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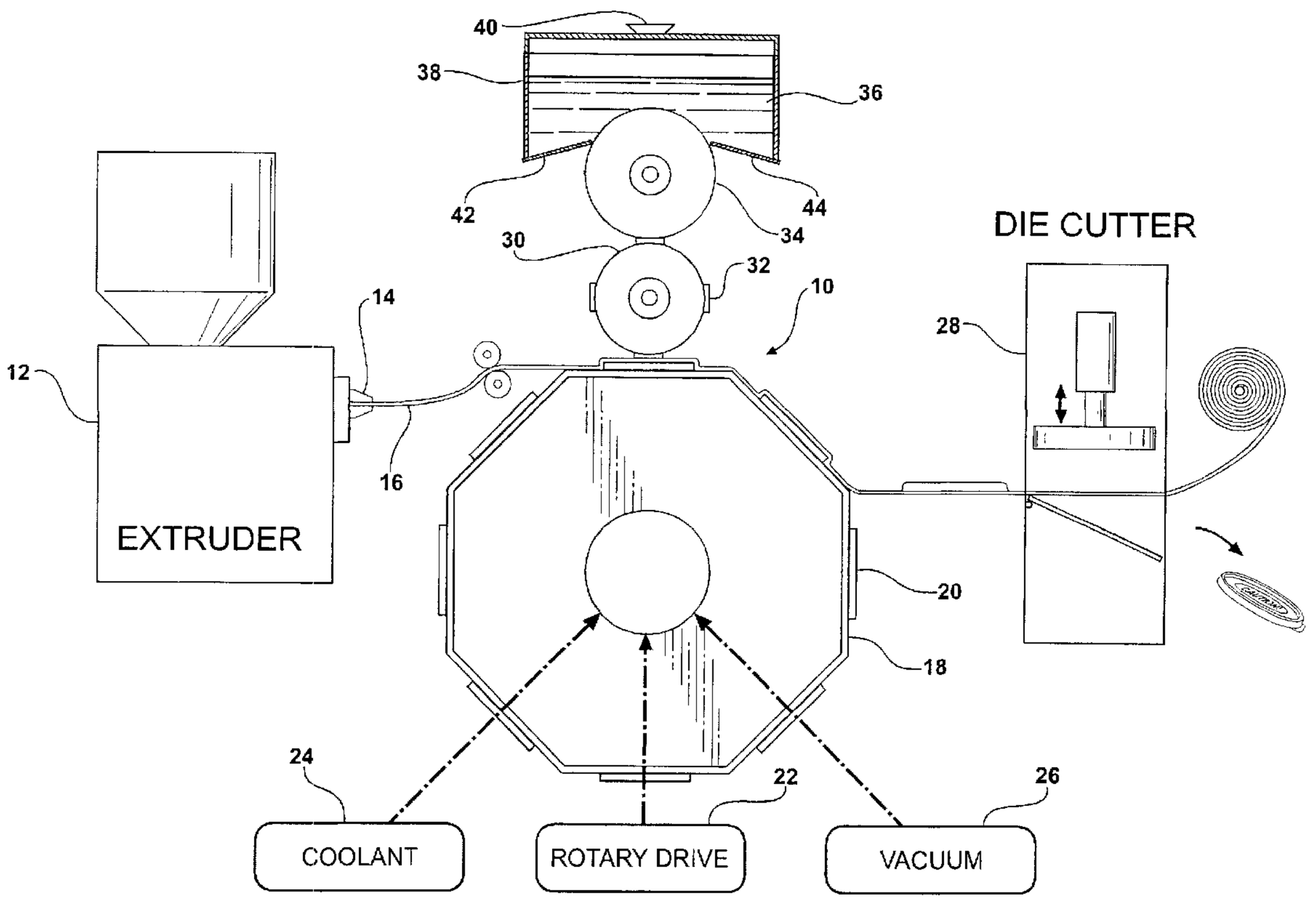
(54) Titre : PROCEDE DE FABRICATION D'ARTICLES EN PLASTIQUE THERMOFORME ET COUVERCLE DE GOBELET FABRIQUE AU MOYEN DE CE PROCEDE

(54) Title: METHOD AND APPARATUS FOR MANUFACTURING VACUUM THERMOFORMED THIN PLASTIC ARTICLES AND DRINK CUP LID MADE BY SUCH METHOD



