber of tear drop sectional configuration includes.

a first portion having a part-cylindrical configuration;

a second portion disposed between said first portion and said exit slot, said second portion being of triangular sectional configuration.

6. A coating apparatus as set forth in claim 1 further including:

an inlet disposed in fluid communication with said chamber for permitting the flow of the coating material through said inlet into said chamber.

7. A coating apparatus as set forth in claim 6 wherein said chamber includes a first and a second end, said inlet being disposed to said first end of said chamber.

8. A coating apparatus as set forth in claim 1 wherein said exit slot includes:

a first and a second extremity, said first extremity extending from said chamber, said second extremity being disposed adjacent to the moving web during operation of said coating apparatus.

9. A coating apparatus as set forth in claim 8 wherein said exit slot tapers from said first extremity toward said second extremity, the arrangement being such that said second extremity of said exit slot is more narrow than said first extremity.

10. A coating apparatus as set forth in claim 9 wherein

said first extremity has a width within the range 2 to 4 millimeters;

said second extremity has a width within the range .6 to1.9 millimeters.

11. A coating apparatus as set forth in claim 8 wherein said exit slot further includes:

an expansion chamber disposed between said first and second extremity, said expansion chamber being of generally circular sectional configuration having an axis of symmetry disposed substantially parallel to said cross-machine direction of the moving web.

12. A coating apparatus as set forth in claim 11 wherein said expansion chamber further includes:

an upstream portion which tapers outwardly in a direction from said first extremity toward said second extremity;

a downstream portion which tapers inwardly in a direction from said first extremity toward said second extremity.

13. A coating apparatus as set forth in claim 1 wherein said shear means includes:

a perforated plate which extends along substantially the entire width of said chamber in a direction substantially parallel to the cross-machine direction of the moving web, the arrangement being such that during operation of the apparatus, when the coating material flows through said perforated plate toward said exit slot, a shearing action is applied to the coating material which reduces the viscosity of the coating material so that such reduced viscosity is maintained during passage of the coating material through said exit slot such that uniformity of flow of the coating material onto the moving web in a cross-machine direction is enhanced.

14. A coating apparatus as set forth in claim 1 wherein

said shear means is rotatably disposed within said chamber;

said coating apparatus further including:

variable speed drive means drivingly connected to said shear means for varying a rotational speed of said shear means within said chamber commensurate with the type of coating material being applied to the moving web in order to optimize said uniform flow of the coating material through said exit slot.

