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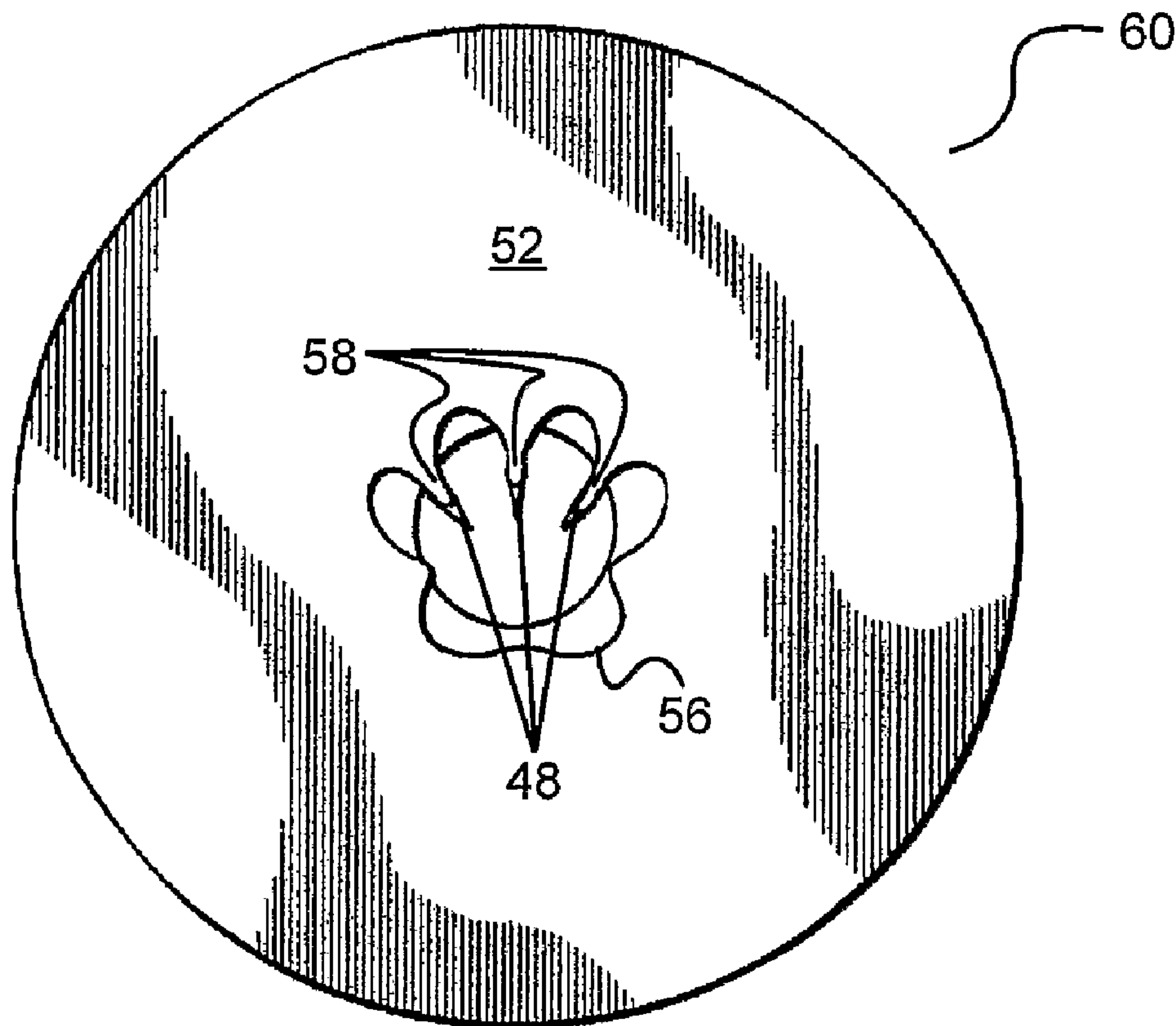
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ALIMENTAIRES A EXPANSION DIRECTE A FORMES COMPLEXES
(54) Title: APPARATUS AND METHOD FOR IMPROVING THE DIMENSIONAL QUALITY OF DIRECT-EXPANDED
FOOD PRODUCTS HAVING COMPLEX SHAPES



(57) Abrégé/Abstract:

The present invention comprises an improved extruder die assembly and method for using same to improve the quality of dimensional design aspects of extruded, complexly shaped, direct expanded food products. The improved system includes an

(57) Abrégé(suite)/Abstract(continued):

improved extruder die assembly comprising a transition insert section, a plurality of spacer insert elements, an imprinting insert element, and a forming insert element, all of which are coaxially aligned and interlocking. The improved extruder die assembly of the present invention is designed for adaptation to a wide variety of commercial-grade extrusion devices (e.g., twin screw, single screw, forming extruders, and pasta extruders) common in the food industry.

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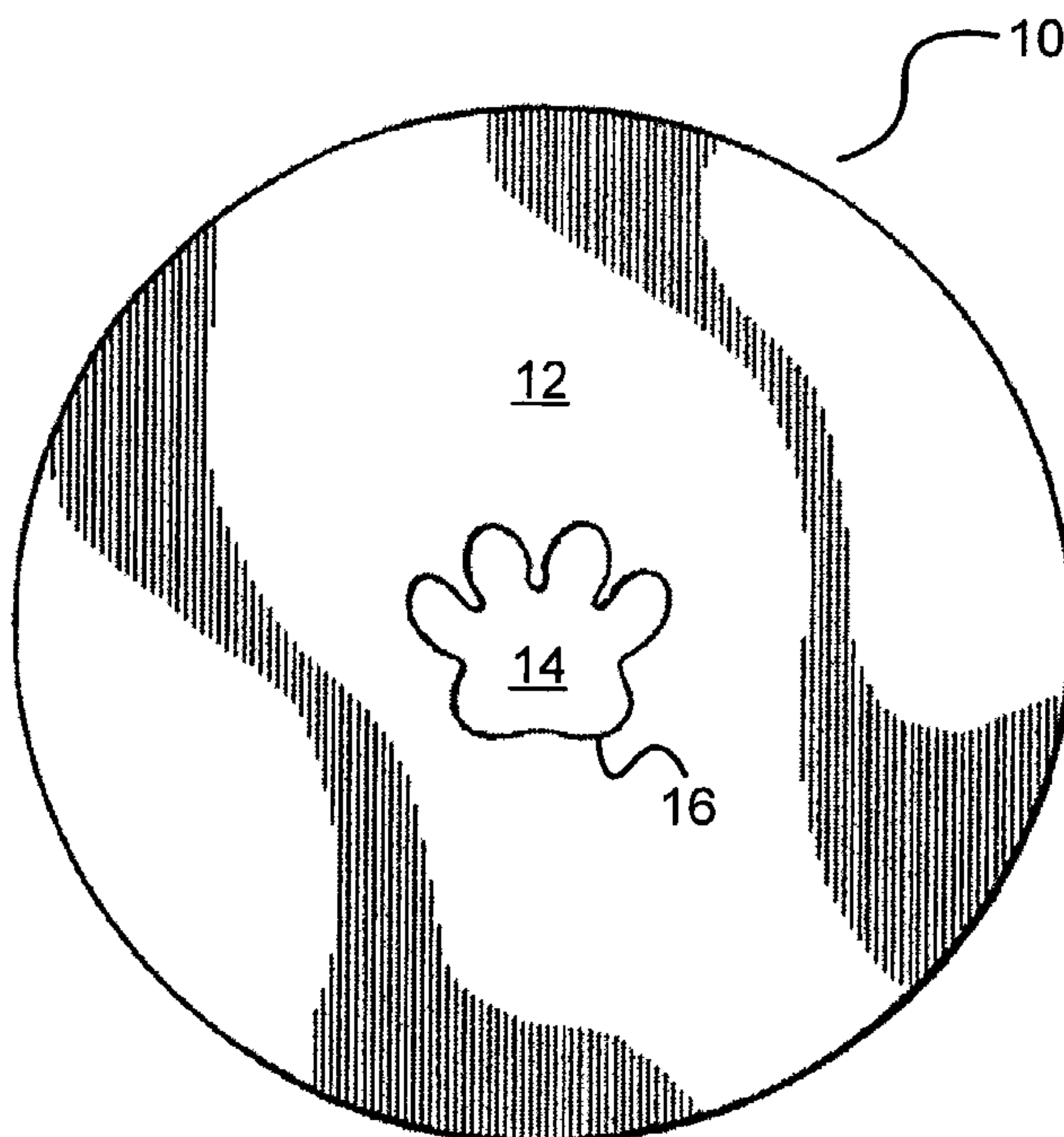
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(54) Title: DIMENSIONAL QUALITY OF DIRECT-EXPANDED FOOD PRODUCTS