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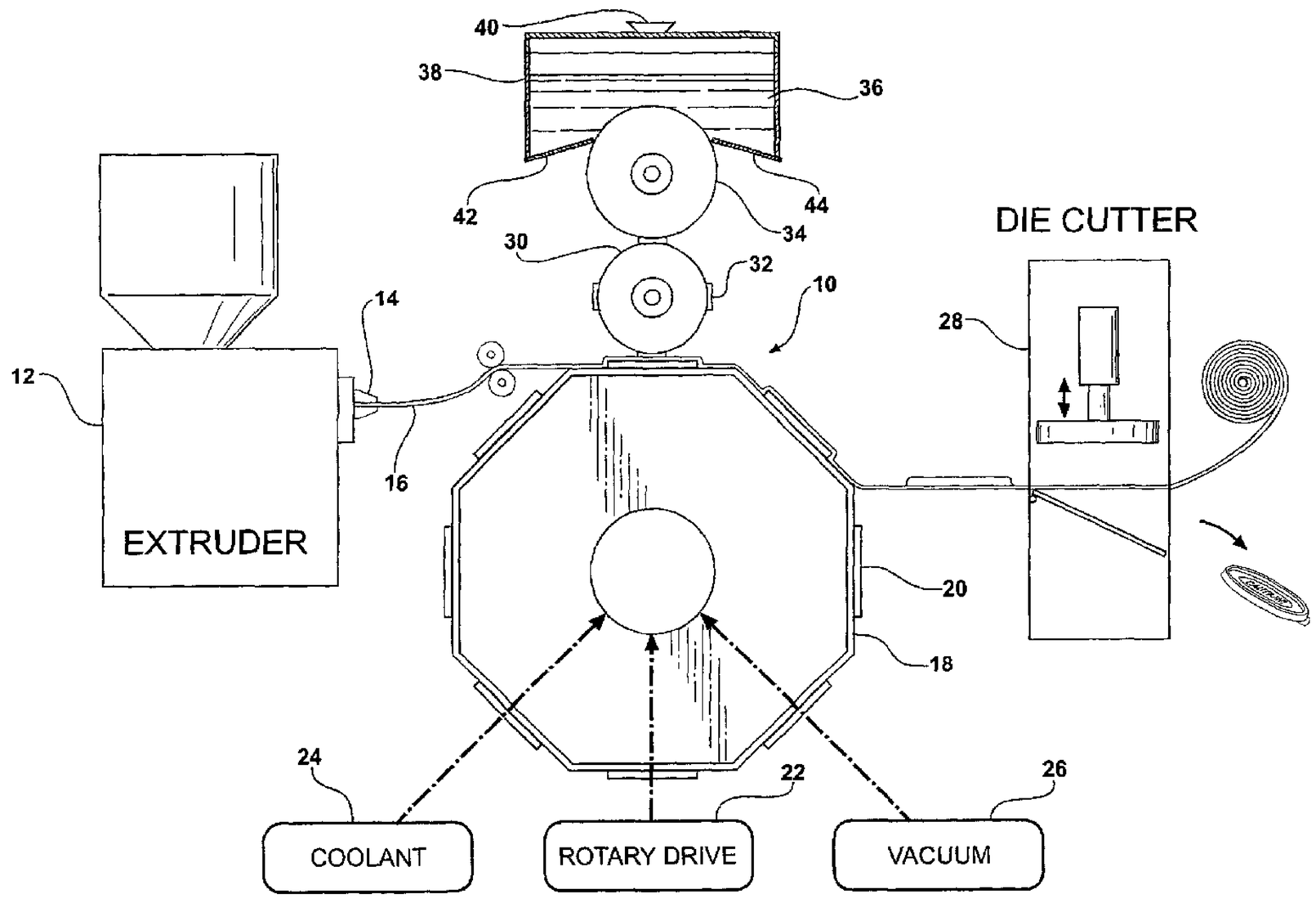
(54) **Title:** METHOD AND APPARATUS FOR MANUFACTURING VACUUM THERMOFORMED THIN PLASTIC ARTICLES AND DRINK CUP LID MADE BY SUCH METHOD



(57) **Abstract:** A method and apparatus for vacuum thermoforming disposable drink cups lids (50) including the step of imparting printing to the lids while they are in contact with the vacuum thermoforming platen.

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METHOD OF MANUFACTURING THERMOFORMED PLASTIC ARTICLES AND DRINK CUP LID MADE BY SUCH METHOD

Field of the Invention

[0001] This invention relates to vacuum thermoformed plastic articles and particularly to a vacuum thermoformed disposable drink cup lid having printed indicia thereon and a method of manufacturing such an article.

Background of the Invention

[0002] It is well known to manufacture thin plastic articles such as disposable drink cup lids by vacuum thermoforming. Such articles are manufactured by causing a web of extruded plastic sheet material to contact a metal die having the desired shape of the article formed into a surface thereof. Vacuum is applied to the platen surface through small holes to draw the plastic material over the contours of the die. The articles are thereafter cooled, separated from the web by die cutting, and stacked and/or boxed using conventional automation devices.

[0003] It is also known to vacuum form logos and other indicia on the plastic lids. Such indicia are typically forms of raised surfaces in a central deck area of the lid. Because thermoformed plastic lids are usually white, it is difficult to clearly see such vacuum embossed indicia. To add definition, the raised surfaces of the embossed indicia may be colored in a secondary operation carried out by printing machinery separate from the thermoforming machinery.

Brief Summary of the Invention

[0004] According to the present invention vacuum thermoformed articles such as disposable drink cup lids are thermoformed and printed; i.e., provided with coloring on embossed surfaces and/or printed with logos and other indicia on non-embossed surfaces, in what is essentially a single operation. The invention increases manufacturing efficiency and lowers manufacturing costs.

[0005] In general, this is accomplished by extruding a thin web of thermoformable plastic sheet material, contacting the web while hot with a vacuum

thermoforming dies configured to form articles such as disposable drink cup lids having printable areas within the boundaries of said articles, applying vacuum to form the articles, immediately thereafter applying ink to the printable areas while the articles remain in the web and at an elevated temperature and, thereafter, separating the fully formed and printed articles from the web. As stated above, the term "printed" is used herein to refer to both adding color to embossed surfaces and placing indicia on essentially flat surfaces.

[0006] In the preferred form hereinafter described, the method is carried out by means of an apparatus which comprises a rotating thermoforming drum carrying a series of plates with die inserts for forming articles, and a multi-surface rotatable printing cylinder which rotates in synchronism with the thermoforming drum. The printing cylinder rotates in synchronism with the drum and with an Anilox roller which carries ink from a supply to the pads on the printing cylinder. Synchronism is preferably maintained by gears to ensure registration between the ink pads and the thermoformed articles. Fully formed and printed articles thereafter pass to a conventional die cutter where they are removed from the web. The articles may be stacked and excess material from the web returned to the extruder supply hopper.

[0007] Other applications of the present invention will become apparent to those skilled in the art when the following description of the best mode contemplated for practicing the invention is read in conjunction with the accompanying drawings.

Brief Description of the Drawings

[0008] The description herein makes reference to the accompanying drawings wherein like reference numerals refer to like parts throughout the several views, and wherein:

[0009] FIG 1 is a schematic view of a system for carrying out the method of manufacturing disposable drink cup lids;

[0010] FIG 2 is a perspective view of a portion of the machine of FIG 1;

[0011] FIG 3 is a plan view of a drink cup lid made by the inventive method;

[0012] FIG 4 is a sectional view of the FIG 3 lid;

[0013] FIG 5 is a plan view of a second lid made by the inventive method; and

[0014] FIG 6 is a sectional view of the FIG 5 lid.

Detailed Description of the Preferred Embodiment

[0015] Referring to the drawing, FIG 1 illustrates in schematic fashion an apparatus **10** for manufacturing vacuum thermoformed drink cup lids and simultaneously printing the lids in what is essentially a single and continuous manufacturing operation. The apparatus **10** comprises a hot melt extruder **12** for receiving ground or pelletized plastic material such as polystyrene or polyethylene. The extruder is equipped to melt the plastic material and force it through an exit die **14** of convention design to produce a thin web **16** of plastic material. The width of the web may be any desired width; here approximately 24 inches.