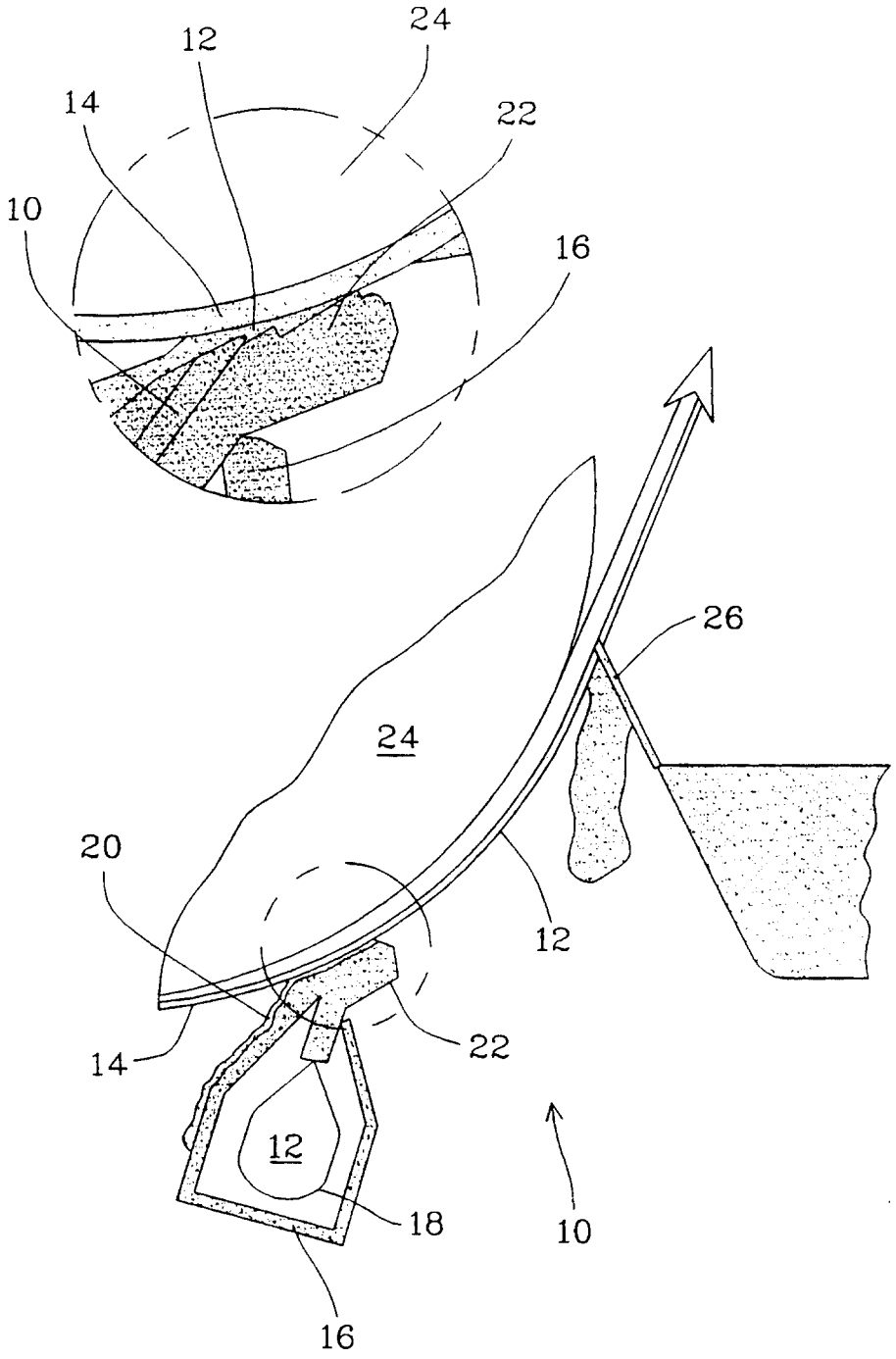


Fig. 1

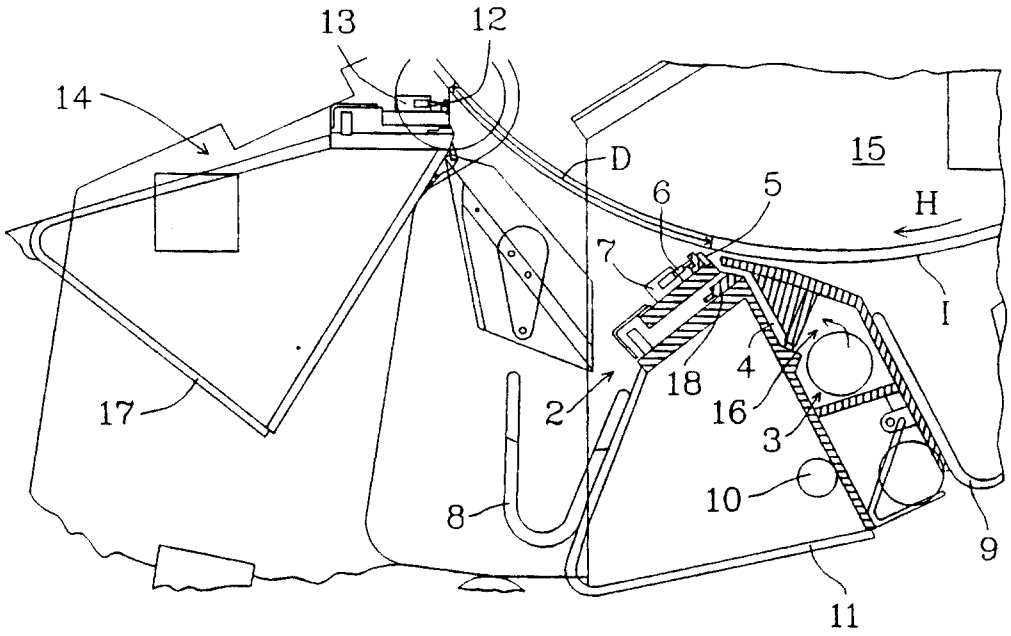

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Fig. 1A

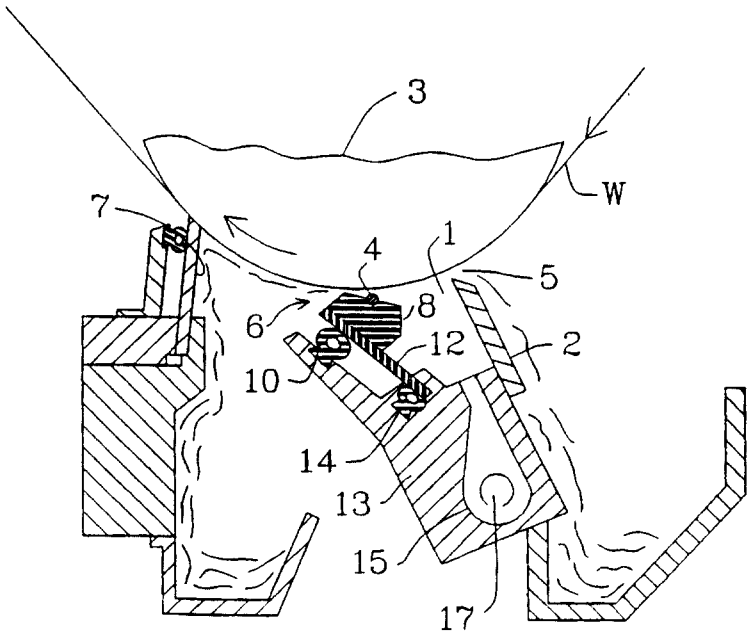