(57) Abstract: The present invention comprises an improved extruder die assembly and method for using same to improve the quality of dimensional design aspects of extruded, complexly shaped, direct expanded food products. The improved system includes an improved extruder die assembly comprising a transition insert section, a plurality of spacer insert elements, an imprinting insert element, and a forming insert element, all of which are coaxially aligned and interlocking. The improved extruder die assembly of the present invention is designed for adaptation to a wide variety of commercial-grade extrusion devices (e.g., twin screw, single screw, forming extruders, and pasta extruders) common in the food industry.

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APPARATUS AND METHOD FOR IMPROVING THE DIMENSIONAL QUALITY OF DIRECT-EXPANDED FOOD PRODUCTS HAVING COMPLEX SHAPES

BACKGROUND OF THE INVENTION

1. Technical Field:

The present invention relates to an apparatus and method for improving the dimensional quality of direct expanded food products. More specifically, the present invention relates to an apparatus and method for improving the dimensional quality of direct expanded food products having complex shapes.

2. Description of the Related Art:

The use of extrusion devices in the preparation of direct expanded food products is long practiced. Utilized to produce a variety of products such as ready-to-eat (R-T-E) cereals, snack foods and confections, extrusion remains prominent among food processes because of its versatility and efficiency.

Food processes utilizing extrusion devices typically include an edible substance such as dough which is introduced into a device and conveyed via a screw pump to an inlet where the substance is forced through an extruder die assembly. The extruder die assembly may perform a variety of functions: it may form or shape the extrudate; it may divide the extrudate into a multiple extrudates; it may inject an additive substance into the extrudate; and it may compress and reduce the cross-sectional area of the extrudate. Upon exiting the extruder die assembly, the extruded mass is directly expanded (*e.g.*, via flash puffing) and typically cut into individual pieces using a reciprocating blade mechanism. The resulting individual pieces typically have a uniform, puffed shape with a cross-sectional shape generally corresponding to the outline of the forming die's exit port. While the characteristics of the resulting individual pieces are satisfactory for simple geometric shapes (*e.g.*, spheres, ovoids, and crescents), the design details of more complex shapes tend to be

obscured or eliminated.

For example, **Fig. 1a** shows the exit face **12** of a forming die **10** used in prior art extruder die assembly. Included within the periphery of the exit face **12** is a complexly shaped exit port **14**. The outline **16** of exit port **14** is designed to resemble a hand with four distinct appendages or fingers. When the forming die **10** is utilized in conjunction with a conventional direct expanded food process, the resulting product is a uniformly puffed food piece **18** as shown in **Fig. 1b**. While the shape of the outline **16** of exit port **14** is somewhat discernable in food piece **18**, the design details of the four distinct appendages is generally diminished and obscured. The individual dimensional aspects of the four distinct appendages are simply absorbed by the dimensional aspects of the palm area of the outline **16** of exit port **14**.

A need, therefore, exists for an improved apparatus and method for enhancing the quality of dimensional design aspects of extruded, complexly shaped, direct expanded food products.

SUMMARY OF THE INVENTION

5 The present invention overcomes many of the shortcomings inherent in prior art apparatus and methods addressing extruder die assemblies. The present invention comprises an improved extruder die assembly and method for using same to improve the quality of dimensional design aspects of extruded, complexly shaped, direct expanded food products.

10 The improved system includes an improved extruder die assembly comprising a transition insert section, a plurality of spacer insert elements, an imprinting insert element, and a forming insert element, all of which are coaxially aligned and interlocking. The improved extruder die assembly of the present invention is designed for adaptation to a wide variety of commercial-grade extrusion devices common in the food industry. The imprinting insert element includes at least one prong which, when properly configured, is aligned with a corresponding projection in the forming insert element, and momentarily disrupts the axial flow of an extrudate
15 altering its velocity profile. By disrupting the axial flow the extrudate in close proximity to the projections in the forming insert element prior to its extrusion, the dimensional quality of the resulting direct expanded food piece is greatly improved.

20 The axial distance between the one or more prongs and its corresponding projection may be adjusted as necessary using spacer insert elements to optimize the dimensional qualities of the resulting food piece depending upon the particular flow characteristics of each extrudate.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be had by reference to the following detailed description when taken in conjunction with the accompanying drawings, wherein:

5 **Fig. 1a** is an exit face view of a forming die used in prior art extruder die assembly;

Fig. 1b depicts the resulting direct expanded food piece formed by utilizing the forming die shown in Figure 1a in a conventional direct expanded food process;

10 **Fig. 2a** is cross-sectional view of an embodiment of the extruder die assembly of the present invention;

Fig. 2b is cross-sectional view of an alternate arrangement of an embodiment of the extruder die assembly of the present invention;

15 **Fig. 3** is an exit face view 32 of a spacer insert element used in an embodiment of the extruder die assembly of the present invention;

Fig. 4 is an exit face view 42 of the imprinting insert element used in an embodiment of the extruder die assembly of the present invention;

Fig. 5 is an exit face view 52 of the forming insert element used in an embodiment of the extruder die assembly of the present invention;

20 **Fig. 6** is an exit face view of an embodiment of the extruder die assembly of the present invention; and

Fig. 7 depicts the resulting direct expanded food piece formed by utilizing an embodiment of the extruder die assembly of the present invention.

25 Where used in the various figures of the drawing, the same numerals designate the same or similar parts. Furthermore, when the terms “top,” “bottom,” “first,” “second,” “upper,” “lower,” “height,” “width,” “length,” “end,” “side,” “horizontal,” “vertical,” and similar terms are used herein, it should be understood that these terms have reference only to the structure shown in the drawing and are utilized only to facilitate describing the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to **Fig. 2a**, a cross-sectional view of an embodiment of the extruder die assembly **20** of the present invention is shown. As shown in the embodiment in **Fig. 2a**, the improved extruder die assembly **20** may include a transition insert section **26**, a plurality of spacer insert elements **30**, an imprinting insert element **40**, and a forming insert element **50**, all of which are coaxially aligned and interlocking.

