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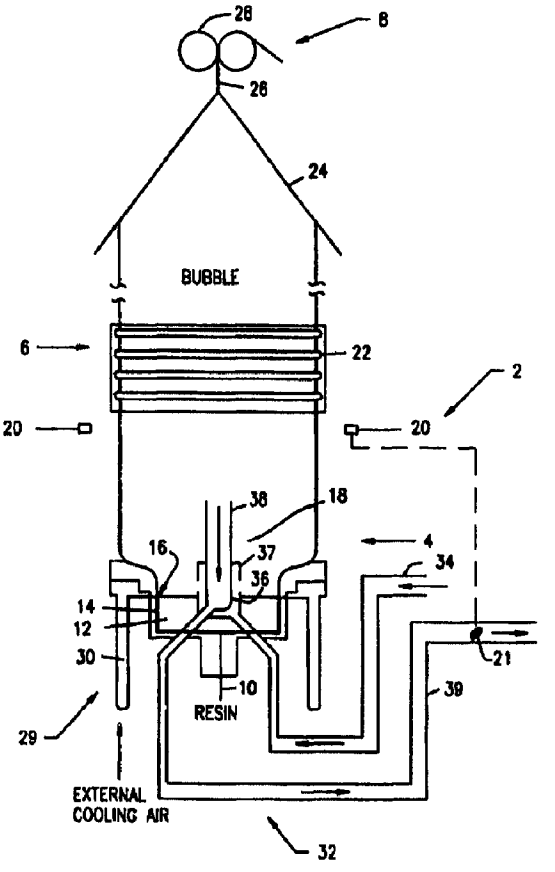
(54) **FILM OBTENU PAR COEXTRUSION-SOUFFLAGE ET PRODUITS REALISES A L'AIDE DE CE FILM**

(54) **COEXTRUDED BLOWN FILM AND PRODUCTS MADE USING THE SAME**



(57) L'invention a pour objet un film (2) obtenu par coextrusion-soufflage. Ce film est réalisé à partir d'au moins une couche d'un polypropylène basse densité linéaire d'alliage organométallique et d'au moins une couche d'un polypropylène de type résistant aux chocs. L'invention a aussi pour objet des dispositifs d'emballage réalisés à partir d'un film obtenu par coextrusion-soufflage.

(57) A coextruded blown film (2) made from at least one layer of a metallocene linear low density polypropylene and at least one layer of an impact grade polypropylene and packaging devices made from coextruded blown film.

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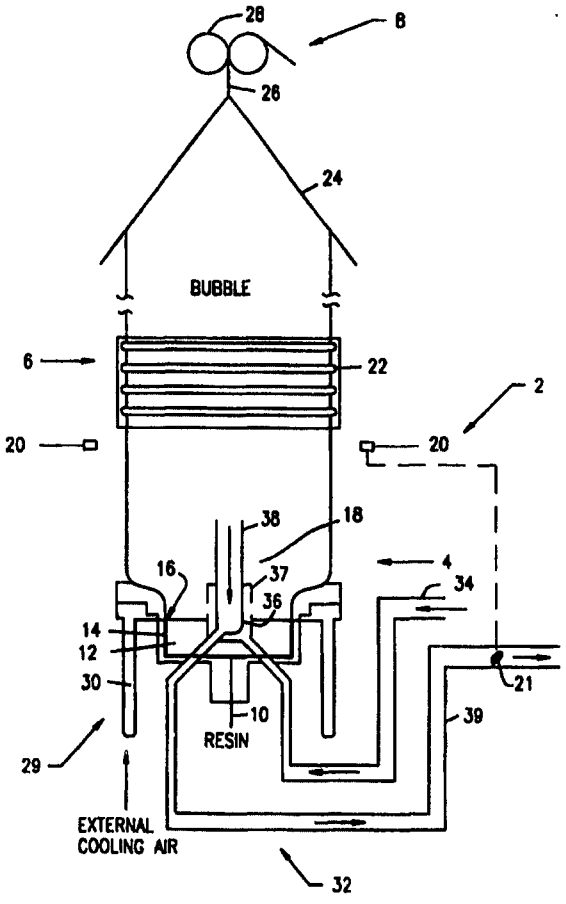
(54) Title: COEXTRUDED BLOWN FILM AND PRODUCTS MADE USING THE SAME

(57) Abstract

A coextruded blown film (2) made from at least one layer of a metallocene linear low density polypropylene and at least one layer of an impact grade polypropylene and packaging devices made from coextruded blown film.



