FORM 1 G.R. CULLEN & CO.

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

We, U.C. INDUSTRIES, INC. of 2 Sylvan Way, Parsippany, New Jersey 07054, United States of America, hereby apply for the grant of a standard patent for an invention entitled:

"FOAM EXTRUSION APPARATUS AND METHOD"

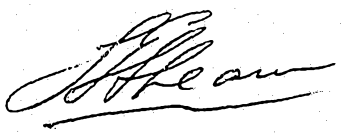
which is described in the accompanying complete specification.

The address for service is:-

G.R. Cullen & Co.,
79 Eagle Street,
Brisbane, Queensland, 4000,
Australia.

DATED this 31st day of October, 1988.

U.C. INDUSTRIES, INC.

By: 

Registered Patent Attorney

TO: THE COMMISSIONER OF PATENTS
AUSTRALIA.

Section 29 (1)
Regulation 3.1 (2)

AUSTRALIA

Patents Act 1990

620823

NOTICE OF ENTITLEMENT

(To be filed before acceptance)

I, WE, U.C. INDUSTRIES, INC. of 2 Sylvan Way, Parsippany, New Jersey
of 07054, United States of America

being the applicant in respect of Application No. 24527/88, state the following:-

Part 1 - Must be completed for all applications.

The person(s) nominated for the grant of the patent:

☐ *is / *are the actual inventor(s)

or

☒ has, for the following reasons, gained entitlement from the actual inventor(s):

the applicant is the assignee of the invention from the inventor

Part 2 - Must be completed if the application is Associated with one or more provisional applications.

The person (s) nominated for the grant of the patent *is / *are:

☐ the applicant(s) of the provisional application(s) listed on the patent request form

or

☐ entitled to make a request under Section 113 of the Act in relation to the provisional application(s) listed on the patent request form.

Part 3 - Must be completed if the application is a Convention application.

The person(s) nominated for the grant of the patent *is / *are:

☐ the applicant(s) of the basic application(s) listed on the patent request form

or

☐ entitled to rely on the basic application(s) listed on the patent request form.

Part 4 - Must be completed if the application was made under the PCT.

The person(s) nominated for the grant of the patent *is / *are:

☐ the applicant(s) of the application(s) listed in the declaration under Article 8 of the PCT

or

☐ entitled to rely on the application(s) listed in the declaration under Article 8 of the PCT.

(Continued over)

Part 5 - Must be completed if the application is a Divisional application.

The person(s) nominated for the grant of the patent *is / *are:

☐ the applicant(s) / patentee(s) of the original application / patent

or

☐ entitled to make a request under Section 113 of the Act in relation to the original application / patent.

Part 6 - Must be completed if the application relates to a microorganism and relies on Section 6 of the Act.

The person(s) nominated for the grant of the patent *is / *are:

☐ the depositor(s) of the deposits listed hereafter (by number, depositary institution and date)

or

☐ entitled to rely on the deposits listed hereafter (by number, depositary institution, date, and depositor's name and address) for the following reasons:

.....

.....

.....

Part 7 - Must be completed if the application is a Convention application, or the application was made under the PCT and the applicant made a declaration under Article 8 of the PCT in respect of the basic application.

☐ Except as stated in the next paragraph, the basic application(s) *listed on the patent request form / *referred to in the declaration under Article 8 of the PCT *is / *are the application(s) first made in a Convention country in respect of the invention.

☐ A request has been made under Section 96 of the 1990 Act (or Section 142AA of the 1952 Act) to disregard the following application.

.....

.....

Signed on behalf of the applicant,
U.C. INDUSTRIES, INC

by ..... 17 December, 1991
(Signature) (Date)
their Patent Attorney, IAN de JONGE, Cullen & co

Part 8 - Must be completed if the applicant for a patent of addition is not the applicant or patentee of the main invention.

I, ...

the *applicant / *patentee for *application / *patent No. .....

authorise .....

to apply for a further patent for an improvement in, or modification of, the main invention.

Note: This MUST be signed by the applicant or patentee of the main invention.

....
(Signature) (Date)

G.R. CULLEN & CO.