The extruder die assembly **20** of the present invention is designed for adaptation to a wide variety of commercial-grade extrusion devices common in the food industry. While the embodiment illustrated is shown as being generally cylindrical in shape, the exterior housing of the extruder die assembly **20** may be of any shape necessary for adaptation to commercial-grade extrusion devices common in the food industry. The extruder die assembly **20** is inserted into the appropriate compartment within an extrusion device (not shown) and connected to a coaxially aligned supply conduit **24** having a passageway **25** whereby an extrudate **22** (e.g., a paste or a cereal dough) is directed through the assembly **20**. Upon exiting the improved extruder die assembly **20**, the extrudate **22** is thereupon directly expanded and cut into individual pieces in the conventional manner.

The transition insert section **26** attaches to the supply conduit **24** and directs the flow of extrudate **22** through passageway **28** to a passageway defined by apertures in each of the spacer insert elements **30**. The cross sectional area of the passageway **28** defined through the transition insert section **26** may be reduced as necessary to smoothly transition the flow of extrudate **22** from the passageway **24** of supply conduit **24** to the passageway defined by apertures in each of the plurality of spacer insert elements **30**. Of course, the transition insert section **26** may be dispensed with entirely if the supply conduit **24** may be attached directly to the plurality of spacer insert elements **30**.

As illustrated in **Fig. 3**, which depicts an exit face view **32** of a spacer insert element in one embodiment, each of the plurality of spacer insert elements **30** includes a matching aperture **34** defined therethrough having a circumference **36**, such that

when coaxially aligned, the plurality of spacer insert elements **30** define a passageway through which the extrudate **22** may flow.

Referring now to **Fig. 4**, an embodiment of the exit face view 42 of the imprinting insert element **40** is illustrated. The imprinting insert element **40** includes an aperture **44** defined therethrough having a circumference **46** which generally corresponds to the circumference **36** of the aperture **34** defined in the spacer insert elements **30**, with the exception that the aperture **44** of imprinting insert element **40** includes one or more prongs **48** projecting into the aperture **44**.

Fig. 5 shows an embodiment of an exit face view 52 of a forming insert element **50** used in the present invention. The forming insert element **50** includes an aperture **54** defined therethrough having a complexly shaped circumference **56**. The complex shape of circumference **56** is defined by one or more projections **58** which extend into the center of aperture **54**.

As shown in the exit face view 52 of an embodiment of the extruder die assembly 60 of the present invention illustrated in **Fig. 6**, when the improved extruder die assembly **20** of the present invention illustrated in **Figs. 2a** and **2b** is properly assembled and configured, each of the projections **58** of the forming insert element **50** is aligned with a prong **48** of the imprinting insert element **40**. The prongs **48** momentarily disrupt the axial flow of the extrudate **22** altering its velocity profile prior to its extrusion through the aperture **54** of the forming insert element **50**. By disrupting the axial flow the extrudate **22** in the vicinity of the projections **58** in the forming insert element **50** prior to its extrusion, the dimensional quality of the resulting direct expanded food piece is greatly improved. As shown in **Fig. 7**, the resulting food piece **70** exhibits an improved three-dimensional quality such that each of the appendages **72 a-d** is more clearly defined and distinguishable one another.

The axial distance between the one or more projections **58** and its corresponding prongs **48** may be adjusted as necessary to optimize the dimensional qualities of the resulting food piece depending upon the particular flow characteristics (*e.g.*, flow velocity, viscosity, and texture) of each extrudate **22**. For example, as shown in **Fig. 2a**, in one configuration of an embodiment of the extruder die assembly **20**, the imprinting insert element **40** is positioned directly upstream

insert element **50**. Alternatively, as shown in **Fig. 2b**, in another configuration of the embodiment of the extruder die assembly **20a**, two spacer insert elements **30** are inserted between the imprinting insert element **40** and the forming insert element **50**. The thickness of each individual imprinting insert element **30** may be varied to allow incremental change of the axial distance between the imprinting insert element **40** and the forming insert element **50**. The axial distance between the imprinting insert element **40** and the forming insert element **50** varies from 5mm – 55mm, but in a preferred embodiment is 10mm.

It will now be evident to those skilled in the art that there has been described herein an improved extruder die assembly and method for using the same to improve the quality of dimensional design aspects of extruded, complexly shaped, direct expanded food products.

Although the invention hereof has been described by way of a preferred embodiment, it will be evident that other adaptations and modifications can be employed without departing from the spirit and scope thereof. The terms and expressions employed herein have been used as terms of description and not of limitation; and thus, there is no intent of excluding equivalents, but on the contrary it is intended to cover any and all equivalents that may be employed without departing from the spirit and scope of the invention.

CLAIMS:

1. An extruder die assembly for improving the dimensional quality of complexly shaped, direct expanded food products, comprising in combination:
 - (a) an imprinting insert element having a first aperture defined therethrough and at least one prong extending into the first aperture;
 - (b) a forming insert element having a second aperture defined therethrough which is coaxially aligned with the first aperture and positioned downstream from the imprinting insert element, wherein the shape of the second aperture is defined by at least one projection extending into the second aperture;

wherein each of the at least one projection aligns with each of the at least one prong.
2. The extruder die assembly of Claim 1 further comprising in combination a plurality of spacer insert elements having a third aperture defined therethrough, wherein said apertures are all coaxially aligned.
3. The extruder die assembly of Claim 2 wherein the plurality of spacer insert elements are positioned upstream of the imprinting insert element.
4. The extruder die assembly of Claim 2 wherein at least one of the plurality of spacer insert elements is positioned between the imprinting insert element and the forming insert element.
5. The extruder die assembly of Claim 2 further comprising in combination a transition insert section having a passageway with an inlet and an outlet defined therethrough and positioned upstream of the said elements, wherein the passageway and said apertures are all coaxially aligned.
6. The extruder die assembly of Claim 5 wherein the outlet has a circumference matching the third aperture.

7. The extruder die assembly of Claim 1 wherein the forming insert element is positioned at least 5 mm downstream from the imprinting insert element.
8. The extruder die assembly of Claim 1 wherein the forming insert element is positioned less than 55 mm downstream from the imprinting insert element.
9. The extruder die assembly of Claim 1 wherein the forming insert element is positioned approximately 10 mm downstream from the imprinting insert element.
10. An apparatus for improving the dimensional quality of complexly shaped, direct expanded food products, comprising in combination:
 - (a) means for supplying an extrudate flow wherein said means for supplying comprises means for receiving and directing the extrudate flow down a first passageway;
 - (b) an imprinting insert die positioned downstream from the supplying means and having a first aperture defined therethrough which is coaxially aligned with the first passageway, and having at least one prong extending into the first aperture;
 - (c) a forming insert die positioned downstream from the imprinting insert and having a second aperture defined therethrough which is coaxially aligned with the first passageway and the first aperture, and wherein the shape of the second aperture is defined by at least one projection extending into the second aperture;

wherein each of the at least one projection aligns with each of the at least one prong.
11. The apparatus of Claim 10 further comprising in combination a plurality of spacer insert dies positioned downstream from the supplying means and having a third aperture defined therethrough which is coaxially aligned with the first passageway and the first and second apertures.

