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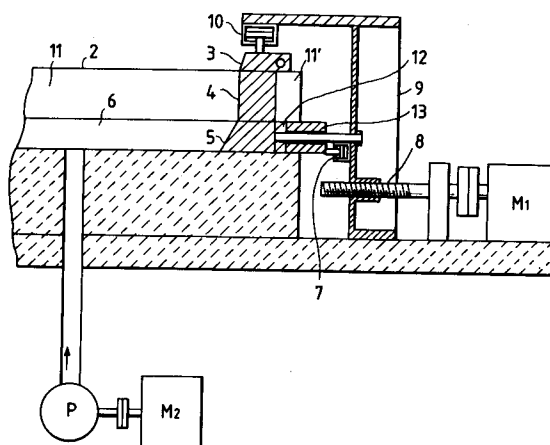
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W-8000 München 22 (DE)(54) **Coating method and apparatus.**

(57) In a coating method or apparatus in which a coating solution is applied through a coating nozzle to a belt-shaped flexible support which is run continuously, a coating width regulating member together with a seal member is employed which includes a guide board, a spacer inserted into the slit of the coating nozzle, and a pocket plug inserted into the pocket of the latter, the seal member being used for preventing the leakage of the coating solution from a pocket plug inserting hole, and drive means operates to move the coating width regulating member and the seal member in a direction of width of the coating nozzle according to a given coating width, whereby, when a coating width is changed, the flow rate of the coating solution is changed that a coating solution layer formed on the support is uniform in thickness.

FIG. 1**EP 0 530 751 A1**

BACKGROUND OF THE INVENTION

This invention relates to a method of coating a belt-shaped flexible support with a coating solution to manufacture photographing photo-sensitive materials such as photographing film and photographic paper, photographic printing plate materials, photo-sensitive sheets, heat-sensitive sheets, magnetic materials, and so forth, and an apparatus for practicing the method, and more particularly to a coating method in which a coating width is changed, and an apparatus for practicing the method.

Heretofore, in a coating operation with a coating apparatus having a coating nozzle for jetting a coating solution, in order to change the width of a belt-shaped flexible support, or to change the coating width according to the size of a product to be formed, at least the guide board, preferably the guide board and the spacer for regulating the width of the slit of the coating nozzle, and the pocket plug for regulating the width of the pocket of the coating nozzle are moved according to the coating width, or exchanged for those different in dimension, and the speed of rotation of the coating solution supplying pump is also changed according to the coating width. For this purpose, the operation of the coating apparatus is suspended for about one hour. During this pause period, the apparatus is lowered in work efficiency, and the coating solution is wasted. This difficulty is serious especially in the manufacture of a photographing photo-sensitive material. That is, if the supplying of the coating solution is stopped during the pause period, then it will be solidified. In order to overcome this difficulty, even if the apparatus is stopped, a small quantity of coating solution is kept supplied to the extent that it is not solidified. This loss of the coating solution during the pause period cannot be disregarded. On the other hand, in order to change the coating width, it may be necessary to remove the coating solution from the coating nozzle; however, if the coating solution is removed in this manner, then it is essential to wash the coating nozzle before the coating operation is started again.

In view of the foregoing, coating apparatuses with which a coating width can be changed relatively quickly have been disclosed by Japanese Patent Application (OPI) No's 109616/1982, 107368/1990, and 95363/1981, Japanese Utility Model Application (OPI) No. 120974/1989, and Japanese Patent Application No. 34942/1989 (the term "OPI" as used herein means an "unexamined published application").

In the apparatuses disclosed by Japanese Patent Application (OPI) No's 109616/1982 and 95363/1981, and Japanese Patent Application No. 34942/1989, the width of an extrusion molding die is changed by controlling the die lip, and no countermeasure against the leakage of solution is provided, and when the width of the die lip is changed, the flow rate of solution is not controlled. Hence, when the die width is changed, the resultant product is not uniform in film thickness, thus being unacceptable.