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

DECLARATION IN SUPPORT OF A

CONVENTION APPLICATION FOR PATENT

In support of the Convention Application made for a patent for an invention entitled

"FOAM EXTRUSION APPARATUS AND METHOD"

I/~~We~~, J.L. Weinstein

of U.C. INDUSTRIES, INC., 2 Sylvan Way, Parsippany, New Jersey 07054, United States of America,

do solemnly and sincerely declare as follows:-

1. I am/~~We are~~ authorised by , the applicant for the patent to make this declaration on its behalf.

2. The basic application as defined by Section 141 of the Act was made in United States of America on 3rd August, 1987 by Rafael Pagan.

3. RAFAEL PAGAN, of 6394 Gale Drive, Seven Hills, Ohio 44131 United States of America, is the actual inventor of the invention and the facts upon which the applicant is entitled to make the application are as follows:

   The said U.C. INDUSTRIES, INC. is the assignee of the said RAFAEL PAGAN.

4. The basic application referred to in paragraph 2 of this Declaration was the first application made in a Convention country in respect of the invention(s) the subject of this application.

DECLARED at Parsippany, NJ USA this 12 day of December 1988

J.L. Weinstein, President

Signature of Declarant

TO: THE COMMISSIONER OF PATENTS
AUSTRALIA.

(12) PATENT ABRIDGMENT (11) Document No. AU-B-24527/88
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 620823

(54) Title
FOAM EXTRUSION APPARATUS AND METHOD

International Patent Classification(s)
(51)[4] **B29C 067/20** **B29C 047/00**

(21) Application No. : **24527/88** (22) Application Date : **31.10.88**

(43) Publication Date : **03.05.90**

(44) Publication Date of Accepted Application : **27.02.92**

(71) Applicant(s)
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(72) Inventor(s)
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(74) Attorney or Agent
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(56) Prior Art Documents
US 4044084
US 3704083

(57) Claim

1. A foam extrusion apparatus comprising a vacuum chamber (10), a bulkhead plate (11) and extrusion die (16) at one end of said chamber, a liquid baffle at the opposite end of said chamber operative to seal the chamber and through which the extrudate passes from the chamber to atmosphere, said liquid baffle comprising a pond of liquid (30) having, in use, a higher level (32) in the chamber and a lower level (31) outside the chamber, and means (50,51) to circulate liquid from the higher level to the lower level during extrusion to maintain such higher level in the chamber, and means (43) to guide said extrudate into the higher level pond within the chamber and then through said liquid baffle to exit to atmosphere from the lower level pond outside the chamber.

7. A method of preparing foam plastic, comprising the steps of extruding a foamable plastic melt into a vacuum chamber (10), passing the foamed extrudate (40) into a body of liquid (30) which is partially within and partially outside of such chamber (10) to exit the chamber through such body of liquid,

.../2

wherein the level of liquid is higher within said chamber (10) than outside said chamber, the level of that portion (32) of the body of liquid (30) within such chamber (10) into which the extrudate (40) passes being controlled by circulating liquid from that portion (32) within the chamber to that portion (31) outside the chamber (10) from which the extrudate exits to atmosphere.

620623

COMMONWEALTH OF AUSTRALIA

The Patents Act 1952-1969

Name of Applicant(s): U.C. INDUSTRIES, INC.

Address of Applicant(s): 2 SYLVAN WAY,
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Actual Inventor(s): RAFAEL PAGAN

Address for Service: G.R. CULLEN & COMPANY,
Patent & Trade Mark Attorneys,
Dalgety House,
79 Eagle Street,
Brisbane, Qld. 4000,
Australia.

COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

"FOAM EXTRUSION APPARATUS AND METHOD"

The following statement is a full description of the invention including the best method of performing it known to us:-

FOAM EXTRUSION APPARATUS AND METHOD

DISCLOSURE

This invention relates generally as indicated to a foam extrusion apparatus and method, and more particularly one such method and apparatus utilizing a large horizontal vacuum chamber.