12. The apparatus of Claim 11 wherein the plurality of spacer insert dies are positioned upstream of the imprinting insert die.
13. The apparatus of Claim 11 wherein one or more of the plurality of spacer insert dies are positioned between the imprinting insert die and the forming insert die.
14. The apparatus of Claim 11 further comprising in combination a transition insert section positioned downstream from the supplying means but upstream from said dies and having a second passageway with an inlet and an outlet defined therethrough, wherein said second passageway is coaxially aligned with the first passageway.
15. The apparatus of Claim 14 wherein the inlet of the second passageway matches the circumference of the first passageway and the outlet has a circumference matching the third aperture.
16. The apparatus of Claim 10 wherein the forming insert die is positioned at least than 5 mm downstream from the imprinting insert die.
17. The apparatus of Claim 10 wherein the forming insert die is positioned less than 55 mm downstream from the imprinting insert die.
18. The apparatus of Claim 1 wherein the forming insert die is positioned approximately 10 mm downstream from the imprinting insert die.
19. A method for improving the dimensional quality of complexly shaped, direct expanded food products, comprising in combination:
 - (a) supplying an extrudate flow comprising receiving and directing the extrudate flow down a first passageway;
 - (b) directing the extrudate flow through an imprinting insert die positioned downstream from the first passageway, wherein said imprinting insert die has a first aperture defined therethrough which is coaxially aligned

with the first passageway, and has at least one prong extending into the first aperture;

- (c) directing the extrudate flow through a forming insert die positioned downstream from the imprinting insert, wherein said forming insert die has a second aperture defined therethrough which is coaxially aligned with the first passageway and the first aperture, and the shape of the second aperture is defined by one or more projections extending into the second aperture;

wherein each of the at least one projection aligns with each of the at least one prong.

- 20. The method of Claim 19 further comprising in combination, positioning a plurality of spacer insert dies upstream from the forming insert die, wherein said spacer insert dies each have a third aperture defined therethrough which is coaxially aligned with the first passageway and the first and second apertures.
- 21. The method of Claim 20 wherein the plurality of spacer insert dies are positioned upstream of the imprinting insert die.
- 22. The method of Claim 20 wherein one or more of the plurality of spacer insert dies are positioned between the imprinting insert die and the forming insert die.
- 23. The method of Claim 19 wherein the forming insert die is positioned at least 5 mm downstream from the imprinting insert die.
- 24. The method of Claim 19 wherein the forming insert die is positioned less than 55 mm downstream from the imprinting insert die.
- 25. The method of Claim 19 wherein the forming insert die is positioned approximately 10 mm downstream from the imprinting insert die.