One of the apparatuses disclosed by Japanese Utility Model (OPI) No. 120974/1989 is so designed that the end of a base board (or support) is detected to drive a masking bar, and, when the width of the base board is changed, control is so made as to make the coating width constant, or to make the non-coating width constant. Another apparatus disclosed thereby is free from problems that the coating solution leaks to the backup roll, thus lowering the yield. Those apparatuses are still disadvantageous in that they also suffer from the above-described two difficulties, and with a support constant in width, the coating width cannot be freely changed according to the size of a product to be formed.

In the apparatus disclosed by Japanese Patent Application (OPI) No. 107368/1990, the coating width is changed by exchanging the spacer member; that is, the coating width cannot be changed without suspension of the operation of the apparatus.

SUMMARY OF THE INVENTION

Accordingly, an object of this invention is to eliminate the above-described difficulties accompanying a conventional coating method or apparatus.

More specifically, an object of the invention is to provide a coating method in which a period of time required for changing a coating width is minimized, or zeroed.

Another object of the invention is to provide a coating apparatus with which a loss of coating solution which otherwise incurs when a coating width is changed is minimized or zeroed, and the coating width can be changed while a coating operation is being performed; that is, even when the coating width is changed, a coating solution layer formed on the support is uniform in thickness.

A further object of the invention is to provide a coating apparatus in which the leakage of coating solution from the coating nozzle is minimized, and even when the coating solution has leaked more or less and has been solidified, the coating operation is carried out smoothly.

According to one aspect of the invention, there is provided a coating method in which a coating solution supplied to a coating nozzle is applied through a slit in the coating nozzle to a belt-shaped flexible support

which is continuously run, in which, according to the invention, when a coating width is changed, the coating solution is changed in flow rate so that a coating solution layer formed on the support by the coating solution is uniform in thickness.

According to another aspect of the invention, there is provided a coating apparatus in which a coating solution supplied to a coating nozzle is applied through a slit in the coating nozzle to a belt-shaped flexible support which is continuously run, which comprises: a coating width regulating member including parts which are inserted into a pocket and a slit in the coating nozzle and/or a guide board; a seal member for preventing the leakage of the coating solution from an inserting hole through which the part of the coating width regulating member is inserted into the pocket; and drive means for moving the coating width regulating member and the seal member in a direction of width of the coating nozzle.

In the coating apparatus, the seal member is made of an elastic material.

More specifically, the seal member comprises: a cup-shaped head portion equal in sectional area to the pocket; and a barrel portion integral with the head portion which is smaller in sectional area to the pocket. When the seal member is installed, the head portion is radially outwardly spread even with a small force applied to the end face of the barrel portion, thus providing a sealing effect.

Furthermore in the coating apparatus, the guide board has a washing water supplying hole in its surface which is brought into contact with the opening of the slit of the coating nozzle.

In the invention, the coating nozzle has a slit or slits; that is, it includes both an extrusion type coating nozzle, and a slide hopper type coating nozzle. More specifically, the coating nozzle includes not only one having one slit but also one having a plurality of slits for forming a plurality of coating solution layers simultaneously.

Furthermore, the coating method and the coating apparatus according to the invention include methods of forming extrusion coatings, bead coatings, and curtain coatings, and apparatuses for practicing the methods.

The nature, principle, and utility of the invention will be more clearly understood from the following detailed description of the invention when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING(S)

In the accompanying drawings:

FIGS. 1 and 2 are a front view and a side view, respectively, showing part of a multi-slide-hopper type coating nozzle equipped with one example of a coating width regulating member according to this invention;

FIGS. 3 and 4 are a front view and a side view, respectively, showing part of a multi-extrusion type coating nozzle equipped with another example of the coating width regulating member according to the invention;

FIG. 5 is a sectional view of a cup-shaped seal member employed in the invention; and

FIG. 6 is a side view showing a washing water supplying hole in detail which is employed in the invention.

DETAILED DESCRIPTION OF THE INVENTION

One embodiment of this invention will be described with reference to the accompanying drawings.

In the embodiment, as shown in FIGS. 1 and 3, a coating nozzle 2 is used to apply a coating solution to a belt-shaped flexible support 1 which is run continuously. The coating solution is supplied from a coating solution supplying pump P driven by an electric motor M2. In this coating operation, in order to change a coating width, a coating width regulating member is used which comprises a part which is inserted into a pocket, and a part inserted into a slit and/or a guide. That is, the coating width regulating member is used to change the flow rate of coating solution according to a given change in coating width. For this purpose, the speed of rotation of a motor M2, which is drive means for moving the coating width regulating member in a direction of width of the coating nozzle, is controlled.