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Fig. 1B

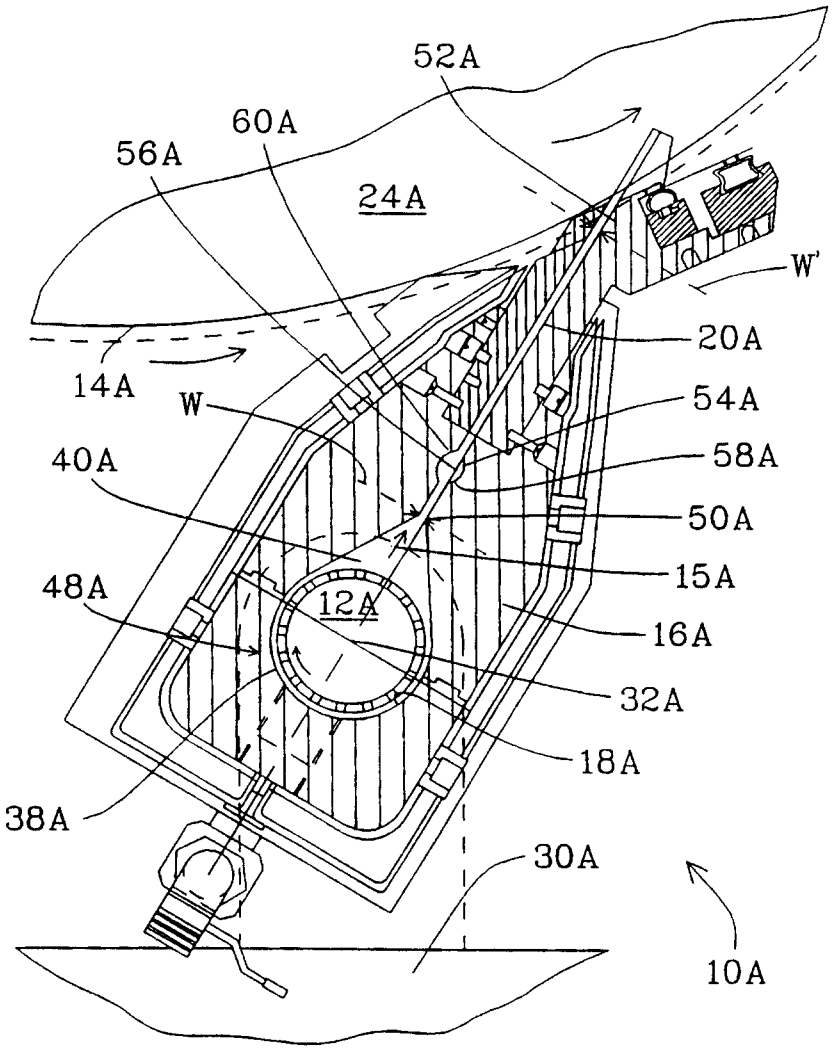
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Fig. 2