COEXTRUDED BLOWN FILM AND PRODUCTS MADE USING THE SAME

TECHNICAL FIELD

The present invention is directed to coextruded blown films of polyolefin having multiple layers which are particularly suited for forming packages for the storage of difficult to store materials.

BACKGROUND OF THE PRIOR ART

The technique of blown film extrusion is well known for the production of thin plastic films. Plastics, such as low, linear low, and high density polyethylene (LDPE, LLDPE, and HDPE) are extruded through a circular die to form a film. Air is introduced through the center of the die to maintain the film in the form of a bubble which increases the diameter of the film about 2 to 6 fold, after which the bubble is collapsed onto rollers.

The formation of coextruded blown films is also known in the art. Coextrusion systems for making multilayer films employ at least two extruders feeding a common die assembly. The number of extruders is dependent upon the number of different materials comprising the coextruded film. For each different material, a different

extruder is used. Thus a five-layer coextrusion may require up to five extruders although less may be used if two or more of the layers are made of the same material.

In the formation of blown films, a melt enters a ring-shaped die either through the bottom or side thereof. The melt is forced through spiral grooves around the surface of a mandrel inside the die and extruded through the die opening as a thick-walled tube. The tube is expanded into a bubble of desired diameter and correspondingly decreased thickness as previously described.

Coextrusion dies are used to form coextruded blown films. They have multiple mandrels that feed the different melt streams to the circular die lip. Feedblocks are employed to stack melt layers from two or more extruders. The multilayered melt stream is then fed to the film die.

Coextruded blown films are commercially available. For example, a coextruded blown film of ethylene vinyl acetate (EVA)/LLDPE/tie resin/nylon/tie resin/LLDPE/EVA is produced by James River Corporation under the tradename Zeelon 590. A three layer coextruded blown film comprising metallocene (m) LLDPE(EVA)/tie resin/nylon/tie resin/mLLDPE(EVA) is produced by United Films under the tradename Unilon 5238. A multilayer coextruded blown film comprised of HDPE/tie-resin/nylon/tie resin/LLDPE/mLLDPE is produced by United Film under the tradename Unilon 5890. Although such products possess acceptable toughness, sealability, impact and

grease/oil barrier characteristics, they are expensive to produce typically ranging from $1.50 to $1.75 per pound.

There is therefore a need in the packaging art to have packages formed from coextruded blown films which possess excellent grease resistance, impact resistance and toughness at less cost than such packages currently available.

SUMMARY OF THE INVENTION

The present invention is directed to a coextruded blown film having multiple layers in which at least one of the layers is a metallocene linear low density polyethylene and at least one other layer is an impact grade polypropylene.

Pouches, bags and other containers made from this combination of materials provide excellent toughness and impact strength and furthermore provide an excellent barrier to grease and oil and light hydrocarbons such as turpentine and the like. The coextruded blown film of the present invention can be used as a packaging substrate alone, as a liner in multi-wall bags, or a strength/sealant ply in laminated structures such as with polyethylene terephthalate or biaxially oriented polypropylene.

BRIEF DESCRIPTION OF THE DRAWING

The following drawings are illustrative of a blown film extrusion apparatus which may be employed to form the coextruded blown film of the present invention. The embodiments shown in the drawing figures are not intended to limit the invention as encompassed by the claims forming part of the application.

Figure 1 is a schematic view of a typical blown film extrusion apparatus; and

Figure 2 is a schematic view of a coextrusion die with multiple mandrels for use in the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figure 1 there is shown a known blown film extrusion device 2 comprised of a bubble forming section 4, a control section 6 and a thin film forming section 8.