In this case, a control unit may be employed in which a computer specifies a suitable speed of rotation for the motor M2 so that the flow rate of coating solution be proportional to the given coating width.

The coating width regulating member according to the invention comprises at least a guide board 3 in the case of FIG. 1; preferably, the guide board 3, a spacer 4 inserted into the slit of the coating nozzle, and a pocket plug 5 inserted into the pocket of the latter in combination. In the case of FIG. 2, it comprises: at least a spacer 4 inserted into a slit; preferably the spacer 4 and a pocket plug 5 in combination.

A seal member 12 is provided for prevention of the leakage of coating solution from a pocket plug inserting hole into which the pocket plug of the coating width regulating member is inserted. More specifically, the seal member is used to prevent the coating solution from leaking through the gap between the pocket 6 and the pocket plug 5, and it is shaped as shown in FIGS. 1, 3 and 5. The seal member 12 is made of an elastic material such as natural rubber, synthetic rubber, and sponge. An air cylinder 7 is used to push the seal member 12 so that its end face is radially outwardly spread to sealingly close the gap between the pocket 6 and the pocket plug 5.

The aforementioned drive means for moving the coating width regulating member and the seal member in a direction of width of the coating nozzle operates to move the coating width regulating member according to a given coating width so that the coating width is changed. For this purpose, it transmits the rotation of an electric motor M1 through a screw 8 to a frame 9.

The guide board 3 is moved according to a given coating width, and it is generally made of synthetic resin. During a coating operation, the guide board 3 is held pushed against the coating nozzle 2 by guide board pushing means, namely, an air cylinder 10; however, when it is required to move the guide board for the purpose of changing the coating width, the pushing force of the air cylinder 10 is reduced or zeroed so that the guide board can be displaced smoothly. However, the guide board pushing means is not limited to the air cylinder 10.

The spacer 4 of the coating width regulating member, which is inserted into the slit of the coating nozzle, is to prevent the leakage of coating solution from a spacer inserting hole which is located laterally of the slit 11, and to regulate a coating width. The spacer 4 is generally made of metal or synthetic resin. The thickness of the spacer 4 is smaller by 0 to 0.05 mm than the internal dimension of the slit, so that the leakage of coating solution therefrom is minimized.

The pocket plug 5 of the coating width regulating member is to prevent the leakage of coating solution from a pocket plug inserting hole which is located laterally of the pocket 6 and through which the pocket plug 5 is inserted into the pocket, and to regulate a coating width. The pocket plug 5 is generally made of synthetic resin. The gap between the pocket 6 and the pocket plug 5 should be minimized to prevent the leakage of coating solution therefrom. However, if the gap is extremely small, then it is necessary to apply a great force to move the pocket plug. Hence, the gap is generally ranged from 0.03 mm to 0.2 mm. With the gap, the leakage of coating solution occurs, and therefore it is necessary to use the seal member 12. The spacer 4 and the pocket plug 5 must be moved together; that is, they should function in association with each other.

The material of the pocket plug 5 is not limited to synthetic resin only. For instance, it may be made of elastic material such as rubber so that it provides a sealing effect.

The seal member 12 is to prevent the leakage of coating solution from the pocket plug inserting hole. Therefore, the seal member may be so modified as to be inserted into the pocket. In this modification, the seal member is made of elastic material in such a manner that its external dimension is slightly larger than the internal dimension of the pocket. However, in order to increase the sealing effect of the seal member, it is preferable that the seal member is formed in such a manner that its external dimension is equal to or slightly smaller than the internal dimension of the pocket, and the end face of the seal member thus formed is pushed against the coating nozzle through a bushing 13 by the air cylinder 7 so that it is spread radially outwardly.

The seal member shown in FIG. 1 or 3 is in the form of a flat plate. In order to spread the seal member radially outwardly, it is necessary to apply a relatively great force to it. This difficulty may be eliminated by modifying the seal member as shown in FIG. 5. That is, the seal member shown in FIG. 5 comprises: a cup-shaped head portion which is equal in sectional area to the pocket; and a barrel portion integral with the head portion which is smaller in sectional area than the pocket. The head portion of the seal member is readily spread radially outwardly with a relatively small force applied to the end face of the barrel portion.