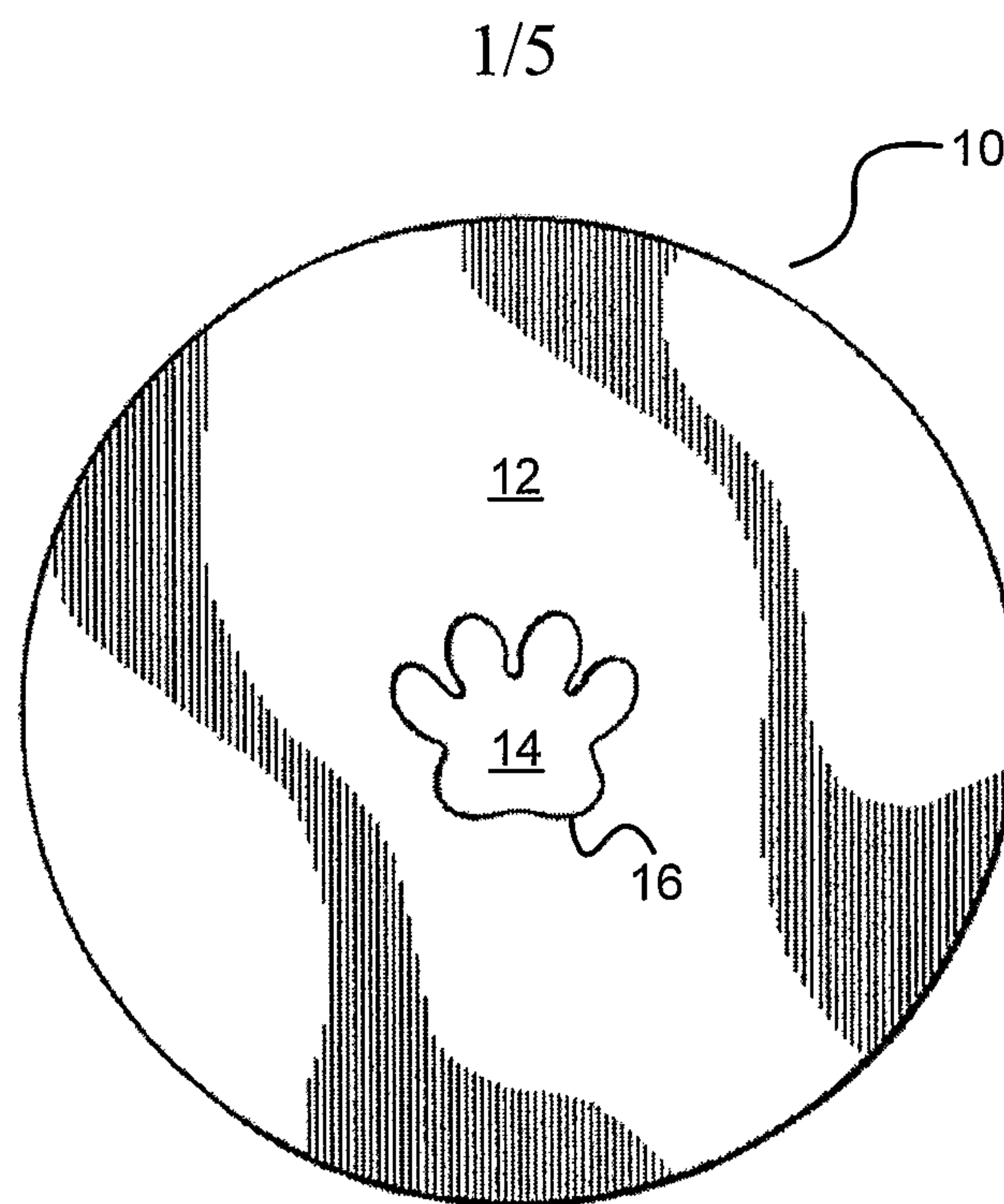


Fig. 1a
(PRIOR ART)
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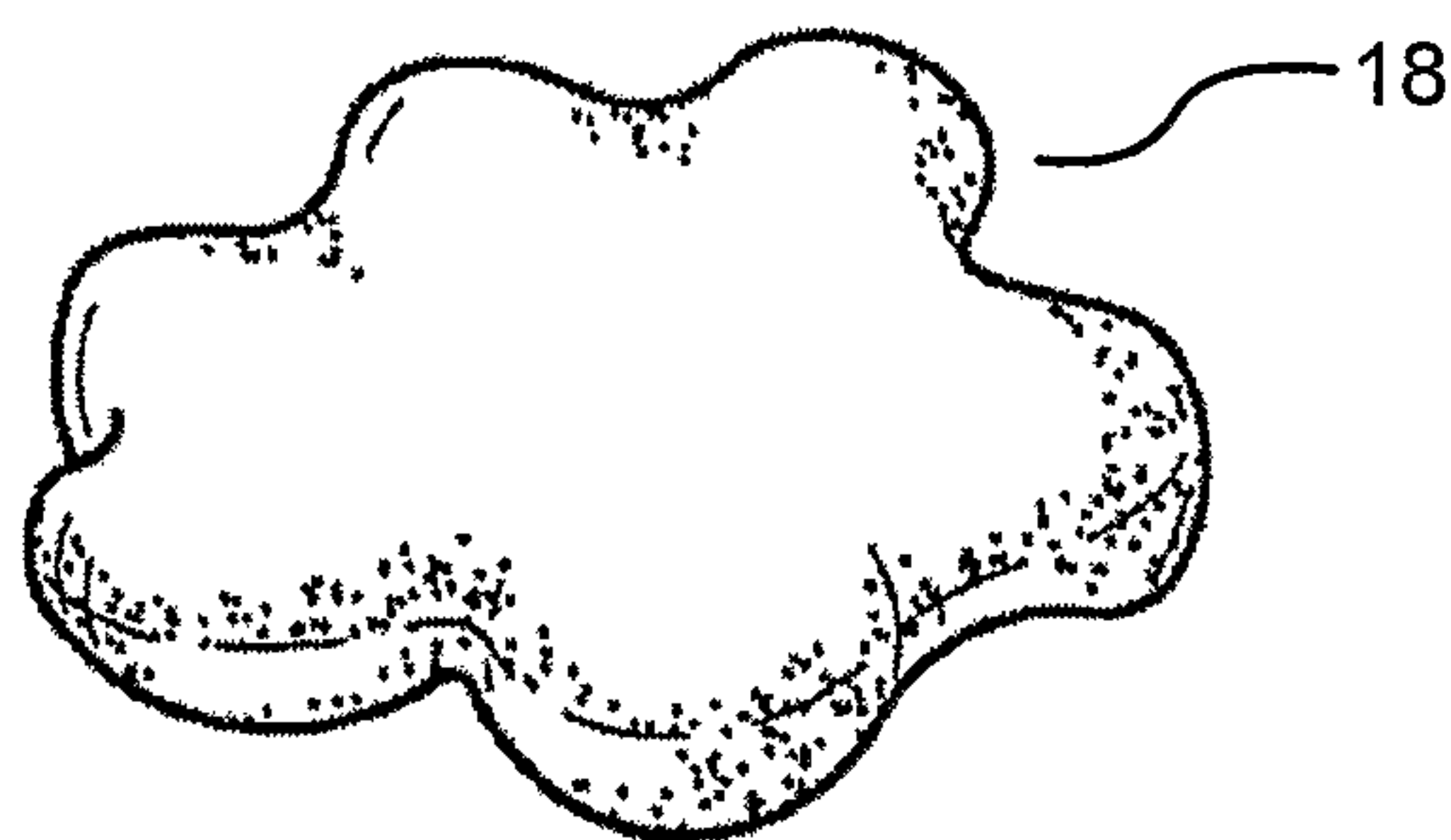
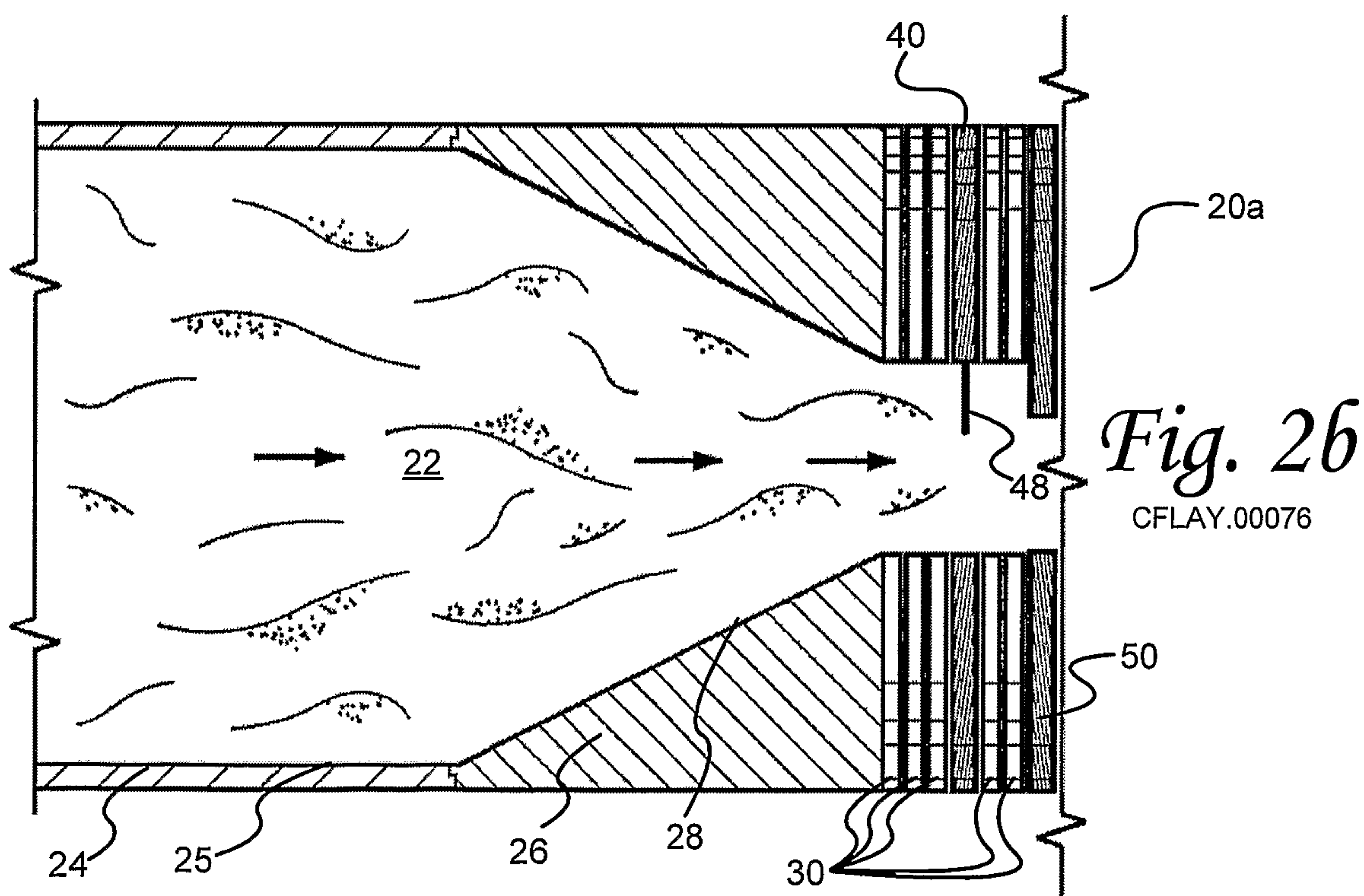
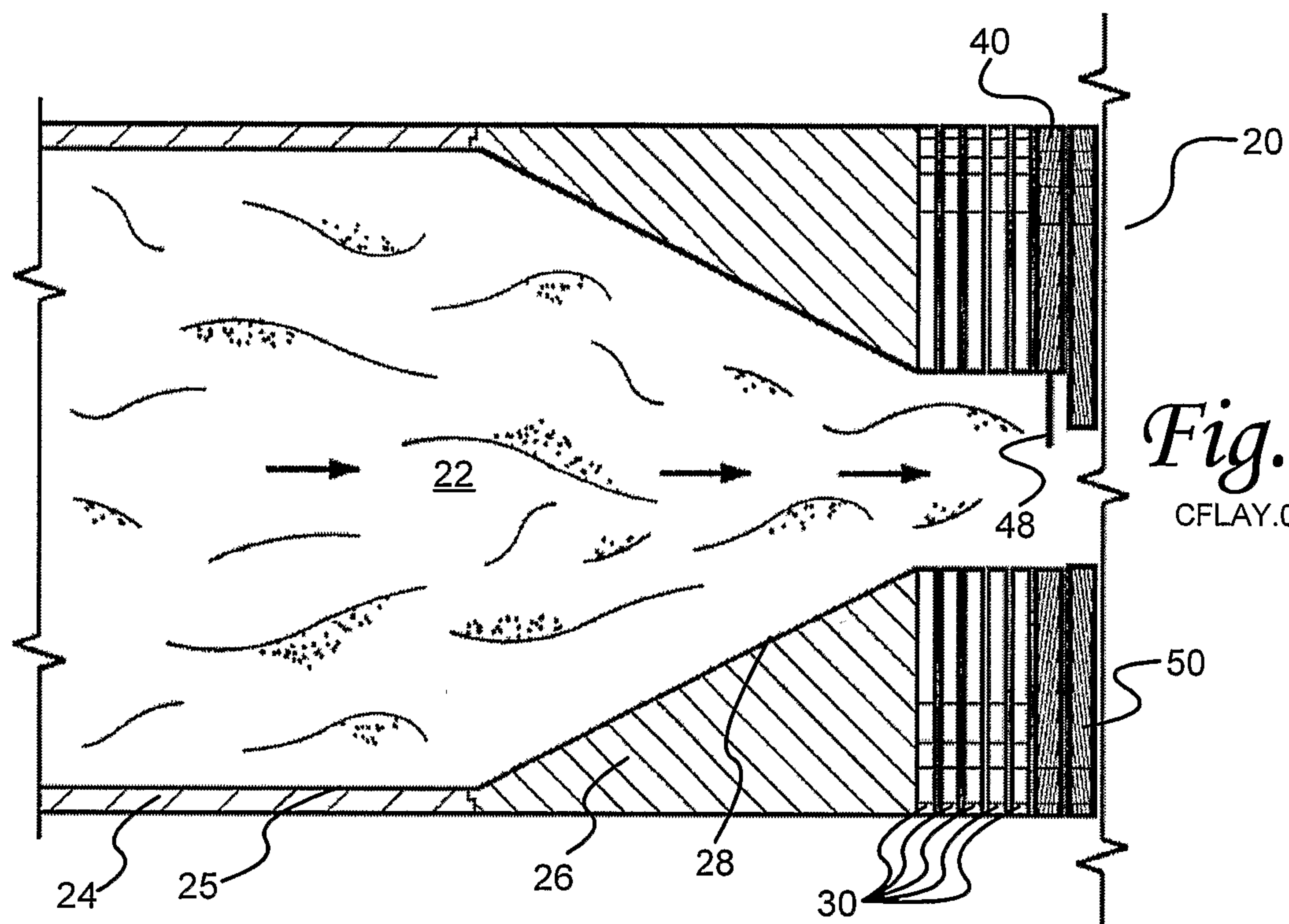
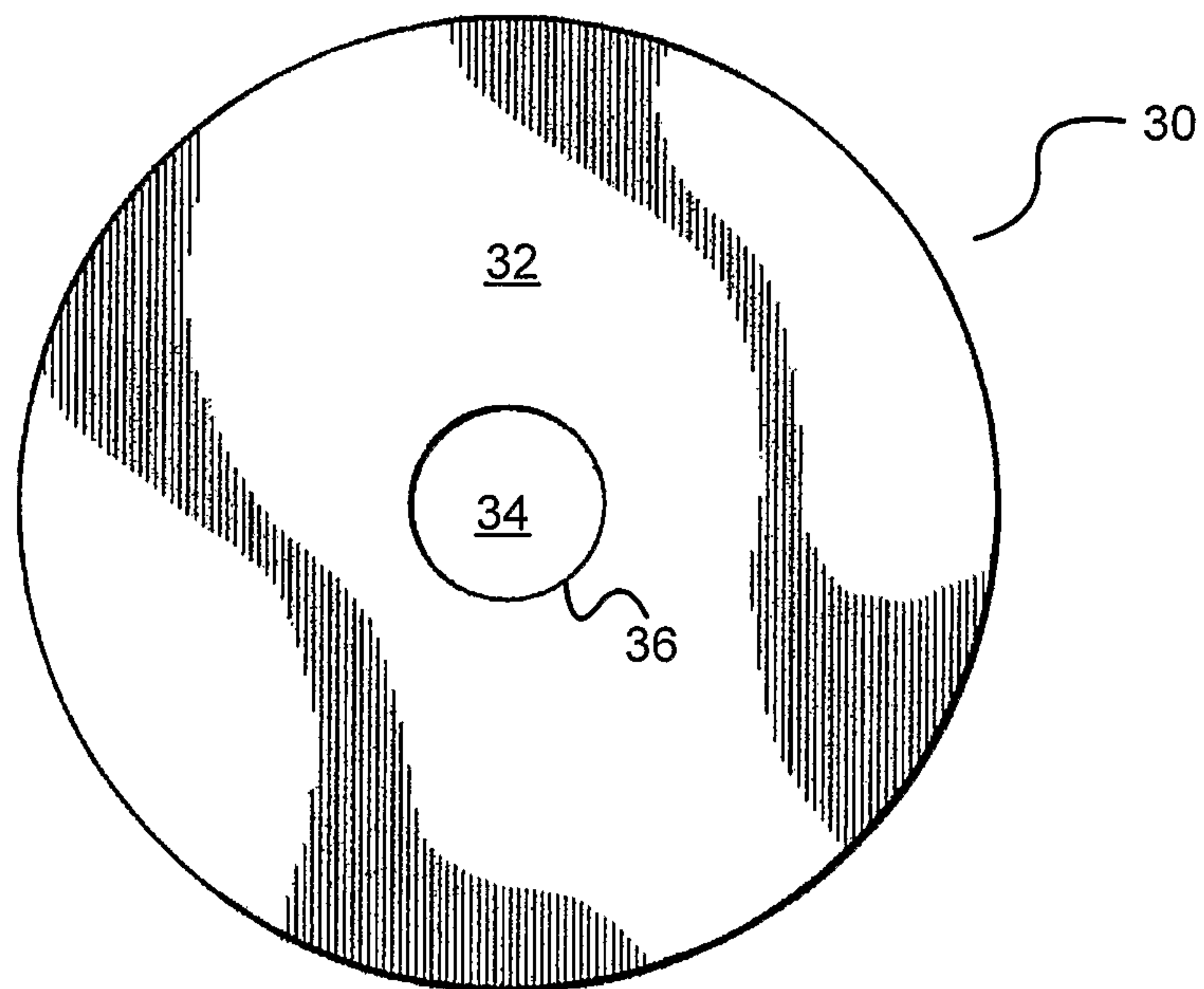