BACKGROUND OF THE INVENTION

It has been shown that extrusion of foamable plastic into a vacuum chamber will produce a high quality low density foam, such as the foam products sold under the trademark FOAMULAR by U.C. Industries of Parsippany, New Jersey. Such products are produced commercially by extruding the plastic melt into an inclined barometric leg which is in the form of a large-diameter pipe which forms a vacuum chamber. The lower end of the pipe which is of substantial length projects into a pond of liquid preferably water. When the chamber is under vacuum the water is drawn from the pond at least partially to fill the chamber. The water serves to seal the chamber and cool the extrudate. The inclined configuration permits the extrudate to be extracted from the chamber on a continuous basis with the aid of a belt conveyor. Examples of such installations may be seen in the following U.S. patents: 3,704,083; 4,044,084; 4,199,310; 4,234,529; 4,247,276; and 4,271,107.

One of the principal problems of the inclined barometric leg installations such as shown in such patents is the cost of construction. Because of the length of the leg or chamber and its inclination, the die end where the extruders are located must be at a substantial elevation above the exit or pond end. Such difference in elevation not only creates construction problems but also material handling problems during operation.

Attempts have been made to employ a horizontally extending vacuum chamber and reference may be had to U.S. Patents 4,487,731 and 4,486,369 for an illustration of horizontal chamber vacuum extrusion systems. As seen such systems avoid a liquid pond or baffle but instead use an exit chamber which must be cycled from atmospheric to vacuum. Also the extrudate must be cut and/or stacked within the chamber which makes

service and control of such equipment difficult. Also spray cooling of the product within the chamber may be inadequate for a large cross sectional size extrudate.

Other types of vacuum extrusion apparatus may be seen in U.S. Patents 3,822,331; 1,990,434; and 2,987,768, but such are obviously not suitable for continuous foam extrusion, particularly extrudates of large cross sectional size.

It is accordingly desirable to employ a horizontal chamber which nonetheless utilizes a water baffle or seal in which the extrudate is immersed as it exits the vacuum chamber.

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided a foam extrusion apparatus comprising a vacuum chamber (10), a bulkhead plate (11) and extrusion die (16) at one end of said chamber, a liquid baffle at the opposite end of said chamber operative to seal the chamber and through which the extrudate passes from the chamber to atmosphere, said liquid baffle comprising a pond of liquid (30) having in use a higher level (32) in the chamber and a lower level (31) outside the chamber, and means (50,51) to circulate liquid from the higher level to the lower level during extrusion to maintain such higher level in the chamber, and means (43) to guide said extrudate into the higher level pond within the chamber and then through said liquid baffle to exit to atmosphere from the lower level pond outside the chamber.

According to yet another aspect of the invention there is provided a method of preparing foam plastic, comprising the steps of extruding a foamable plastic melt into a vacuum chamber

(10), passing the foamed extrudate (40) into a body of liquid (30) which is partially within and partially outside of such chamber (10) to exit the chamber through such body of liquid, wherein the level of liquid is higher within said chamber (10) than outside said chamber, the level of that portion (32) of the body of liquid (30) within such chamber (10) into which the extrudate (40) passes being controlled by circulating liquid from that portion (32) within the chamber to that portion (31) outside the chamber (10) from which the extrudate exits to atmosphere.

In a preferred form of the invention, a foam extrusion system and method employs a horizontal vacuum chamber with a bulk head and extrusion die at one end of the chamber, the extrusion die being inside the chamber when the bulkhead is closed. A liquid baffle, preferably water, is provided at the opposite end of the chamber through which the extrudate passes from the chamber to atmosphere. The baffle comprises a pond of liquid having a higher level in the chamber and a lower level outside the chamber. The higher level of the pond is formed between a dam plate and a seal plate, the latter forming the opposite end of the chamber. The seal plate includes a size adjustable window through which the extrudate passes, the extrudate being guided by a conveyor to extend inclined downwardly into the pond and to exit through the seal plate and pond with a large radius upwardly curved section. The level of liquid in the chamber is controlled by circulating liquid from the higher level of the pond within the chamber to the lower level of the pond outside the chamber with the amount of liquid circulated being inversely proportional to the absolute pressure in the vacuum chamber. Optionally the

circulated liquid may pass through a cooler to control the liquid temperature. The size adjustment of the window or exit orifice in the seal plate may be used to control the flow of liquid from the lower level pond portion outside the chamber to higher level pond portion inside the chamber, particularly during start up.