When it is required to change the coating width, the seal member may be moved as it is (spread); however, the force applied to the end face of the barrel portion should be reduced or zeroed to move it smoothly.

In the above-described embodiment, the air cylinder 7 is employed for pushing the end face of the seal member; however, the invention is not limited thereto or thereby.

Furthermore, the seal member may be in the form of a rubber balloon, which is used as follows: During the coating operation, the rubber balloon is inflated to provide a sealing effect.

In FIGS. 2 and 3, the pocket, the pocket plug, and the seal member are circular; however, the invention is not limited thereto or thereby.

The movement of the coating width regulating member and the seal member in a direction of width of the coating nozzle may be achieved, for instance, by a servo motor, pulse motor, air cylinder or manual

handle.

When the gap between the slit 11 and the spacer 4 is reduced, and the seal member is employed in the above-described manner, the leakage of coating solution can be minimized. However, in the case where the coating apparatus is run for a long time, the coating solution may leak from the gap between the slit 11 and the spacer 4 and from around the pocket plug 5, although its quantity is considerably small.

In manufacture of a photographing photo-sensitive material, the coating solution thus leaked is solidified with time, thus catching the pocket plug or the spacer in the coating nozzle. This results in a difficulty that, when it is required to change the coating width, the pocket plug or the spacer cannot be moved.

In order to overcome this difficulty, a water supplying hole 14 is formed in the guide board set above the slit. That is, a washing water is supplied through the water supplying hole 14 to the end of the slit 11 and the end of the pocket to wash them, thereby to prevent the pocket plug or the spacer from being caught in the coating nozzle.

In the above-described embodiment, the water supplying hole is formed in the guide member; however, it goes without saying that the water supplying hole may be formed in a component other than the guide member.

The technical concept of the invention may be applied to a film forming extrusion die, laminating extrusion die, and so forth.

(Concrete Example)

As conducive to a full understanding of the invention, its concrete example will be described. However, it should be noted that the invention is not limited thereto or thereby.

With a coating apparatus equipped with the coating width regulating member as shown in FIGS. 1 and 2, a coating solution for forming a photographing photo-sensitive material was applied to a polyethylene terephthalate support 180 μ m in thickness and 1200 mm in width at a coating speed of 100 m/min.

In the coating operation, the coating width was changed from 1170 mm to 1120 mm. The speed of movement of the coating width regulating member was 2 mm/sec., and it took 25 sec. to change the width as much as 50 mm. On the other hand, the coating solution supplying conditions were changed with the speed of movement of the coating width regulating member as indicated in the following Table 1:

Table 1

coating width	flowing rate	speed of rotation of the coating solution pump (motor)
1170 mm	4.68 l/min.	1000 r.p.m.
1120 mm	4.48 l/min.	957.26 r.p.m.

The seal member as shown in FIG. 5 was employed (which, as was described before, has the cup-shaped head portion equal in sectional area to the pocket, and the barrel portion smaller in sectional area the pocket). The seal member pushing force was 15 kg when a coating operation was carried out, and 3 kg when the coating width regulating member was moved.

The air cylinder 10 was so adjusted that the guide member pushing force was 100 kg/(whole width) when the coating operation was carried out, and 20 kg/(whole width) when the coating width regulating member was moved. The gap between the slit and the spacer was 0.02 mm. The flow rate of the washing water was 50 cc/min. which was supplied through the water supplying hole 14 formed in the guide board.

The test resulted as follows:

(1) under the above-described conditions, it took 25 sec. to change the coating width from 1170 mm to 1120 mm in 25 sec.

That is, when the coating width was changed, the speed of movement of the coating width regulating member was 2 mm/sec., and the rate of change of the speed of rotation of the coating solution pump set was 1.71 rpm/sec. = (1000 rpm - 957.26 rpm)/25 sec. When the coating width was changed, the resultant coating solution layer formed on the support was uniform in thickness.