[0016] The web **16** exits the extruder die **14** at approximately 320°F to 340°F and passes to a vacuum forming drum **18** which is suitably mounted for rotation by a drive **22** in either direction to cause the web to contact forming dies **20** mounted on the drum **18** for the desired time. Coolant and vacuum are applied to the drum by sources **24** and **26** respectively to control temperatures and to produce vacuum forming.

[0017] After the desired time of contact with the dies **20** on the drum **18** the web **16** with the articles formed therein passes to a die cutter and stacker **28** of conventional design.

[0018] To carry out the printing operation simultaneously and in synchronism with the thermoforming operation, a printing cylinder **30** is mounted above the drum **18** by means to be described with reference to FIG 2. The printing cylinder **30** is equipped with pads **32** which contact the vacuum formed articles after they have cooled to a temperature of between about 150°-250°F, the elevated temperature being effective to rapidly dry the ink which is applied to the vacuum thermoformed articles by the pads **32** on the printing cylinder **30**.

[0019] The pads **32** on the printing cylinder **30** are continuously inked by an Anilox roller **34** which picks up ink **36** from an ink fountain **38** having a filler mechanism **40**. Seals and proper ink distribution are provided by Nylon doctor blade

42 and **44** which form the bottom of the ink fountain **38** and engage the upper quadrant of the Anilox roller **34**.

[0020] The drum **18**, printing cylinder **30** and Anilox roller **34** all rotate in precise synchronism as a result of means hereinafter described in detail with reference to FIG 2. In addition the printing cylinder **30**, Anilox roller **34** and ink fountain **38** adapt for vertical movement by means to be described in order to accommodate the irregular surface of the octagonal thermoforming drum **18**.

[0021] Referring now to FIGS 3 and 4 a specific thermoformed article **50** is shown to comprise a thin plastic drink cup lid of approximately 3 ½ inches in diameter and configured to be applied to the upper rim of a standard plastic or paper disposable drink cup **52**. The specific article **50** shown in FIGS 3 and 4 is a hot drink cup lid producing what is known in the trade as a plug fit by means of a 300• channel **54** which is vacuum thermoformed into the material of the lid **50**. A skirt **56** is also vacuum formed around the periphery of the lid and finally formed by the die cutting operation carried out by device **28** shown in FIG 1.

[0022] The lid **50** is shown to comprise a drink-through tear-back tab **58** defined by a partially die cut area near the periphery of the lid and within the discontinuity of the plug fit channel **54**. A raised feature **60** is formed in the lid **50** adjacent a shallow hinge **64** such that the raised operating feature **60** may be folded back and locked back into a receiver cavity **62** formed immediately behind the hinge **64**. The details of the tear-back/lock-back features of the lid **50** are more fully described in the co-pending application for United States patent Serial Number 09/952,154 filed September 14, 2001 the entire disclosure of which is incorporated herein by reference.

[0023] The lid **50** is shown to comprise a large flat central deck area **66** in which there is embossed during the thermoforming operation a raised logo **68** the features of which have relatively flat raised surfaces. In accordance with the invention coloring is imparted to the raised surfaces of the logo **68** by the printing cylinder **30** and the apparatus of FIG 1. FIG 5 and 6 illustrate a second lid **50'** of a configuration which is slightly different from the configuration of lid **50**. Specifically, the lid **50'** has no embossed logo. Accordingly, the pads **32** of the printing cylinder **34** must be

formed, like conventional rubber stamps, to carry the desired lettering on other indicia.

[0024] Referring now to FIG 2, the octagonal drum **18**, the printing cylinder **30**, the Anilox roller **34** and the ink fountain **38** are shown in greater detail. A continuous gear surface **74** is formed around the left peripheral end of the drum **18** with teeth extending parallel to the axis of rotation of the drum **18**. The gear surface **74** is in constant contact with a print cylinder gear **76** which is mechanically attached to the printing cylinder **30** to rotate the printing cylinder **30** and the ink pad **32** in precise synchronism with the rotation of the drum **18** thereby to ensure continuous registry of the ink pad **32** with the locations of the mold inserts or dies **20** which are carried by plates **21** attached by machine screws to the flat surfaces of the drum **18**. In this instance there are three lid forming dies **20** across each of the plates **21** but this number is merely illustrative. The molding features of the inserts **20** may differ from insert to insert but it is desirable that all of the inserts be male dies and have essentially the same height so as to be properly engaged by the printing surfaces of the pads **32**. The feature **60** shown in FIGS 3 and 4 of the drawings requires that the ink pads be sized and located to clear the feature **60** as they engage the top surfaces of the logo **68** during the printing operation.

[0025] The printing cylinder **30** with the associated gear **76** is mounted on a print head frame **70** which is adapted for pivotal rotation about an axle **72**. Cam rollers **78** mounted on both sides of the frame **70** for rotation relative thereto contact cam surfaces **84** formed on the drum **18**. The cam surfaces are continuous, and, although essentially octagonal, have machined corners to permit smooth and continuous contact between the cam surfaces and the associated rollers **78**. The clearance between the rollers **78** and the cam surfaces **84** may be adjusted by means of adjustment screws **88** shown in FIG 2 to vary the pressure of the ink pads **32** on the molded plastic articles during the printing operation.

[0026] To ensure a synchronous drive relationship between the printing cylinder **30** and the Anilox roller **34**, the gear **90** is mounted on the printing cylinder **30** inboard of the gear **76** and meshes with a gear **92** mounted on the left end of the

Anilox inking roller **34** as shown in FIG 2. The Anilox roller **34** is mounted on the frame **70** by conventional bearings.

[0027] The ink fountain **38** may be adjusted in relationship to the surface of the Anilox roller **34** by means of a plate **96** which lies between opposite lateral sections of the frame **70** and carries spacing adjustment screws **98**. The drum **18** is mounted on a frame **100** for rotation as previously described.