To the accomplishment of the foregoing and related ends the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

In the annexed drawings:

Figure 1 is a side elevation of a vacuum foam extrusion system in accordance with the present invention with the liquid circulation and level controls shown schematically;

Figure 2 is a front view of the seal plate showing the variable gate through which the submerged extrudate passes; and

Figure 3 is a somewhat enlarged side elevation of the system at the seal plate separating the two levels of the liquid pond.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to Figure 1 there is illustrated a large elongated horizontally extending vacuum chamber 10 which includes a bulkhead 11 at one end and a seal plate 12 at the opposite end. The chamber is substantially elongated and is horizontal throughout its length and is in the form of a large diameter pipe. The chamber may be formed of interconnected and sealed large diameter concrete pipe sections such as shown in prior U.S. Patent 4,199,310.

The bulkhead 11 may be mounted for movement on a carriage indicated generally at 14 for movement toward and away from the end of the vacuum chamber 10. On the exterior of the bulkhead there is provided one or more extruders indicated at 15 while the extrusion die is on the interior of the bulkhead as seen at 16. Also mounted on the interior of the bulkhead are shaping rolls to control the configuration and shape of the extrudate exiting the die. For more detail as to the configuration of the shaping rolls and the manner of mounting both the die and shaping rolls on the bulkhead, reference may be had to prior U.S. Patents 4,234,529; 4,247,276 and 4,469,652. In any event the vacuum chamber may be opened and closed by

moving the bulkhead 11 horizontally toward and away from the end of the chamber.

Positioned in the chamber fairly close to the bulkhead 11 is a dam plate 20, the upper edge 21 of which extends somewhat above a horizontal centerline of the chamber.

Positioned outside the chamber beyond the seal plate 12 is a containment structure 24 which includes side walls 25 and 26 and an end wall 27 remote from the chamber 10. The opposite end wall of the containment structure indicated at 28 includes the seal plate 12.

The containment structure together with the vacuum chamber forms a containment for a pond shown generally at 30 of liquid, preferably water, extending from the dam plate to the containment structure plate 27. As indicated, a portion 31 of the pond is outside the vacuum chamber 10 while a portion 32 is inside the vacuum chamber. Such portions are of course on opposite sides of the seal plate and communication between such portions is obtained by a window illustrated generally at 34 in seal plate 12. A vertically movable gate 36 mounted on the seal plate and driven vertically by motor 37 controls the size of the opening of window 34.

The foam extrudate shown generally at 40 leaves the die 16 to expand and be shaped and then passes under the end 42 or tail pulley of a conveyor belt 43 which is inclined downwardly to bring the extrudate below the level of the pond in the vacuum chamber. The foam extrudate will of course float up against the conveyor belt and the speed of the conveyor belt is closely controlled to draw the foam extrudate from the vacuum chamber. The conveyor belt 43 passes through the window 34 and then curves upwardly as indicated at 45 terminating in head pulley 46 driven from drive 47. The curvature of the conveyor belt need not necessarily be uniform but in no case should the curvature be on a radius less than 150 feet. Reference may be had to prior U.S. Patents 4,044,084 and 4,199,310 for disclosures of such conveyors used in inclined barometric legs or vacuum chambers. After the extrudate 40 exits the portion 31 of the pond outside of the vacuum chamber it is of course exposed to atmosphere and the extrudate proceeds in the direction of the arrow 48 for subsequent cutting and processing.

When the gate 36 is in its most closed position it provides fairly close clearance for the conveyor 43 and extrudate 40 and acts as a gross flow control valve for water moving from a portion 31 of the pond 30 outside of the chamber to the portion 32 inside the chamber, particularly during start-up.

In order to control the level of the water within the vacuum chamber 10 there is provided two water circulation pumps indicated at 50 and 51 which draw water from the bottom of the vacuum chamber as indicated at 52 and 53, respectively, just inside the dam plate 20. The outlet of the pumps passes through check valves 54 and 55, respectively, and through power operated valves 56 and 57, also respectively. Such power operated valves are in pump outlet lines 59 and 60, respectively, which extend to cooling tower 61 through respective valves 62 and 63. The cooling tower may be bypassed by closing the valves 62 and 63 and causing the water to flow through lines 64 and 65 leading directly into the pond 31 outside of the vacuum chamber. Such lines may also include respective valves 66 and 67 which are opened and closed alternately with valves 62 and 63. Water from the cooling tower 61 returns to the pond 31 through line 69, again outside of the vacuum chamber.