The bubble forming section 4 includes an inlet 10 for receiving a suitable molten, plastic resin. A pathway 14 is provided for the flow of the melted resin from the inlet to a narrow annular outlet 16 which forms the molten resin into a continuous bubble 18 when air is blown into the resin within the circumference of the annular outlet.

The control section 6 controls the size of the bubble. The control section 6 is provided with sensors 20 which detect the diameter of the bubble 18 and transmit a detectable signal to a damper 21 which adjusts internal bubble pressure which determines the size of the bubble.

The film forming section 8 includes a frame 24 which draws the sides of the bubble 18 inwardly so that the sides collapse on one another to form a two layer film 26. The film is passed through nip rolls 28 which draws the two layers of film upward and sends the compressed film to a storage facility (not shown).

The extrusion device 2 is a typically provided with an external cooling section 29 in which air which is cooler than the air within the bubble is obtained from a source (not shown) and is transported via a conduit 30 around the circumference of the bubble 18 as it leaves the outlet 16.

There may also be provided an internal cooling assembly 32 which includes a conduit 34 for receiving ambient or cooled air from a source (not shown) and transporting the same to a outlet 36 having an opening 37 within the bubble 18. Air from the bubble 18 is thereby forced into a return conduit 38 where it is transported through a conduit 39 and past the damper 21.

In a coextrusion process, a coextrusion die is used to form a multilayer film shown as layers A, B and C in Figure 2. Referring to Figure 2 there is shown a coextrusion die shown generally by the numeral 40. Three mandrels 42, 44 and 46 are used to feed different melt streams to the die 40. It will be understood that while three mandrels are shown more than three mandrels can be employed. The die mandrels (42, 44 and 46) can be adjusted to change the die opening and in turn control gauge/uniformity. A die opening 48 is provided which is a ring shaped gap between a die ring 50 and the mandrels (42, 44 and 46). The die opening 48 controls the thickness of the extruded tube.

The materials comprising the coextruded blown film in accordance with the present invention include at least one layer of metallocene linear low density polyethylene and at least one layer of an impact grade polypropylene.

Metallocene linear low density polyethylene (mLLDPE) is a material produced using the catalyst metallocene. It has a narrow molecular weight distribution and excellent heat seal properties. An example of such material is Exceed 350 D60 manufactured by Exxon Corporation. Metallocene linear low density polyethylene provides a leak proof seal for difficult to store materials and seals at relatively low temperatures.

Impact grade polypropylene is polypropylene that typically has from about 8 to 15% by weight of ethylene. An example of such material is PP7031 manufactured by Exxon Corporation and KSO89P manufactured by Montell Corporation. In particular, the modified polypropylene has a density from about 0.890 to 0.905 g/cm^3, a melt flow rate of from about 0.5 to 2.0 g/10 min. and a tensile strength at yield of from about 3400 to 4100 psi.

It has been discovered that mLLDPE in combination with impact grade polypropylene provides a coextruded blown film which has excellent characteristics for packaging of abrasive, corrosive and/or high grease, oil or fat content materials such as pet foods, herbicides, pesticides, oil modified seeds, animal bedding, lawn & garden products, rice, and cornmeal.

The relative amounts of the metallocene linear low density polyethylene and the impact grade polypropylene can vary over a wide range. In a preferred form of the invention, the mLLDPE is present in an amount of from about 25 to 75% by weight and the impact grade polypropylene in an amount of from about 25 to 67% by weight, based on the total weight of the coextruded blown film.

A preferred construction of the present invention comprises a layer of the impact grade polypropylene sandwiched between at least one and preferably two layers of the mLLDPE. In a particularly preferred embodiment of the invention the layers of the

mLLDPE comprise 20 and 40% by weight, respectively of the total weight of the coextruded blown film while the impact grade polypropylene is present in an amount of from about 30 to 50% by weight.

While the thickness of the film can vary of a wide range, the film must be thick enough so that a leak proof seal can be formed. It is preferred for most applications that the coextruded blown film have a thickness of from about 0.0015 to 0.006 inches, preferably from about 0.0030 to 0.0045 inches.

The coextruded blown films of the present invention can be formed into pouches, bags, containers and the like using customary packaging machinery such as heat sealing devices using mandrels and the like.

