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(54) METHOD AND APPARATUS FOR MANUFACTURING MICROPERFORATED ALUMINUM TRAYS FOR FOODSTUFF

(57) In a perforating station (40), a strip (10) of aluminum foil unrolling from a roll (12) is punched to form a plurality of microperforations. In a molding station (14), a portion (P) of aluminum foil is separated from the strip (10) output from the perforating station (40) and molded into the shape of a tray (20). In the perforating station (40), the strip (10) is intermittently punched, in synch with the operation of the molding station (14), at a desired region (R) between a punching plate (42) provided with a plurality of needles (44) and a counter plate (46) suitable to be passed through by the needles (44). The pitch between two consecutive perforated regions (R), as determined by the intermittent punching action, corresponds to the length of the portion (P) of aluminum foil or to a multiple thereof.

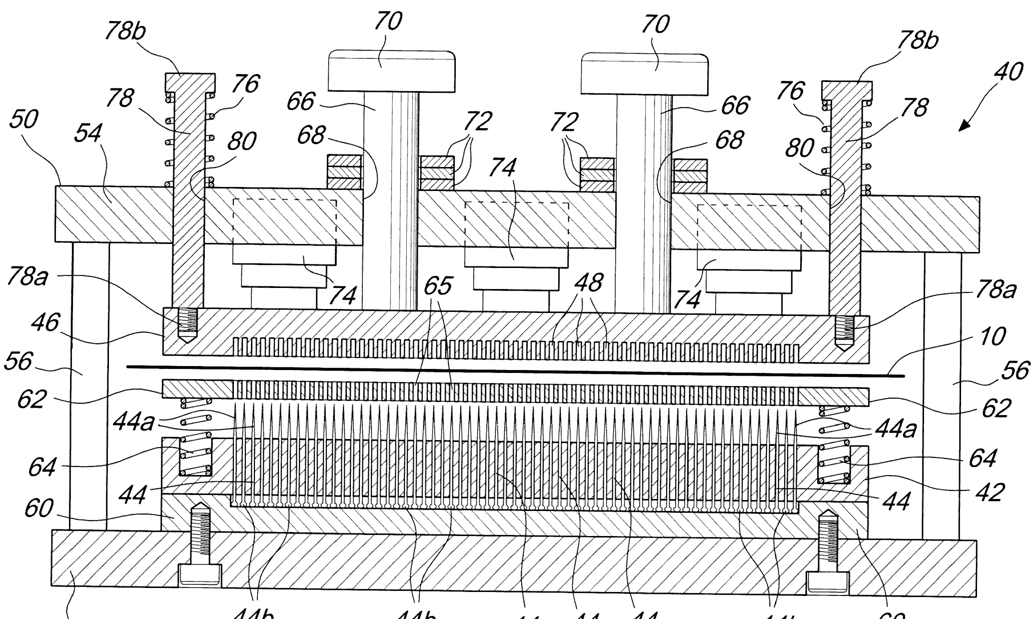

Fig. 2

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Description

[0001] The present invention relates to a method and to an apparatus for manufacturing microperforated aluminum trays for foodstuff.

[0002] As known, disposable trays made of aluminum foil are widely used for baking foods such as cakes, lasagna, puff pastries, and the like.

[0003] The above disposable trays are conventionally manufactured in series starting from an aluminum foil, which is molded between a male mold and a female mold into the final concave shape of a tray.

[0004] A typical aluminum tray may have a substantially flat bottom with a circular or rectangular profile, and a slightly flared peripheral wall having an upper cantilever edge, which is bent outwards parallel to the bottom and terminates with a curled, cut-safe frame.

[0005] Trays are also known which are provided with microperforations in order to improve the baking process and make it faster.

[0006] A known process for manufacturing microperforated trays differs from the conventional one in that the aluminum foil, before the molding process, passes between a couple of counter-rotating, perforating cylinders pressed against each other, which engage the aluminum foil for the entire width thereof. One of the cylinders is provided with small needles which are uniformly distributed over its entire surface, while the other cylinder is made of a yielding material in order to allow the needles to fully penetrate the aluminum foil.

[0007] As a result, with the known manufacturing process the microperforations are distributed over the entire surface of the tray, i.e., the bottom, the peripheral wall, the cantilever edge and the curled, cut-safe frame.

[0008] As well known to the person skilled in the art, the above solution not only is unsatisfactory from an aesthetic point of view, but is also subject to practical drawbacks.