Also, in addition to the outlet check valves 54 and 55 each pump is provided with inlet and outlet shut off valves as seen at 72 and 73 as well as a pressure gauge 74. The pumps may be utilized concurrently or separately.

Vacuum is established in the vacuum chamber 10 by one or more vacuum pumps indicated at 77. The vacuum level is controlled by vacuum controller 78 through an air bleed valve 79.

The vacuum controller 78 is also electronically connected to both level control 80 and motor 37, the latter controlling the position of gate 36 on the seal plate. The level controller connection is by the set point control connection illustrated at 81.

The level controller 80 is connected to both the vacuum and water sides of the vacuum chamber through the valves indicated at 83 and

84. The level controller in turn controls level control valves 56 and 57 in the pump discharge lines 59 and 60, respectively.

The vacuum chamber just to the inside of the dam plate 20 is provided with a sump and drain indicated at 86 in the event water splashes over the top 21 of the dam plate.

During operation of the system the pumps 50 and 51 function to draw water from the portion 32 of the pond within the vacuum chamber and deliver that water either directly or through the cooling tower to the portion 31 of the pond outside the vacuum chamber or exposed to atmosphere. The water thus flows from one end of the pond to the other and circulates back through the adjustable window in the seal plate 12.

Before vacuum is established in the vacuum chamber the water level on both sides of the seal plate will be at a common level. At this point the pumps 50 and 51 are turned on but the level control valves 56 and 57 are closed. When the vacuum chamber is closed, by moving the bulkhead 11 against the end of the chamber, the vacuum controller 78, being set to a desired level, turns on the vacuum pumps 77. As the vacuum level goes up (absolute pressure goes down) water will of course be drawn from the exterior of the chamber into the interior of the chamber causing the water level on the interior of the chamber to rise. During this process, the level controller begins to open the level control valves 56 and 57 and the vacuum controller begins to close gate 36 through motor 37. The control of the gate 36 reducing the size of the orifice acts as a gross flow control valve for water moving into the vacuum chamber.

Both the vacuum controller 78 and the level controller 80 have optimum adjustable set points. When the vacuum controller 78 reaches its set point, it begins to maintain the desired vacuum level by actuating the bleed valve 79. When the level controller 80 reaches its set point it will begin to modulate the level control valves 56 and 57 maintaining the water level within the vacuum chamber within a given narrow range simply by increasing or decreasing the flow or circulation of water from the vacuum chamber to the atmospheric portion of the pond 31. As the vacuum level increases, the water level inside the vacuum chamber increases and in order

to maintain the water level at an acceptable level the water flow through the valves 56 and 57 also increases. During operation of the system the vacuum controller resets the level controller 80 on a continuing basis which in turn modulates the level control valves 56 and 57. In other words, the vacuum controller is the master and the level controller is the slave. By resetting the level controller constantly, the vacuum controller then can anticipate changes in the water level thus maintaining a precise water level inside the vacuum chamber in response to the vacuum level. However, the gate 36, once in its final position, will normally stay in that position and is used as such gross flow control valve only during start up or shut down of the system. In any event the full system permits the water level inside the vacuum chamber to be controlled in response to the vacuum level within the chamber thus obviating the necessity for a long and inclined barometric leg. The system may also operate with less total volume of water.

With the present invention there is provided a foam extrusion line which includes an elongated horizontally extending chamber with the chamber being horizontal throughout its length. The chamber is provided with an extrusion die at one end forming a foam extrudate within the chamber and a water baffle at the opposite end to enable the chamber to be maintained under vacuum. The foam extrudate is guided through the baffle to atmosphere for subsequent cutting and processing. In order to maintain the liquid level within the vacuum the liquid is circulated from the higher level of liquid within the vacuum chamber to the lower level of liquid outside the chamber during extrusion. The amount of liquid circulated is of course inversely proportional to the absolute pressure in the vacuum chamber.