OPERATION

[0028] In a typical operation plastic material is forced from the extruder through the die **14** to form the hot web **16**, the web being continuously drawn from the extrusion die **14** by clockwise rotation of the drum **18**. It will be understood that this drum may rotate in the counter-clockwise direction if desired to extend the web **16** around the bottom of the drum and thereafter to the die cutter **28**.

[0029] Substantially as soon as the web **16** encounters the mold inserts **20** of the drum **18** vacuum is applied and the material of the web is drawn by vacuum over the contours of the dies **20** to form the lids **50** or such other articles as it may be desired in any particular operation to make. The web material cools to between approximately 140°F to 250°F for application of the ink **36** by way of the pads **32** on the printing cylinder **30**. The web material with the articles now formed therein and printed remains in contact with the drum **18** and the dies **20** and plates **21** long enough to cool to between about 70°F and 110°F whereupon they are separated from the drum surface and conveyed to the die cutter apparatus **18**. Extra material from the web not formed into articles **50** may be recovered and ground and returned to the hot melt extruder **21**.

[0030] While the invention has been described with reference to a specific article and a specific apparatus for carrying out the manufacturing method of the article, it is to be understood that it may be carried out using apparatus of different style and design and also that articles other than molded plastic drink cup lids may be manufactured and printed in accordance with the teachings of this patent. While the adjustable cam rollers and gears described above with reference to the illustrative embodiment are preferred at this time, it is to be understood that other and equivalent drive devices such as belts, chains and the like may also be used to synchronize the

rotation of the various components of the thermoforming and printing system. Alternatively or additionally a speed control and synchronization may be achieved electronically using high resolution encoders and variable speed motors and the like. A key consideration is to avoid slip between the rotating drum **18** and the inking cylinder **30** as such slip will deregister the pads **32** from the article **50** being printed.

What is claimed is:

1. A method of manufacturing vacuum thermoformed thin plastic articles such as drink cup lids having a printable area within the boundaries thereof and formed by a die defining said articles and area comprising the steps of:

hot melt extruding a thin web of plastic material;

contacting the web with a vacuum thermoforming die configured to form said article and said area within said article;

applying ink to said area after formation thereof but while said article remains in contact with said die; and

separating said web and article from said die.

2. A method as defined in claim 1 wherein a portion of the printable area is raised relative to said web.

3. A method as defined in claim 1 wherein said die rotates as it is contacted by said web and as said articles are formed.

4. A method as defined in claim 3 wherein the die is metal and is mounted on a drum.

5. A method as defined in claim 1 wherein the step of applying ink is carried out by contacting the formed article with an ink pad.

6. A method as defined in claim 5 wherein the platen is disposed on a rotating drum and said ink pad rotates in synchronization with said drum.

7. A method as defined in claim 1 comprising the further step of die cutting said articles from said web.

8. A method defined in claim 1 wherein the plastic material is polystyrene.

9. The method defined in claim 1 wherein the ink is applied by means of a pad having indicia formed thereon.

10. A thermoformed thin plastic lid for drink cups comprising a raised rim defining a central printable area formed according to the method comprising the steps of:

hot melt extruding a thin web of plastic material;

contacting the web with a vacuum thermoforming platen configured to form said article and said area within said article;

applying vacuum to said platen;

applying ink to said area after formation thereof but while said article remains in contact with said platen; and

separating said web and article from said platen.

11. Apparatus for vacuum thermoforming and printing articles in a substantially continuous fashion comprising:

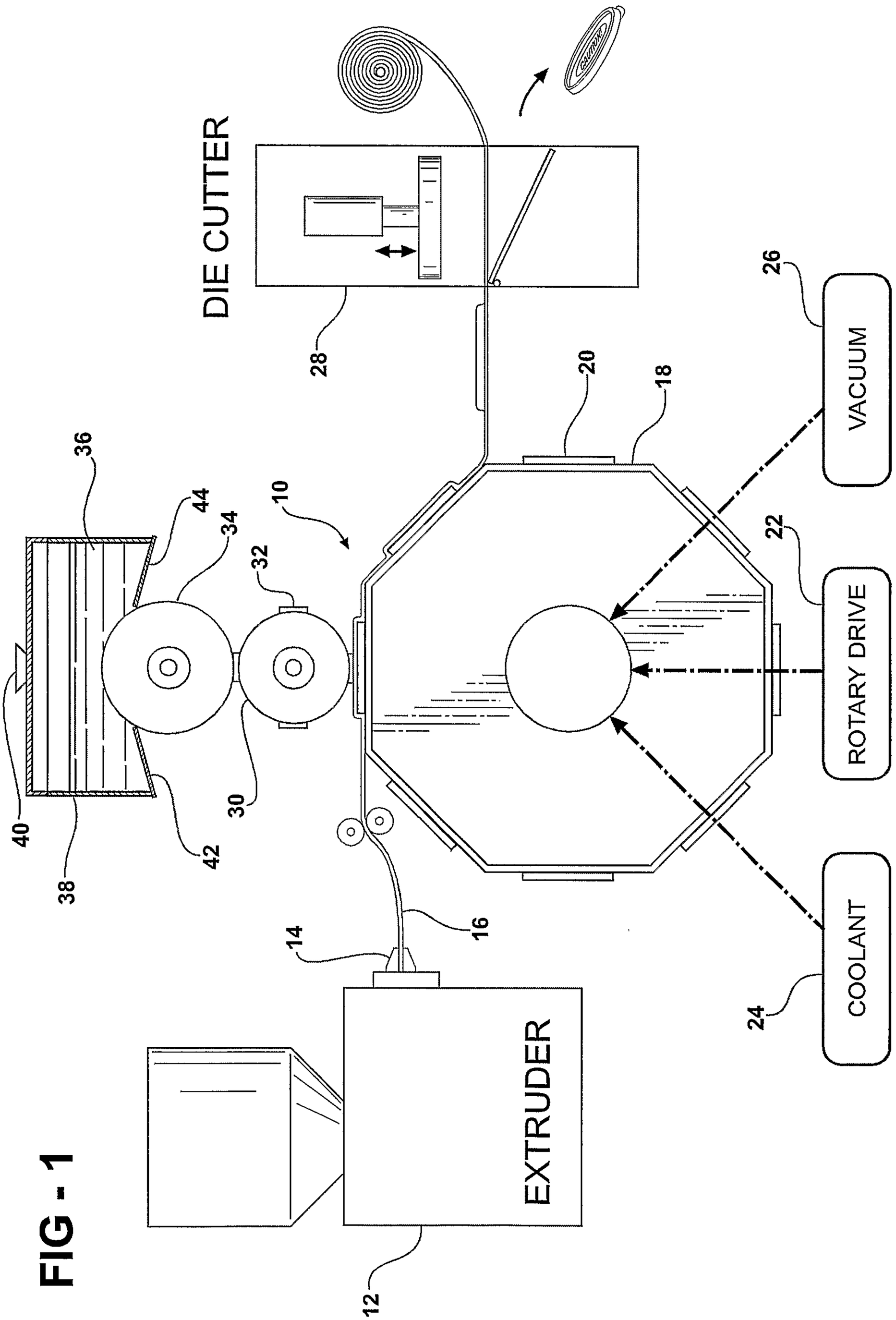
a vacuum thermoforming drum carrying regularly spaced thermoforming dies;