(2) Under the above-described conditions, the washing water supplying operation was carried out, and then the coating operation was carried out for forty-eight hours. Thereafter, the coating width was changed; however, the coating apparatus was free from the difficulty that the solidified coating solution obstructs the coating operation; that is, the apparatus operated satisfactorily.

(Effects of the Invention)

(1) The coating width can be changed in less than one minute. In this connection, it is unnecessary to stop the coating nozzle, or to remove the latter from the coating roll.

(2) The flow rate of the coating solution is controlled according to the coating width changing rate. Therefore, even when the coating width is changed, the resultant coating solution layer formed on the support is uniform in thickness, and accordingly the coating solution and the support can be used economically.

(3) The leakage of coating solution from the coating nozzle is minimized, and the coating solution is prevented from being solidified even when leaked, so that the coating width can be changed smoothly.

(4) When it is required to change the coating width, it is unnecessary to stop the coating apparatus, or to remove the coating nozzle from the coating roll, or to suspend the supply of coating solution. Hence, it is unnecessary to clean or wash the coating nozzle and parts around the coating region, which contributes to reduction of labor.

While there has been described in connection with the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is aimed, therefore, to cover in the appended claims all such changes and modifications as fall within the true spirit and scope of the invention.

Claims

1. A coating method in which a coating solution supplied to a coating nozzle is applied through a slit in said coating nozzle to a belt-shaped flexible support which is continuously run, in which when a coating width is changed, said coating solution is changed in flow rate so that a coating solution layer formed on said support by said coating solution is uniform in thickness.

2. A coating apparatus in which a coating solution supplied to a coating nozzle is applied through a slit in said coating nozzle to a belt-shaped flexible support which is continuously run, which comprises:
a coating width regulating member including a guide board;
a seal member for preventing the leakage of said coating solution from an inserting hole through which said part of said coating width regulating member is inserted into said pocket; and
drive means for moving said coating width regulating member and said seal member in a direction of width of said coating nozzle.

3. A coating apparatus in which a coating solution supplied to a coating nozzle is applied through a slit in said coating nozzle to a belt-shaped flexible support which is continuously run, which comprises:
a coating width regulating member including parts which are inserted into a pocket and a slit in said coating nozzle;
a seal member for preventing the leakage of said coating solution from an inserting hole through which said part of said coating width regulating member is inserted into said pocket; and
drive means for moving said coating width regulating member and said seal member in a direction of width of said coating nozzle.

4. A coating apparatus in which a coating solution supplied to a coating nozzle is applied through a slit in said coating nozzle to a belt-shaped flexible support which is continuously run, which comprises:
a coating width regulating member including parts which are inserted into a pocket and a slit in said coating nozzle and a guide board;
a seal member for preventing the leakage of said coating solution from an inserting hole through which said part of said coating width regulating member is inserted into said pocket; and
drive means for moving said coating width regulating member and said seal member in a direction of width of said coating nozzle.

5. A coating apparatus as claimed in claim 2, in which said seal member is made of an elastic material.

6. A coating apparatus as claimed in claim 3, in which said seal member comprises: a cup-shaped head portion equal in sectional area to said pocket; and a barrel portion integral with said head portion which is smaller in sectional area to said pocket, whereby, when said seal member is installed, said head portion is radially outwardly spread even

with a small force applied to the end face of said barrel portion, thus providing a sealing effect.

7. A coating apparatus as claimed in any one of claims 2 through 6, in which said guide board has a washing water supplying hole in the surface which is brought into contact with the opening of said slit of said coating nozzle.