Although the invention has been shown and described with respect to certain preferred embodiments, it is obvious that equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of this specification. The present invention includes all such equivalent alterations and modifications, and is limited only by the scope of the following claims.

The claims defining the invention are as follows:

1. A foam extrusion apparatus comprising a vacuum chamber (10), a bulkhead plate (11) and extrusion die (16) at one end of said chamber, a liquid baffle at the opposite end of said chamber operative to seal the chamber and through which the extrudate passes from the chamber to atmosphere, said liquid baffle comprising a pond of liquid (30) having, in use, a higher level (32) in the chamber and a lower level (31) outside the chamber, and means (50,51) to circulate liquid from the higher level to the lower level during extrusion to maintain such higher level in the chamber, and means (43) to guide said extrudate into the higher level pond within the chamber and then through said liquid baffle to exit to atmosphere from the lower level pond outside the chamber.

2. The foam extrusion apparatus as claimed in claim 1, characterized in that the amount of liquid circulated is inversely proportional to the absolute pressure in the vacuum chamber (10).

3. The foam extrusion apparatus as claimed in claim 1 or 2, characterized in that said chamber (10) is horizontal and that the extrudate (40) is guided downwardly into the higher level pond (32) within the chamber.

4. The foam extrusion apparatus as claimed in any one of claims 1 to 3, characterized in that a dam plate (20) is provided within said chamber (10) and a seal plate (12) at the end of said chamber opposite said die (16) to form the pond of higher level (32) in the chamber.

5. The foam extrusion apparatus as claimed in claim 4, characterized in that an exit orifice (34) for the extrudate (40) is provided in said seal plate (12) below the pond level and the size of the exit orifice is controlled by a means (37).

6. The foam extrusion apparatus as claimed in claim 5, characterized in that said means (37) controlling the size of said exit orifice (34) comprises a motor driven gate (36) on said seal plate (12).

7. A method of preparing foam plastic, comprising the steps of extruding a foamable plastic melt into a vacuum chamber (10), passing the foamed extrudate (40) into a body of liquid (30) which is partially within and partially outside of such chamber (10) to exit the chamber through such body of liquid, wherein the level of liquid is higher within said chamber (10) than outside said chamber, the level of that portion (32) of the body of liquid (30) within such chamber (10) into which the extrudate (40) passes being controlled by circulating liquid from that portion (32) within the chamber to that portion (31) outside the chamber (10) from which the extrudate exits to atmosphere.

8. The method as claimed in claim 7, characterized in that the amount of liquid circulated is inversely proportional to the absolute pressure within such vacuum chamber (10).

9. The method as claimed in claim 7 or 8, characterized in that the step of controlling comprises the step of controlling a level control valve (56,57) in the outlet line (59,60) of a ciculating pump (50,51).

10. The method as claimed in claim 9, characterized in that the level control valve (56,57) is in turn controlled by a level

controller (80).

11. A foam extrusion apparatus substantially as hereinbefore described with reference to the drawings.

12. A method of preparing foam plastic substantially as hereinbefore described with reference to the drawings.

DATED this Seventeenth day of December, 1991.

U.C. INDUSTRIES, INC.

by their Patent Attorneys

CULLEN & CO.