a printing cylinder carrying printing pads disposed adjacent said drum for contacting and imparting ink to said articles as they are formed over said dies; and

means for rotating said printing cylinder in synchronism with said drum.

12. Apparatus as defined in claim 11 further including an inking roller contacting said printing cylinder; and

means for rotating said inking roller in synchronism with said printing cylinder.


DIE CUTTER
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COOLANT
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EXTRUDER
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FIG - 1

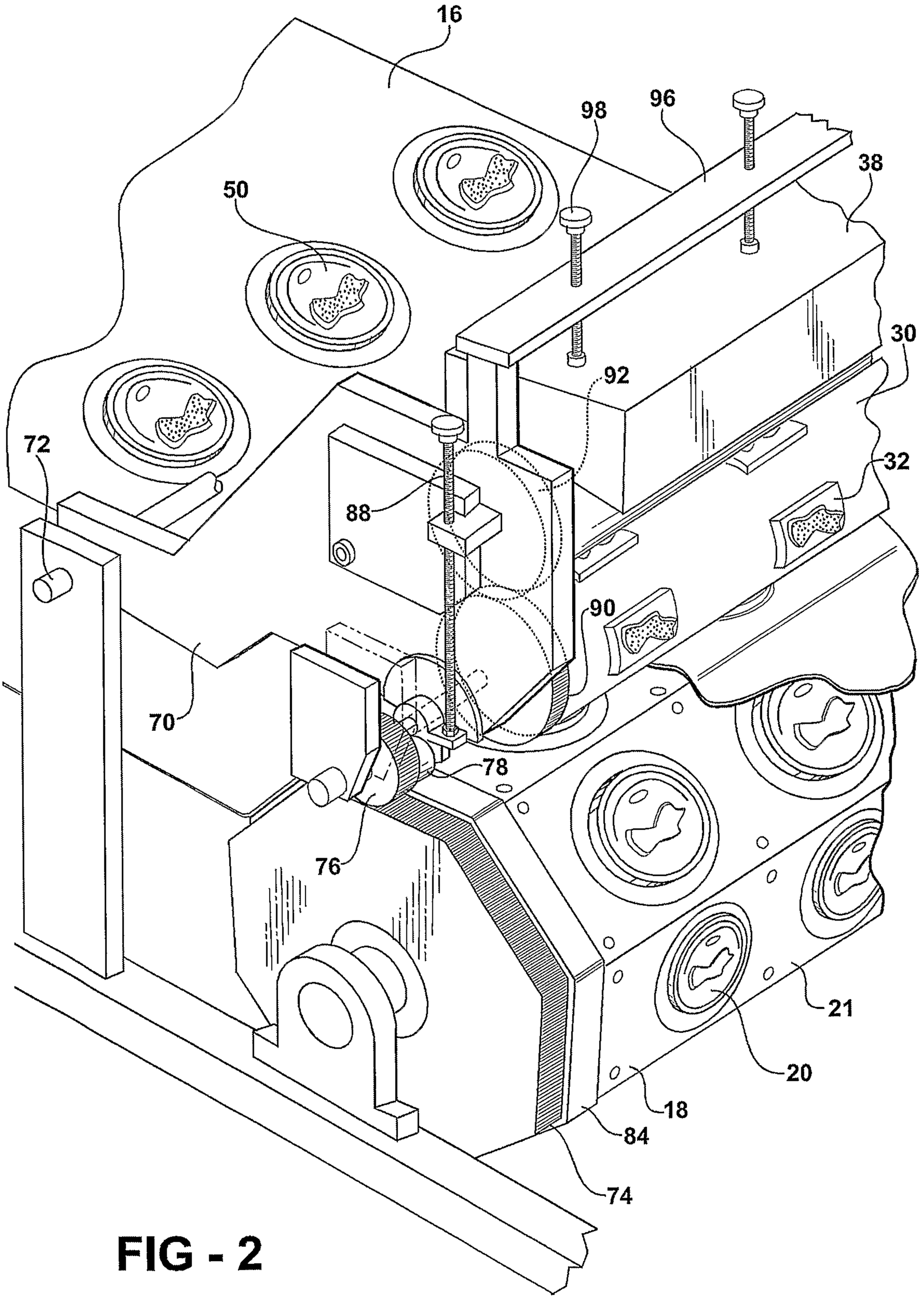


FIG - 2

FIG - 3

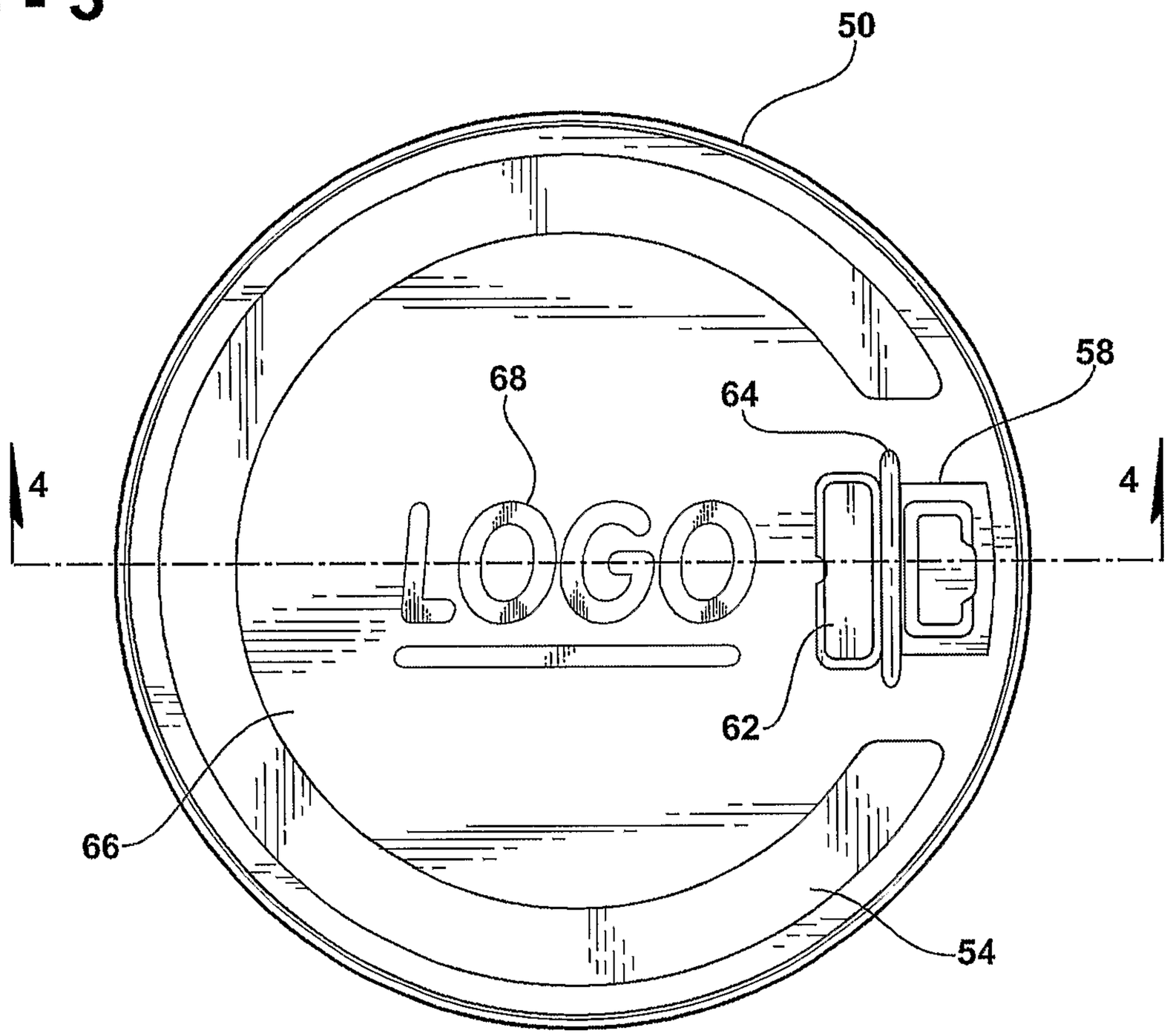


FIG - 4

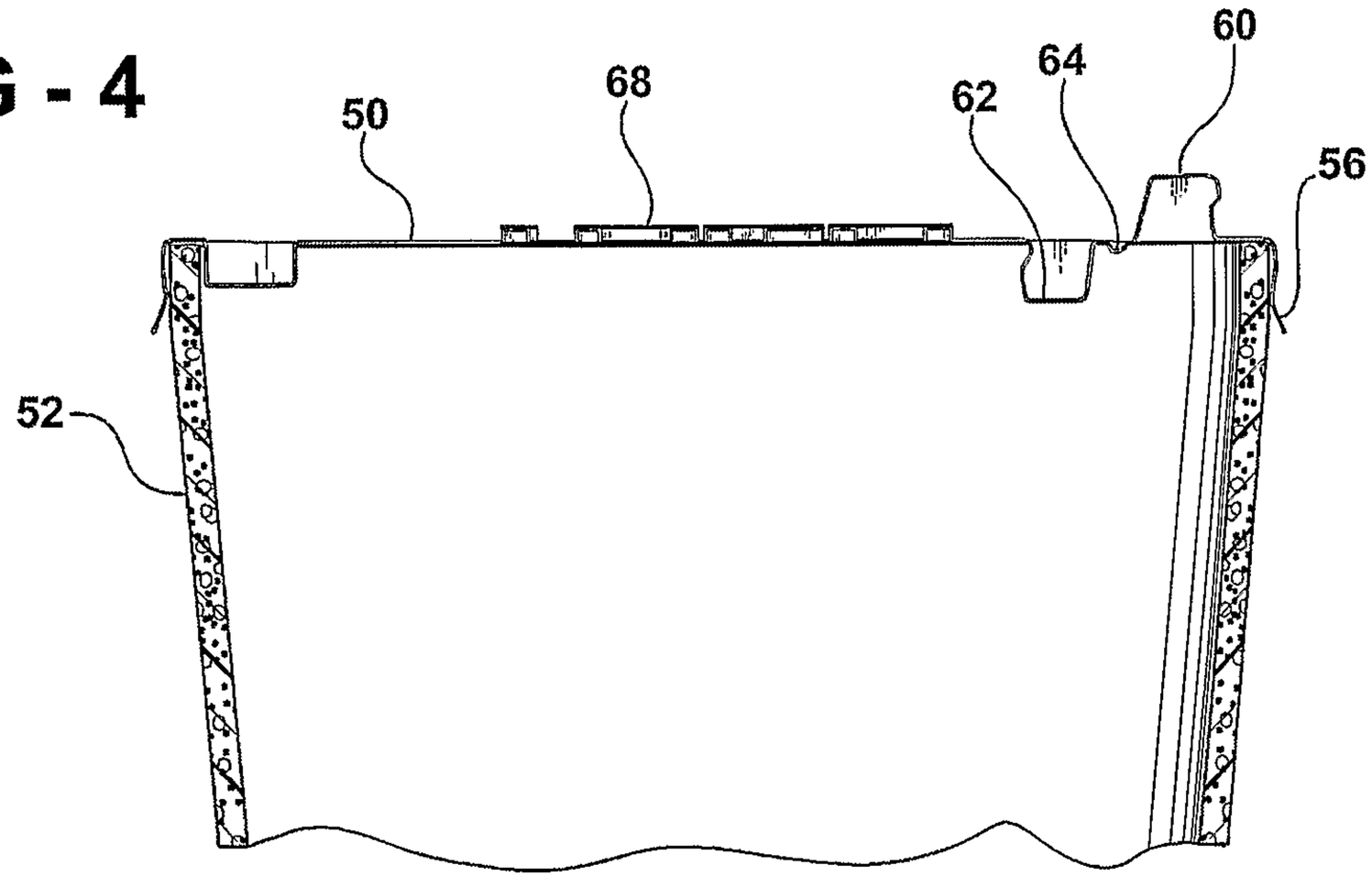
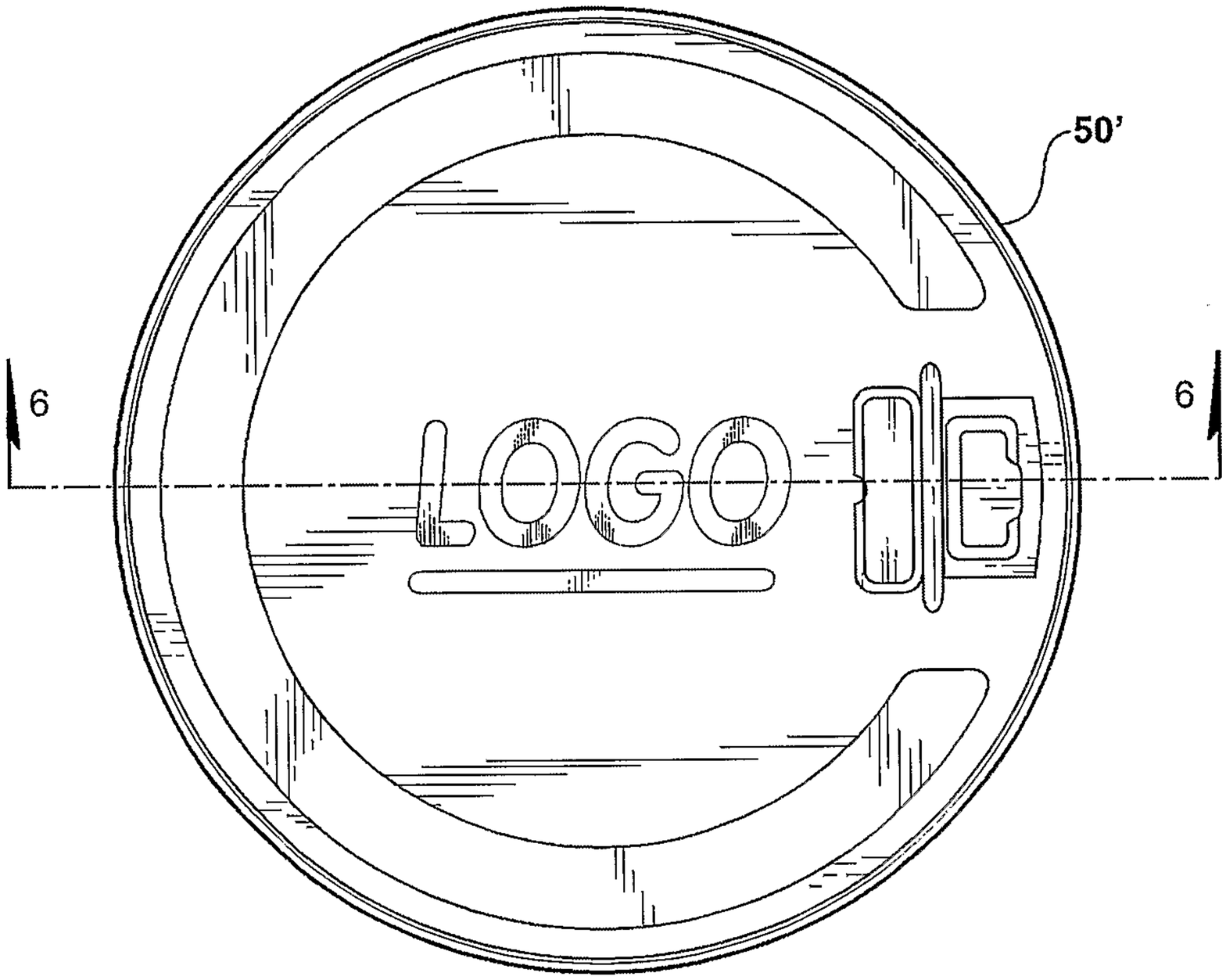