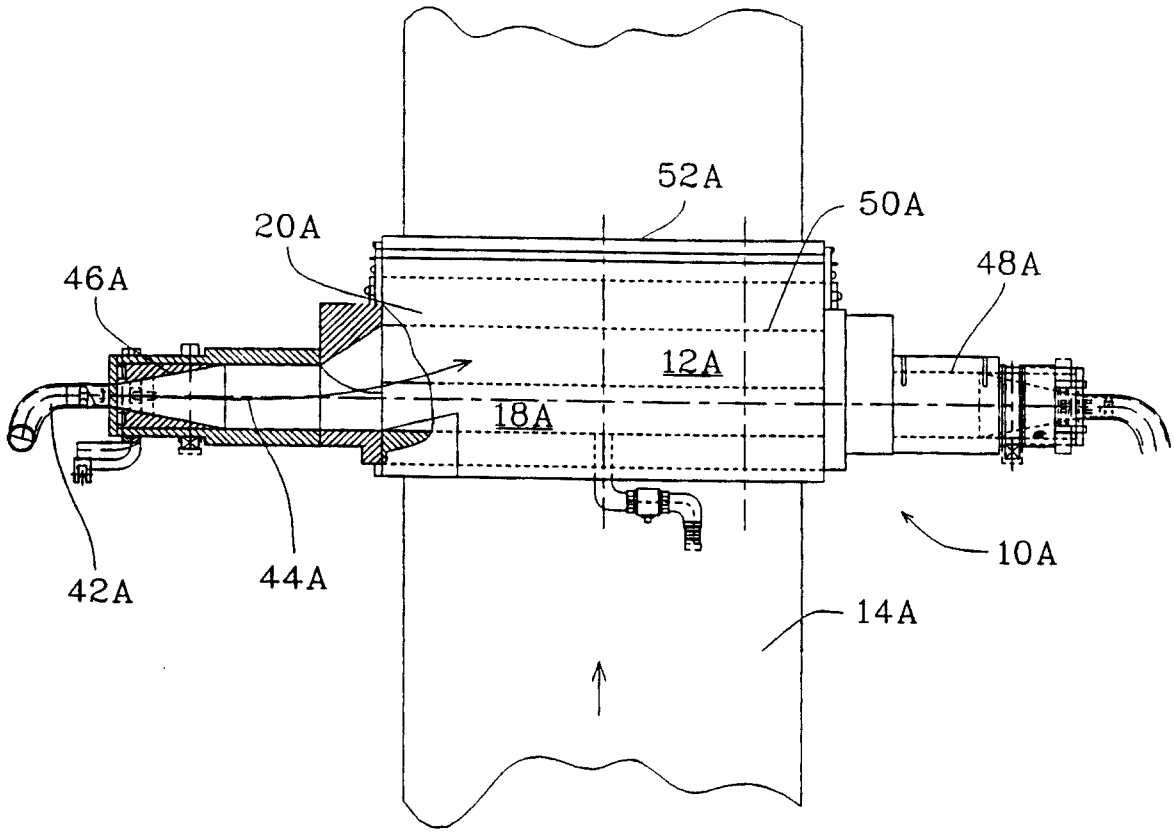

Fig. 3

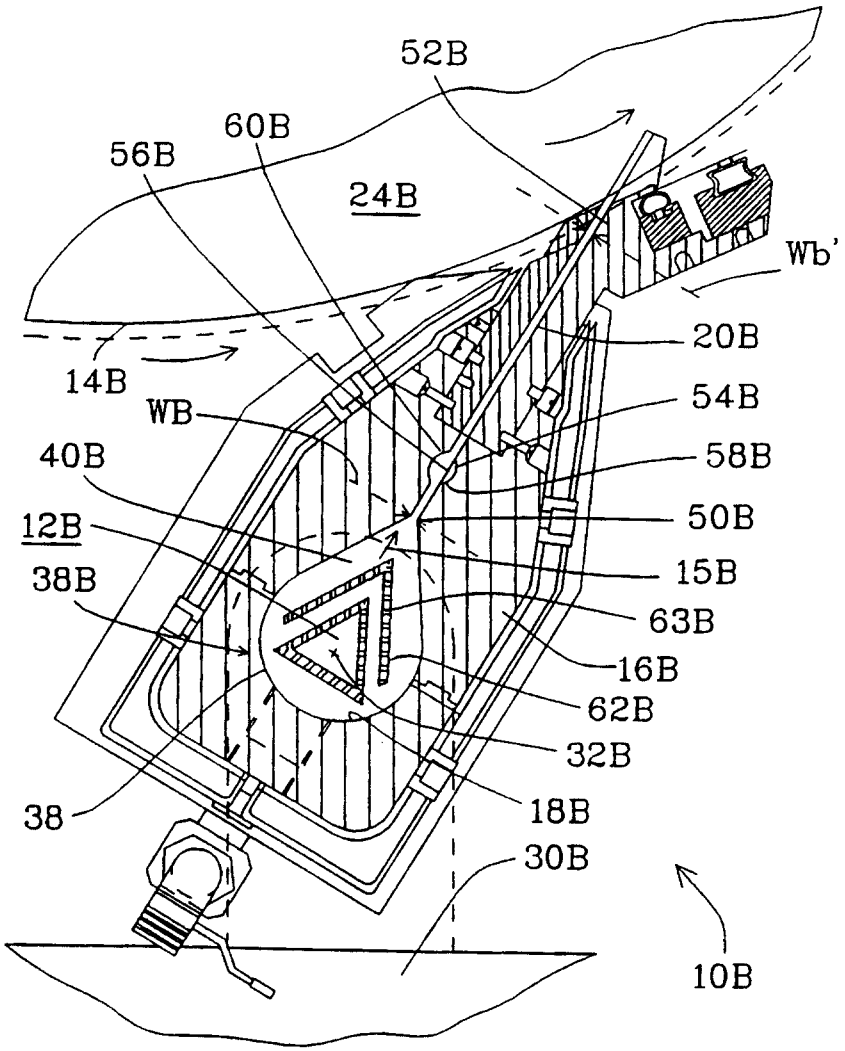
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Fig. 4