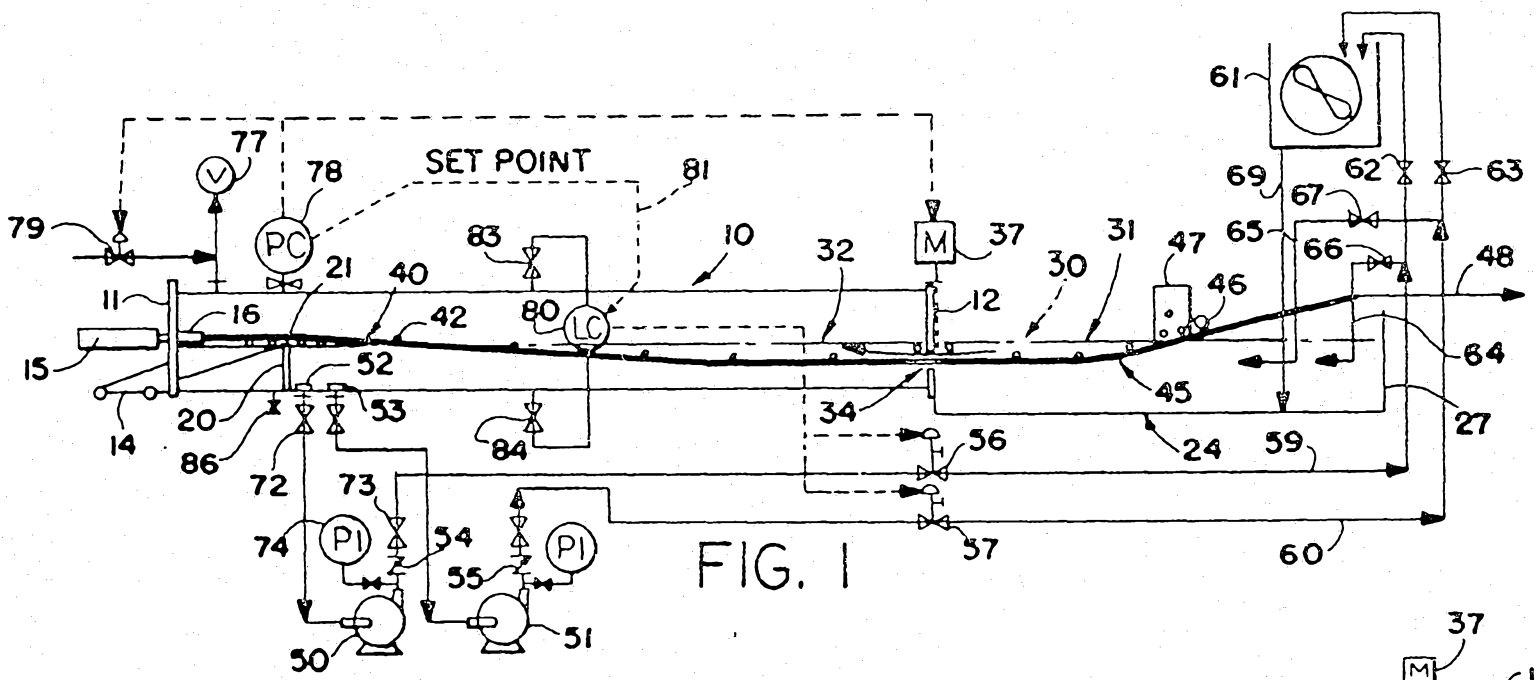

FIG. 1

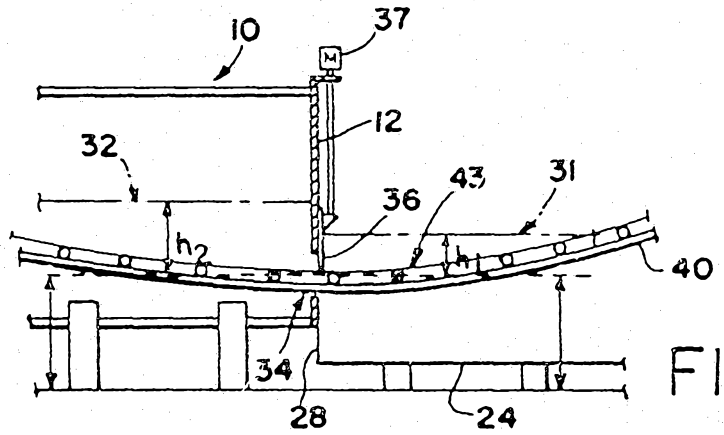

FIG. 3

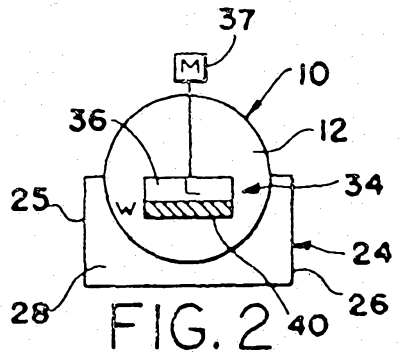

FIG. 2

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