Fig. 16
(PRIOR ART)
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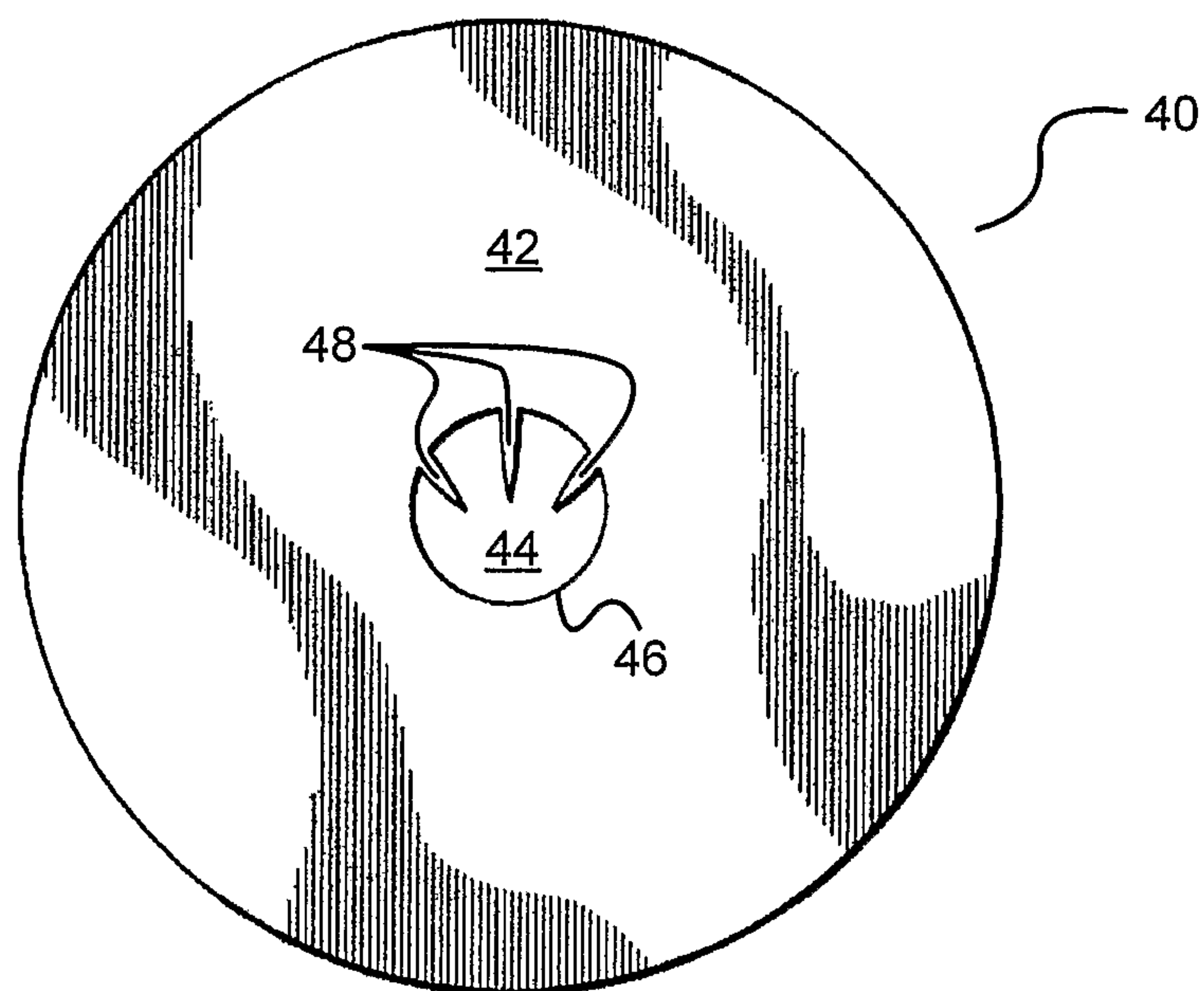
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*Fig. 3*