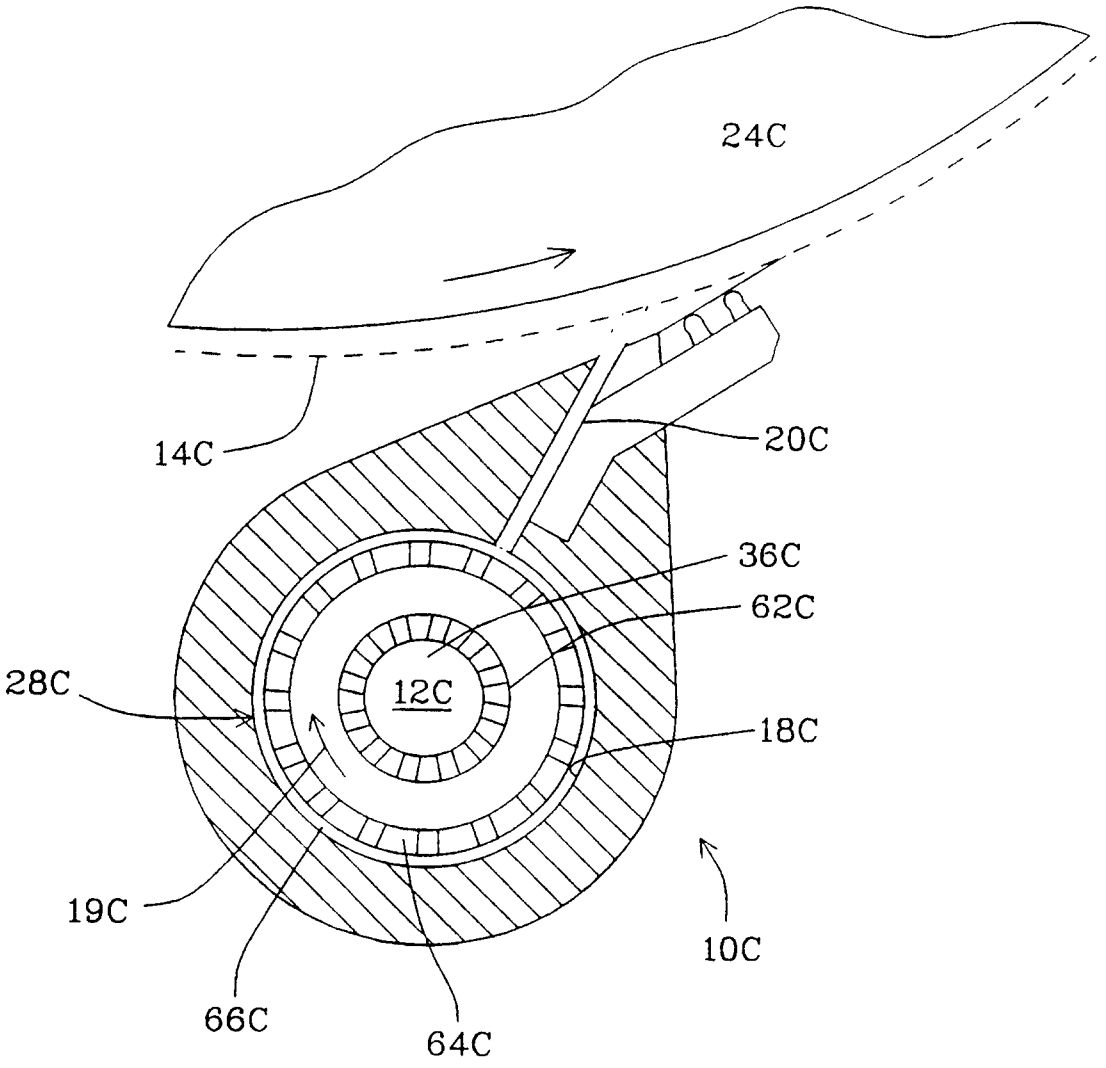


Fig. 5

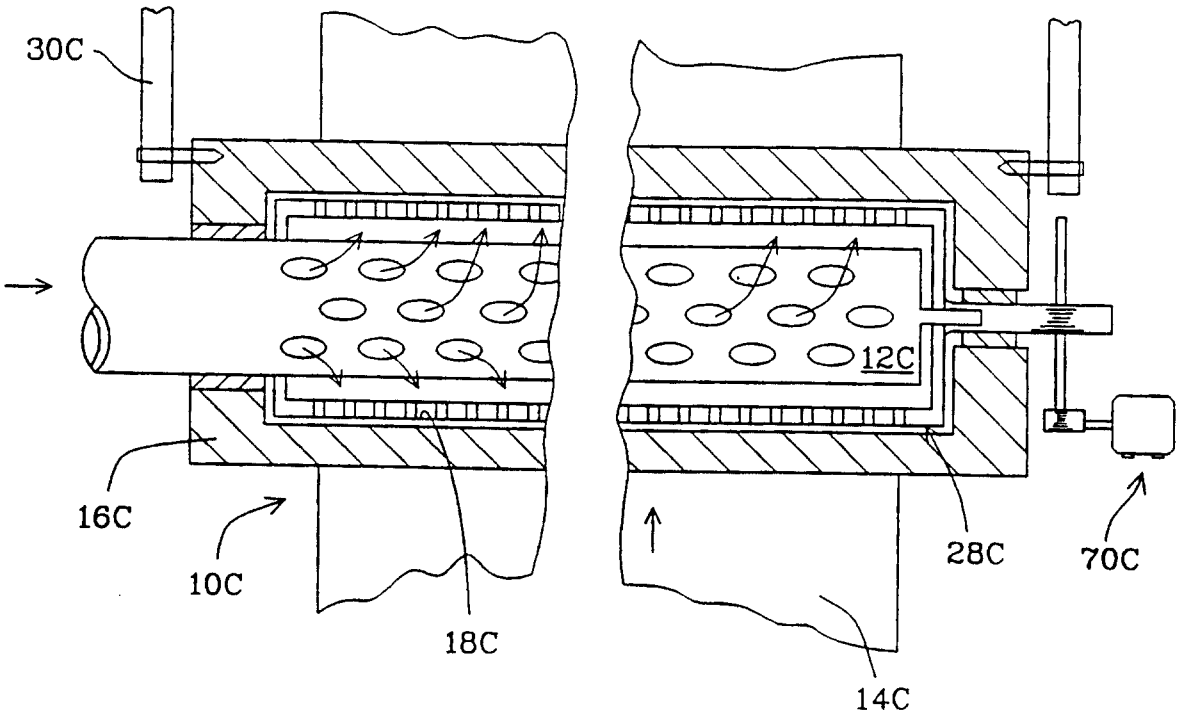


Fig. 6

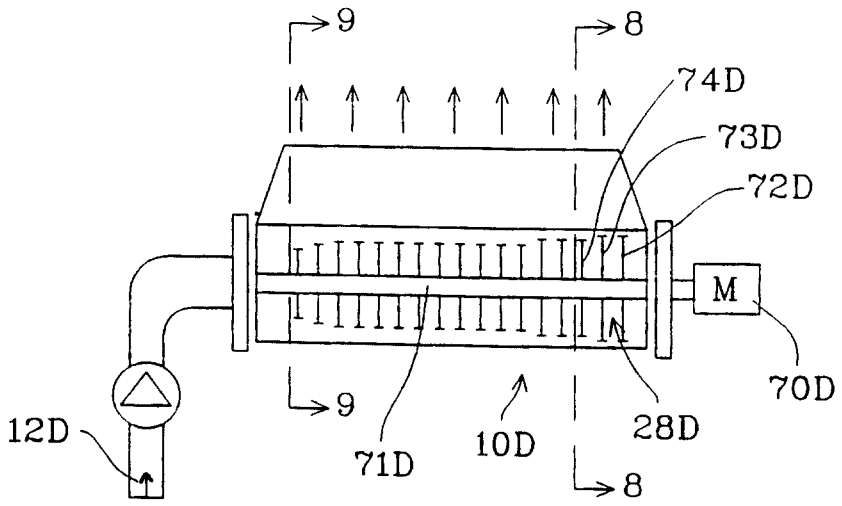