FIG - 5



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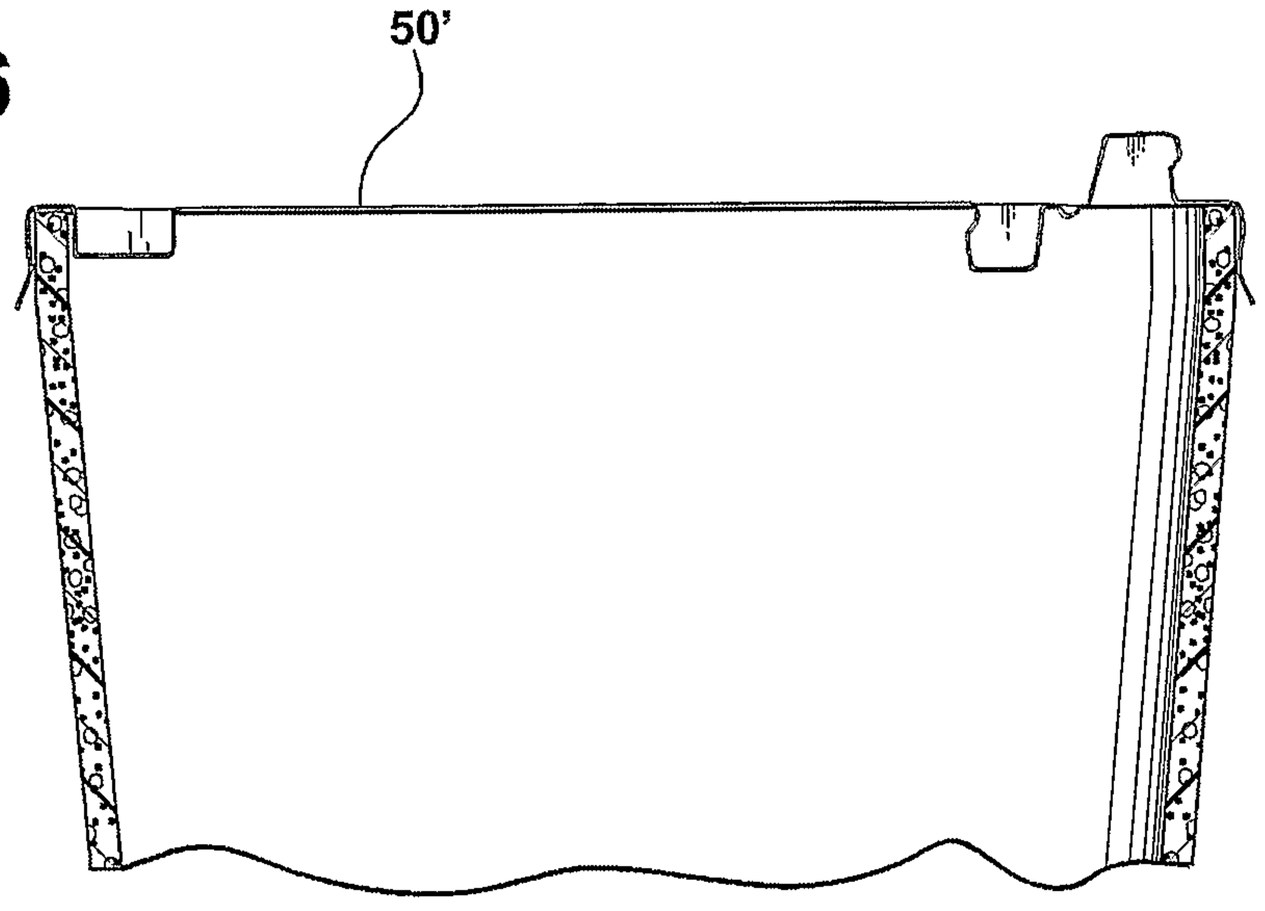

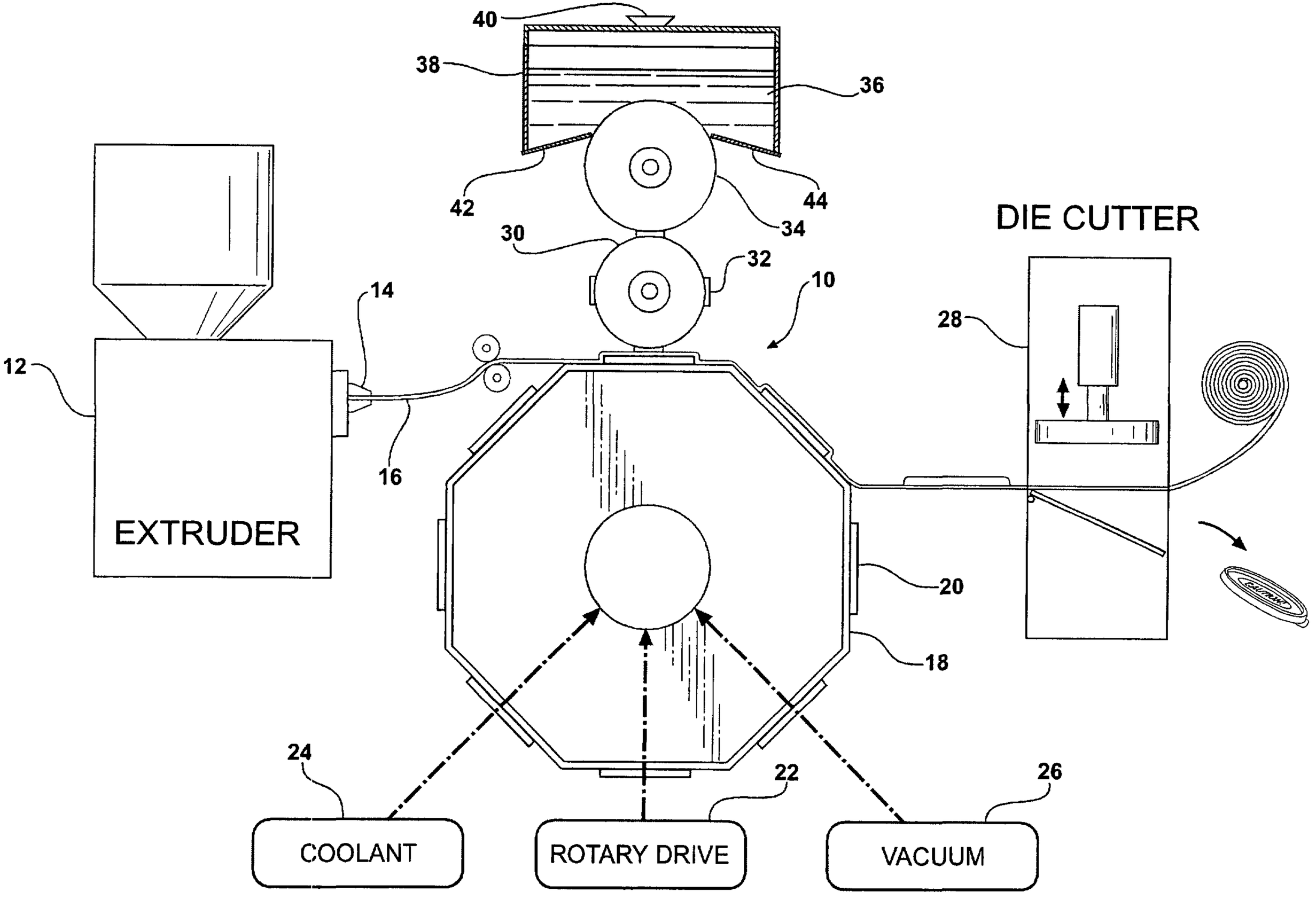
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