EXAMPLE 1

Film has been produced on 3-layer coextrusion system equipped with two extruders and an ABA coextrusion blown film die of the type shown in Figure 2. A film structure was produced which had a total thickness of 0.0046 inches and included the following: 20% by weight Exxon 350 D60 mLLDPE, 50% by weight Exxon PP7031 polypropylene and 30% by weight 350 D60 mLLDPE.

A 3.5" Sano extruder with a 30:1 L/D (Length-to-Diameter ratio) barrier type screw was used to feed a mLLDPE to the outer "A" layers. An extruder temperature profile of 350-400-390-380-380F and a melt temperature at the die of 390F was used in processing the resin.

A 2.5" Sterling extruder with a 30:1 L/D barrier type screw was used to feed the PP copolymer resin to middle "B" layer of the coextruded film. The temperature profile and melt temperature were 410-360-400-405-410F and 417F, respectively.

A 10" Sano ABA Coextrusion Die adjusted to provide a 20:50:30% by weight distribution and a blowup ratio of 2:1 (film bubble diameter to die diameter) was employed in the run. To achieve the proper ratio of layers and total target thickness, the extruder rpm was adjusted for each film component as well as the film haul-off rate.

A 100 pounds of each resin component were processed into film.

Example 2

The procedure of or similar to Example 1 was repeated except that the materials and amounts thereof used to form the film were as follows: 25% by weight of Exxon 350 D 60 m LLDPE, 50% by weight of Montel KSO89P polypropylene and 25% by weight

of Exxon 350 D 60 mLLDPE. The film was processed in a manner similar to Example 1.

Example 3

The procedure of or similar to Example 1 was repeated except that the materials and amounts thereof used to form the film was as follows: 25% by weight of a blend of linear low density polyethylene (LLDPE) and low density polyethylene (LDPE) as the outside layer, 50% by weight of polypropylene as the middle layer and 25% by weight of mLLDPE as the inside layer. The film was processed in a manner similar to Example 1.

Example 4

The procedure of or similar to Example 1 was repeated except that the materials and amounts thereof used to form the film was as follows: 25% by weight of a blend of LLDPE and LDPE as the outside layer, 35% by weight of polypropylene as the middle layer, and 35% by weight of mLLDPE as the inside layer. The film was processed in a manner similar to Example 1.

WHAT IS CLAIMED IS:

1. A coextruded blown film comprising at least one layer of a metallocene linear low density polyethylene and at least one layer of an impact grade polypropylene.

2. The blown film of claim 1 comprising a layer of said polypropylene between layers of said metallocene linear low density polyethylene.

3. The blown film of claim 1 comprising an inside layer, a middle layer and an outside layer, at least one of the inside layer and the outside layer comprising said metallocene linear low density polyethylene.

4. The blown film of claim 3 wherein the inside layer comprises metallocene linear low density polyethylene.

5. The blown film of claim 1 wherein the weight of said polypropylene is from about 25 to 67% by weight based on the total weight of the coextruded blown film.

6. The blown film of claim 1 wherein the weight of said metallocene linear low density polyethylene is from about 25 to 75% by weight based on the total weight of the coextruded blown film.

7. The blown film of claim 1 comprising from about 20 to 40% by weight of a first layer of metallocene linear low density polyethylene, from about 30 to about 50% by weight of said polypropylene and from about 20 to 40% by weight of a second layer of said metallocene linear low density polyethylene.

8. The blown film of claim 1 wherein the thickness of the blown film is sufficient to enable a leak proof seal to be formed.

9. The blown film of claim 8 having a thickness of from about 0.0015 to 0.006 inches.

10. The blown film of claim 9 wherein the thickness of the blown film is from about 0.0030 to 0.0045 inches.

11. A packaging device comprising a blown film, said blown film comprising at least one layer of a metallocene linear low density polyethylene and at least one layer of an impact grade polyethylene.

12. The packaging device of claim 11 wherein the blown film comprises a layer of said polypropylene between layers of said metallocene linear low density polyethylene.