Fig. 7

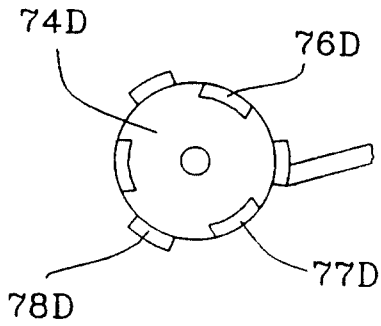


Fig. 8

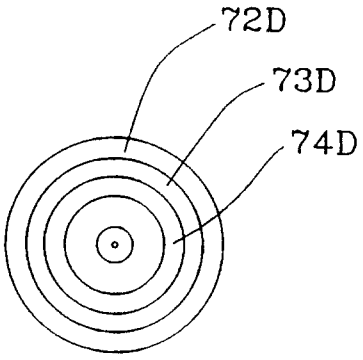


Fig. 9

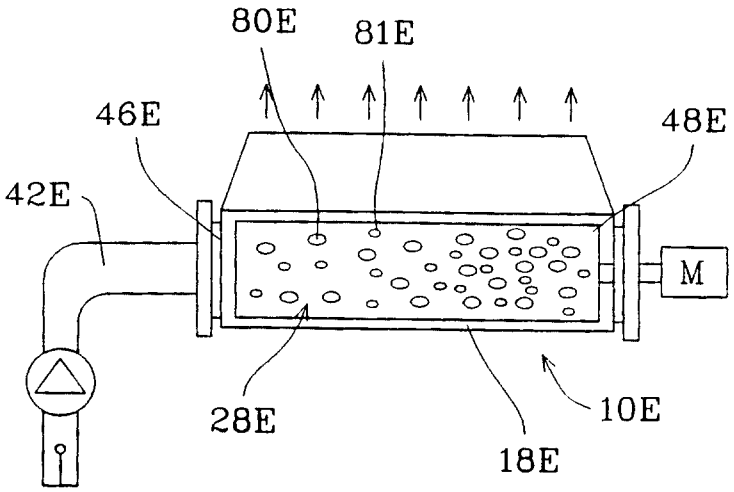


Fig. 10

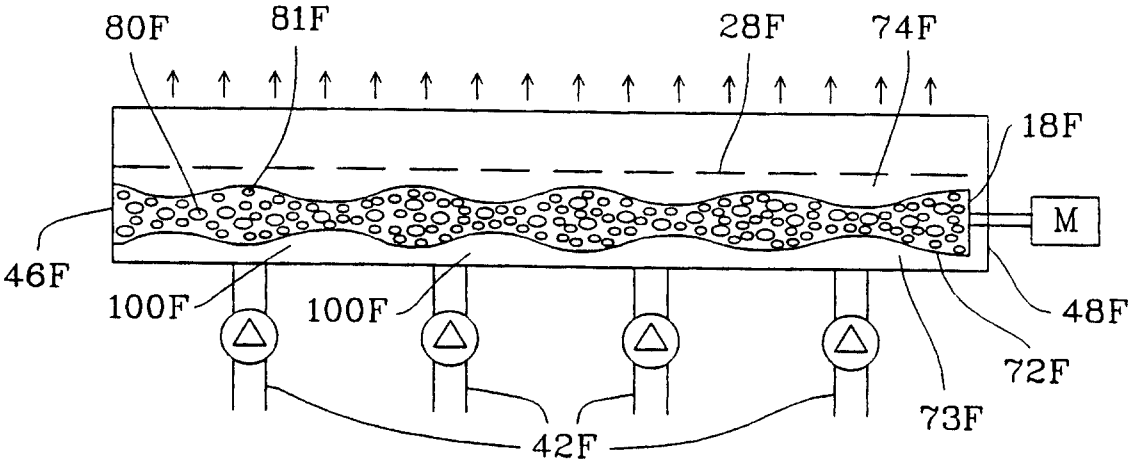


Fig. 11