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FIG. 1

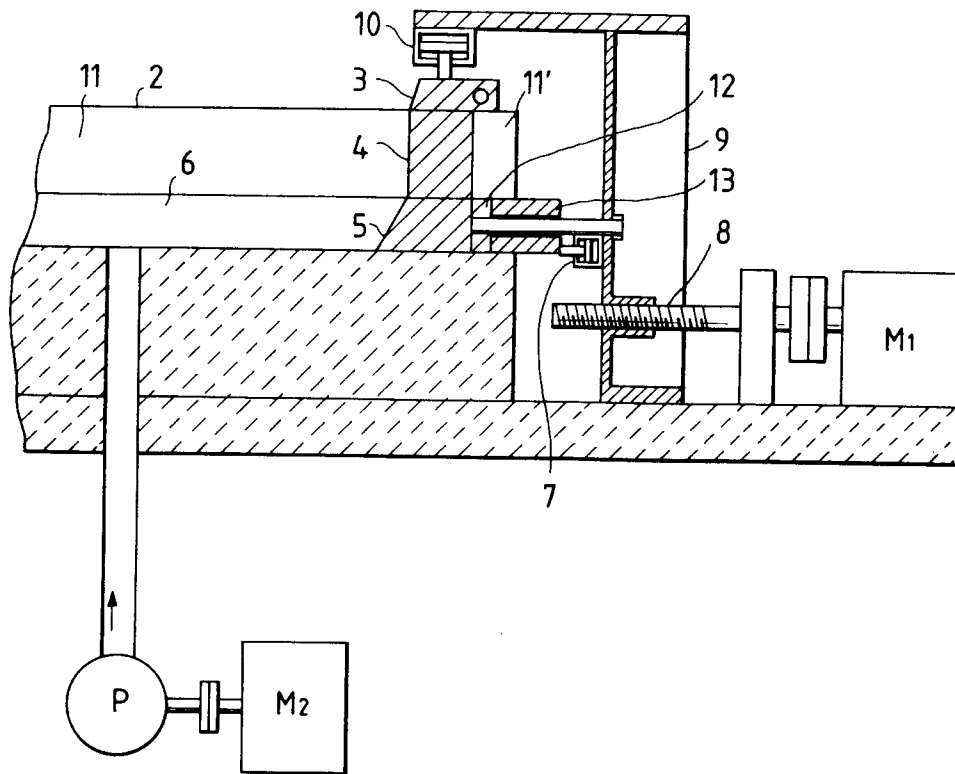


FIG. 2

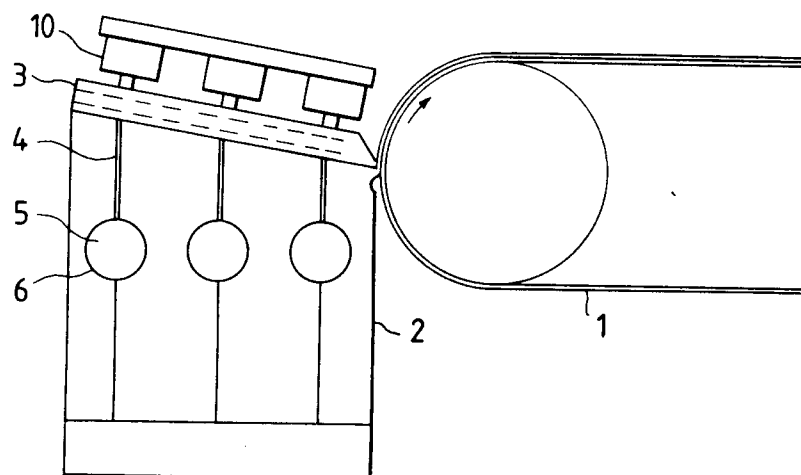


FIG. 3

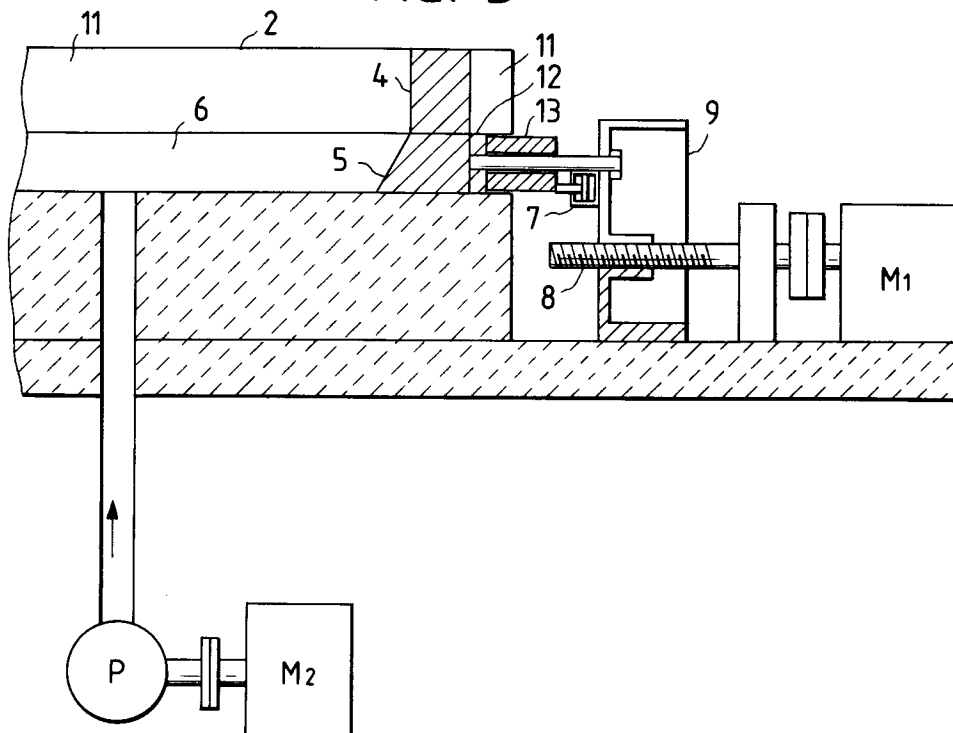


FIG. 4

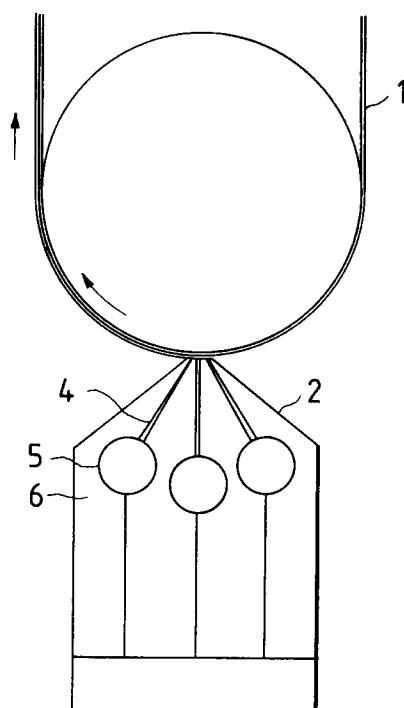


FIG. 5

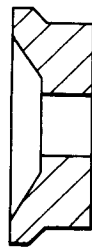
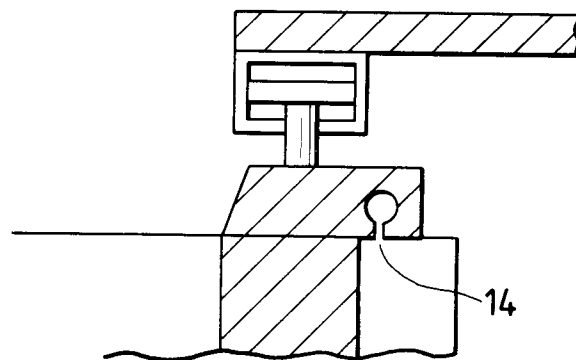


FIG. 6





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EUROPEAN SEARCH REPORT

Application Number

EP 92 11 4935

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DD-A-269 661 (VEB FILMFAB. WOLFEN) 5 July 1989 * the whole document * ---	1	G03C1/74 B05C11/10
X	FR-A-2 270 952 (AGFA-GEVAERT AKTIENGESELLSCHAFT) * the whole document * ---	2,5	
Y	EP-A-0 018 029 (AGFA-GEVAERT NAAMLOZE VENNOOTSCHAP) * page 19, line 15 - line 18 * ---	2	
Y	PATENT ABSTRACTS OF JAPAN vol. 6, no. 204 (M-164)15 October 1982 & JP-A-57 109 616 (MATSUSHITA DENKO K.K.) 8 July 1982 * abstract * ---	2	
Y	DE-A-4 027 515 (FUJI PHOTO FILM CO., LTD.) * the whole document * ---	2	
A	US-A-4 357 899 (JONES D. P. ET AL.) * the whole document * ---	1	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	DE-A-2 722 594 (HELMUT FRIZ GMBH & CO) * the whole document * -----	2	G03C B05C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 03 NOVEMBER 1992	Examiner BARATHE R.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			