13. The packaging device of claim 11 wherein the blown film comprises an inside layer, a middle layer and an outside layer, at least one of the inside layer and outside layer comprising said metallocene linear low density polyethylene.

14. The packaging device of claim 13 wherein the inside layer comprises metallocene linear low density polyethylene.

15. The packaging device of claim 11 wherein the thickness of the blown film is sufficient to form a leak proof seal.

16. The packaging device of claim 15 wherein the thickness of the blown film is from about 0.0015 to 0.006 inches.

17. The packaging device of claim 16 wherein the thickness of the blown film is from about 0.0035 to 0.0045 inches.

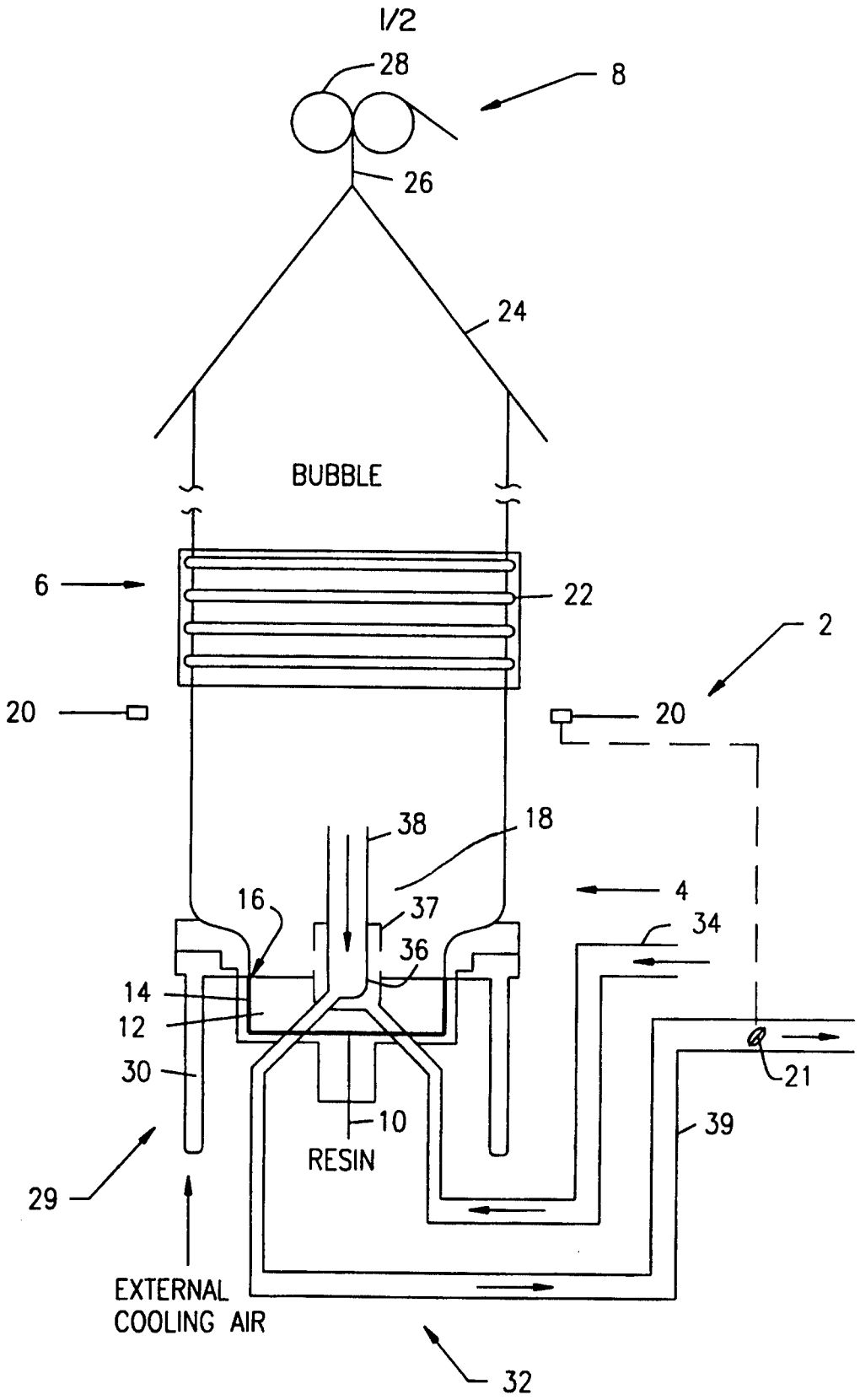

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FIG. 1

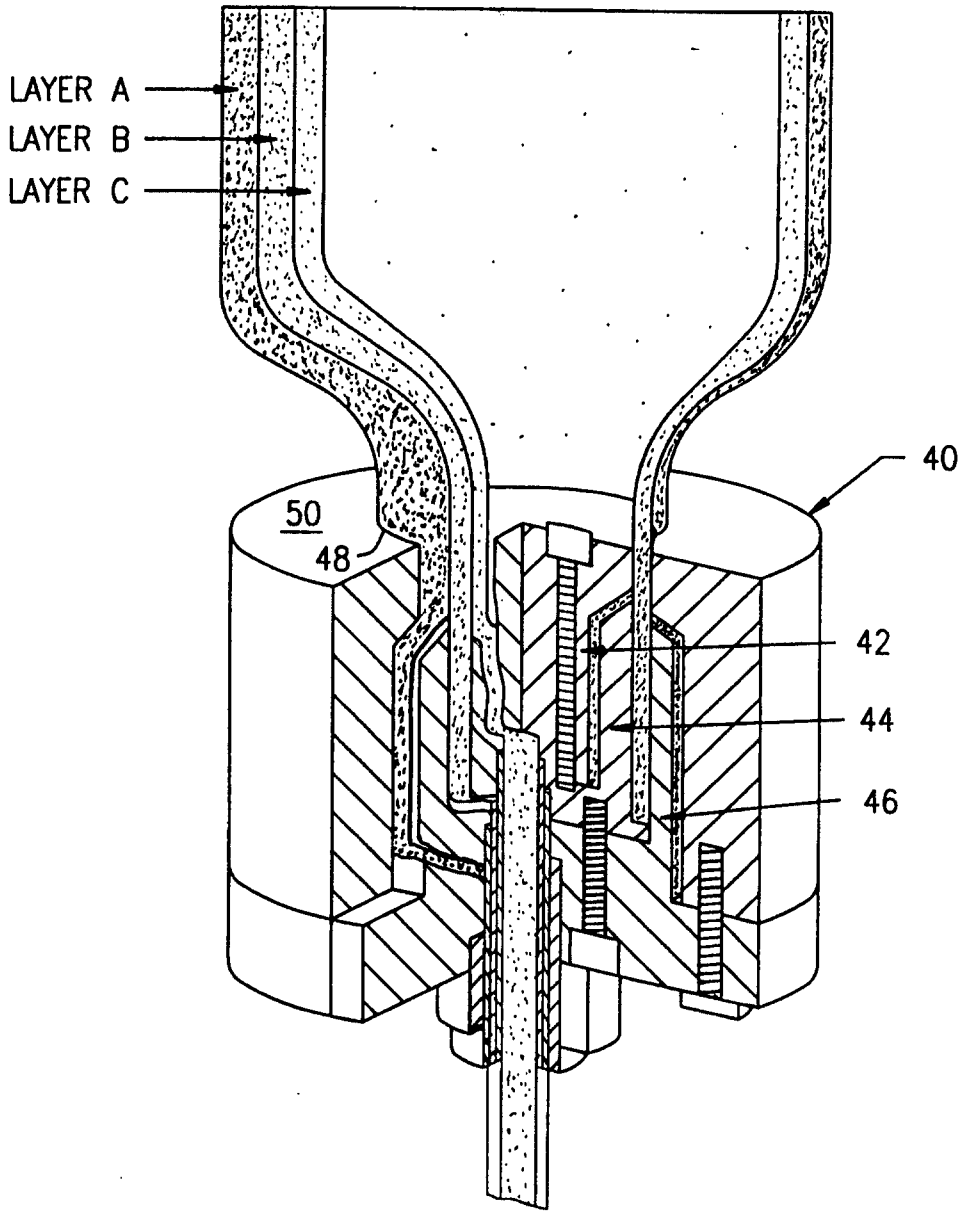
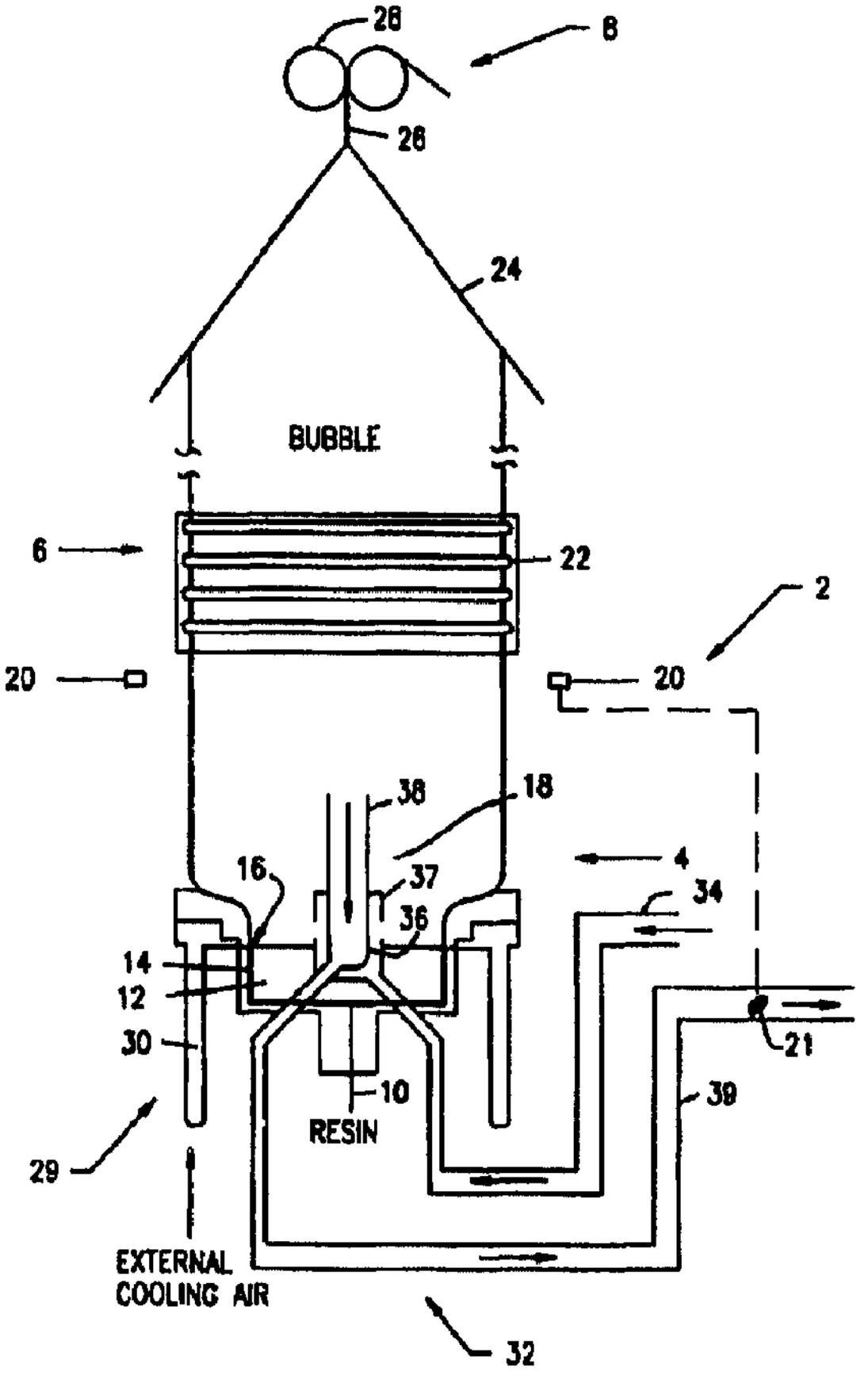


FIG. 2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