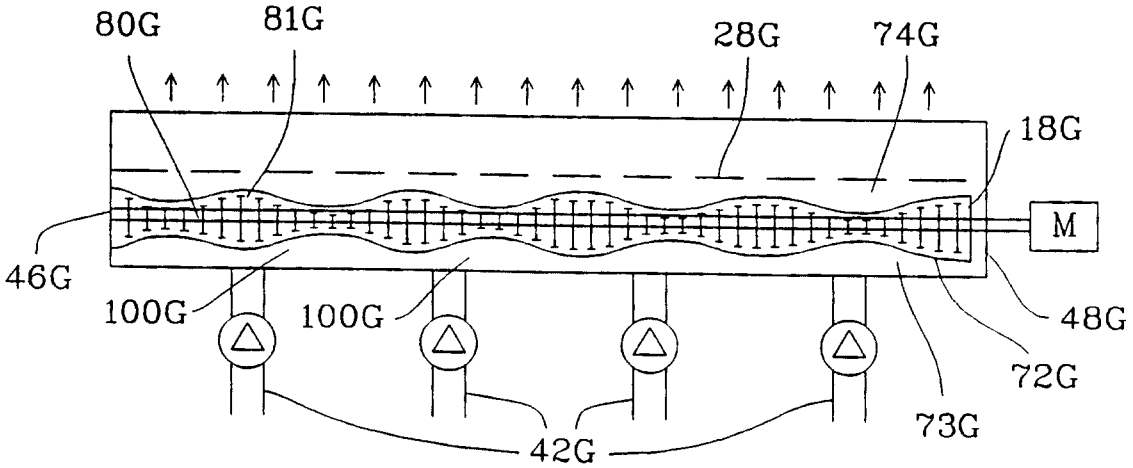
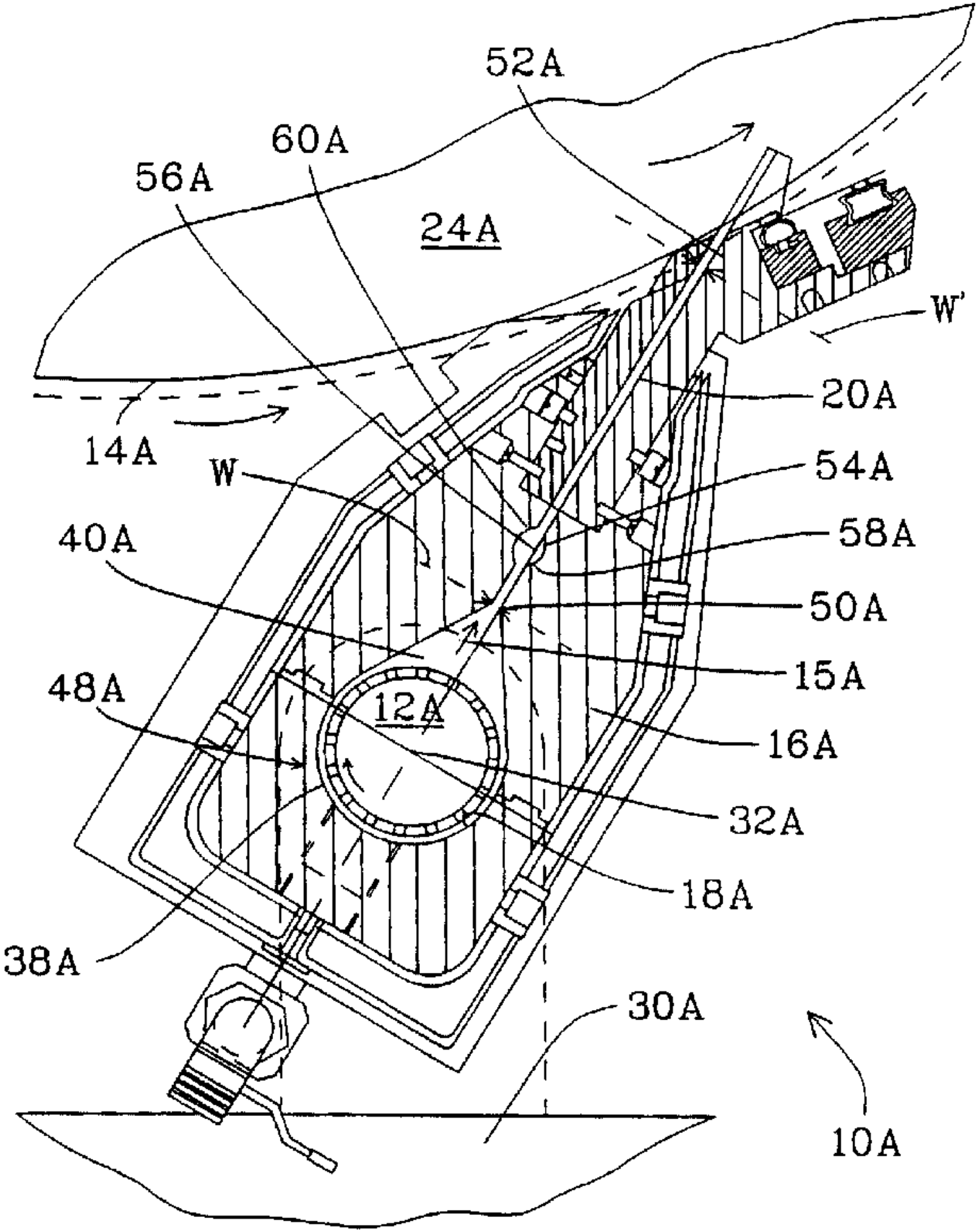


Fig. 12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