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*Fig. 4*

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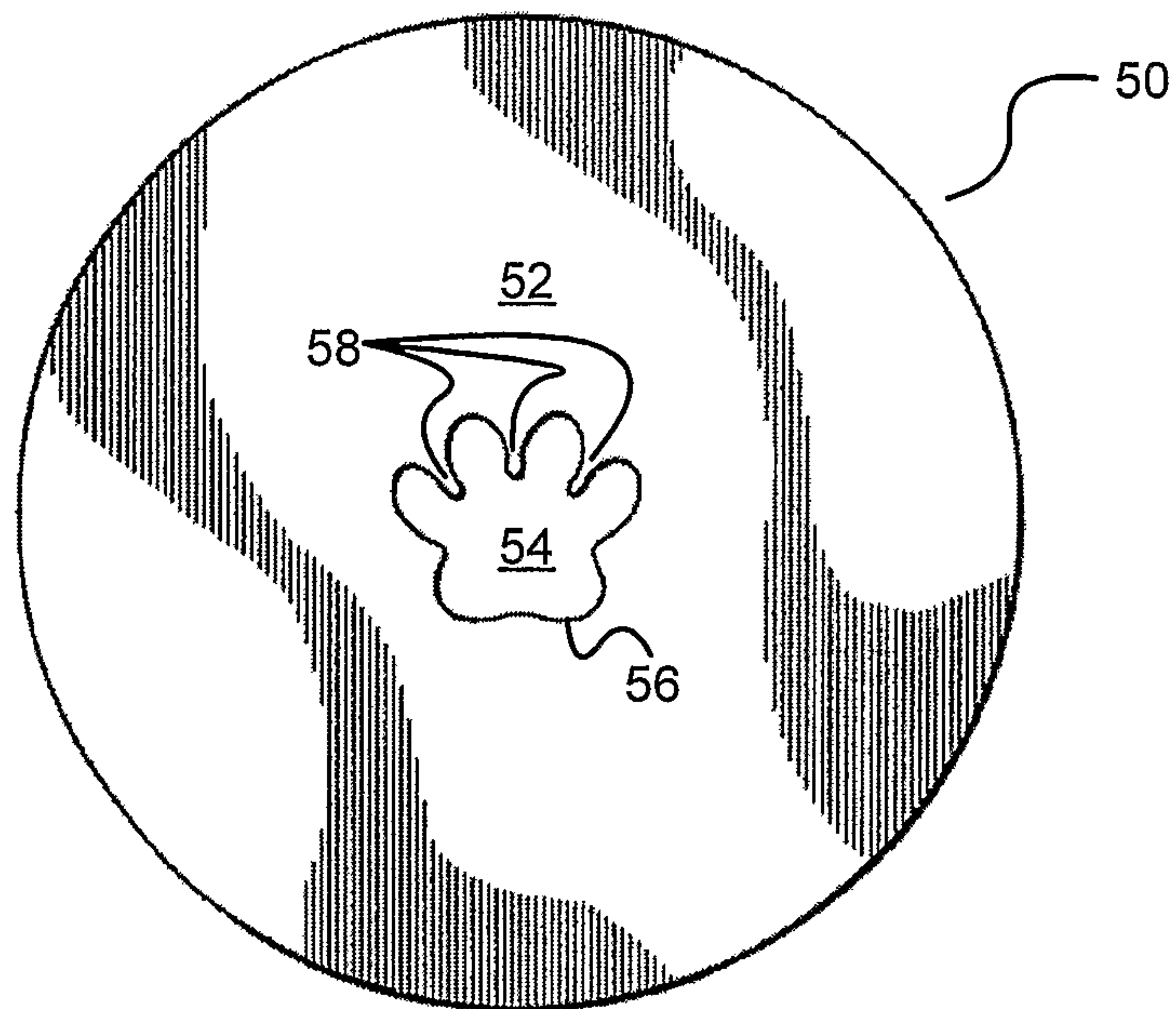


Fig. 5
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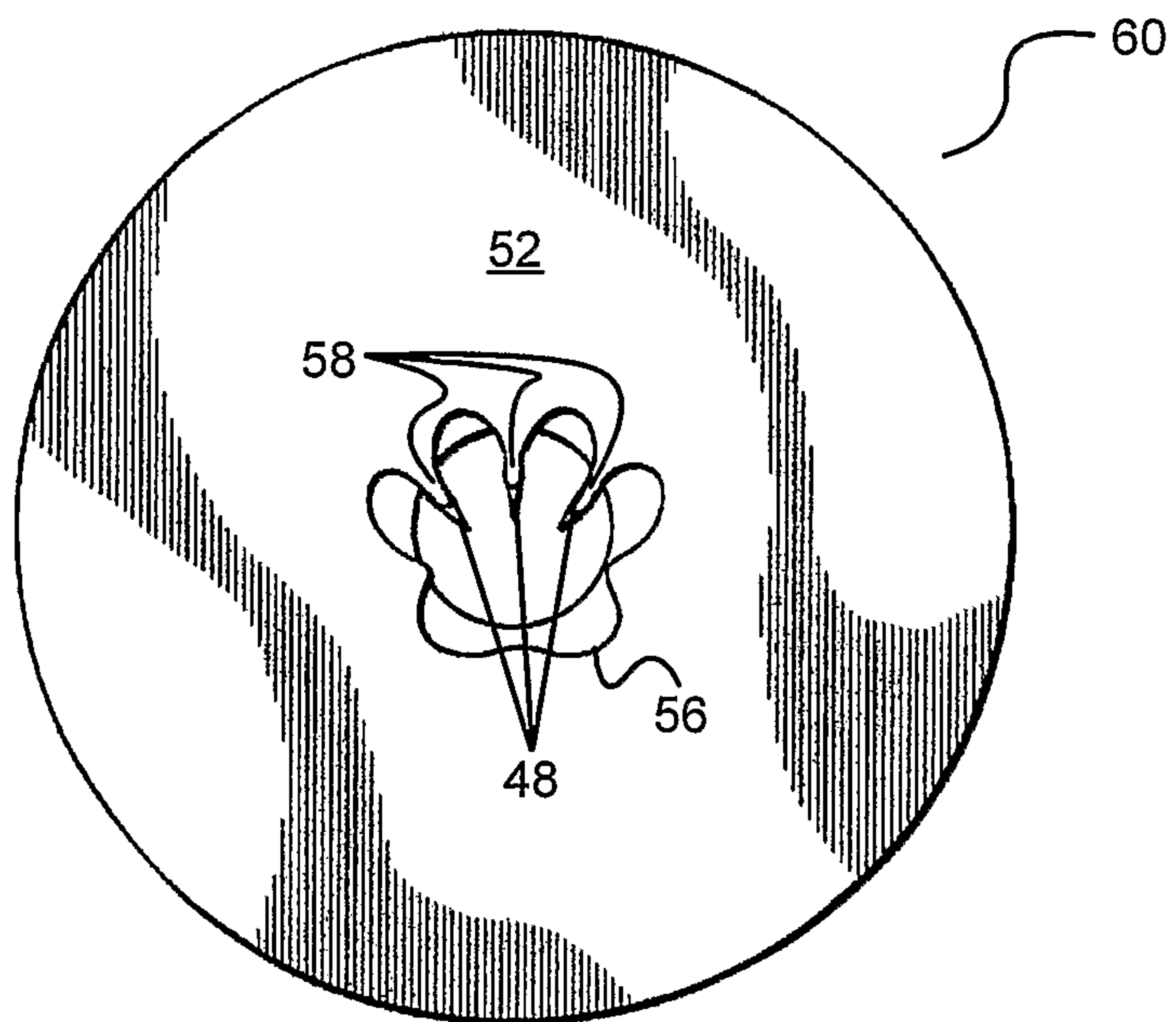


Fig. 6
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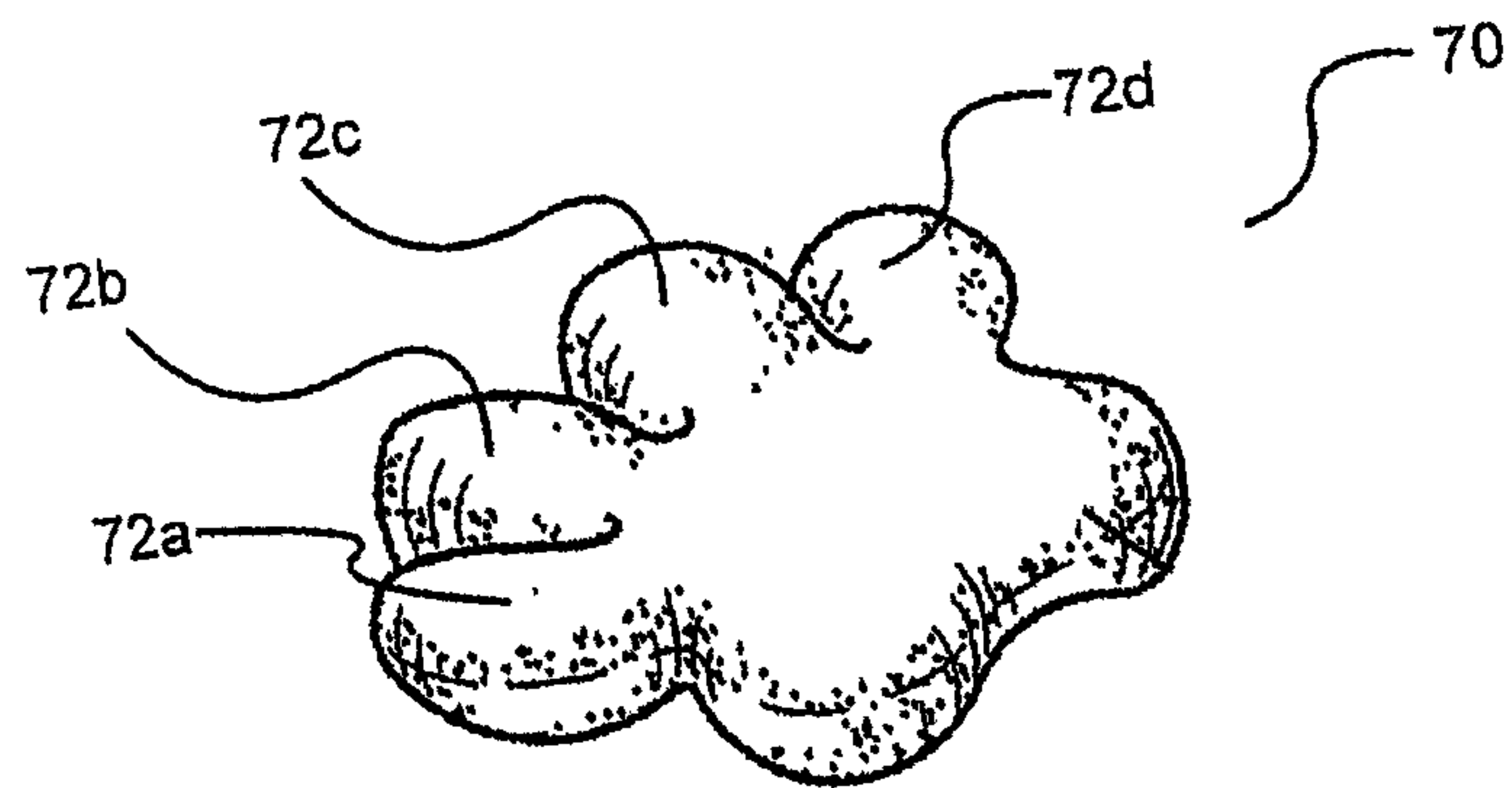


Fig. 7