[0009] Firstly, the micro-perforations on the peripheral wall and the cantilever edge inevitably compromise the rigidity of the tray.

[0010] In addition, small flakes or fragments of aluminum generated during the perforation, particularly in the area of the curled, cut-safe frame, may remain attached to the surface of the tray. In use, such flakes or fragments may detach from the material of the tray and pollute the food contained therein.

[0011] Furthermore, the microperforations on the curled, cut-safe frame make its surface rough and its shape uneven. As well known to the person skilled in the art, the aforementioned roughness and unevenness of the curled, cut-safe frame can compromise the correct unstacking of the trays during certain steps of the production process and packaging process.

[0012] Nevertheless, the micro-perforations in the area of the curled, cut-safe frame may generate sharp spikes that can hurt the user.

[0013] Furthermore, in order to vary the diameter of the microperforations it is necessary to manually replace the perforating cylinders, which operation requires the producion line to be stopped for a relatively long time, with consequent negative repercussions on the production yield.

[0014] Therefore, the aim of the present invention is to provide a method and an apparatus for manufacturing microperforated aluminum trays for foodstuff, which allow the drawbacks of the known solutions to be overcome particularly in relation to the weakening of the tray determined by the microperforations, to the possible pollution of the foodstuff by flask or fragments of aluminum detaching from the tray, to the complications in the production process and packaging process deriving from the presence of microperforations particularly in the area of the curled, cut-safe frame, as well as to the undesired sharp spikes which may be generated by the micro-perforation particularly in the area of the curled, cut-safe frames.

[0015] Within this aim an object of the invention is to provide a method and an apparatus which can be easily applied to existing lines for production of conventional (i.e., non-perforated) aluminum trays for foodstuff.

[0016] It is a further object of the invention to provide a method and an apparatus which allow the diameter of the perforations to be adjusted easily and quickly, without requiring a long stop of the production line.

[0017] The above aim and objects and others, which will better appear from the following description, are achieved by a method and an apparatus for manufacturing micro-perforated aluminum trays for foodstuff, which have the features recited in the appended independent claims, while the dependent claims state other advantageous, though secondary features of the invention.

[0018] The invention will be now described in more detail with reference to a few preferred, non exclusive embodiments, shown by way of non-limiting examples in the attached drawings, wherein:

Fig. 1 is a diagrammatical view in side elevation of an apparatus according to the invention;
Fig. 2 is a view in longitudinal cross section of a perforating station of the apparatus according to the invention, in a first operative configuration;
Fig. 3 is a view similar to Fig. 2, which shows the perforating station in a second operative configuration;
Fig. 4 is a view similar to Fig. 2, which shows the perforating station in a third operative configuration;
Fig. 5 shows a detail of Fig. 4 to an enlarged scale;
Fig. 6 is a top plan view of an aluminum foil processed by the method according to the invention, at an intermediate step thereof;
Fig. 7 is a top plan view of a tray manufactured by the method according to the invention.

[0019] With initial reference to Fig. 1, microperforated aluminum trays are manufactured in series starting from a strip 10 of aluminum foil.

[0020] The strip 10 is continuously unrolled from a roll 12 and delivered to a molding station 14, where a portion P of aluminum foil is separated from the strip 10 and molded into the final concave shape of a tray.

[0021] The molding station 14 is conventionally provided with a lower male mold 16 and an upper female mold 18, between which the portion P of aluminum foil is pressed.

[0022] The male mold 16 and the female mold 18 are generally configured in such a way as to generate a tray 20 which is shaped as illustrated in Fig. 7.

[0023] In the embodiment described herein by way of example, the tray 20 has a substantially flat bottom 22 with a circular profile, and a slightly flared peripheral wall 24 having an upper cantilever edge 26 which is bent outwards substantially parallel to the bottom 22 and terminates with a cut-safe curled frame 28.

[0024] In addition, in this embodiment, the strip 10 is continuously unrolled from the roll 12. However, since the aluminum foil must be stationary in the molding station 14, a swinging tensioner roller 30 is conventionally arranged downstream of roll 10 between two idle guiding rollers 32, 34, for temporarily storing the material unrolled in excess during the molding cycle, and then returnig it for the next cycle upon request from a pair of motorized feeding rollers 36, 38 which are intermittently operated in synchronism with the molding station 14.

[0025] A perforating station 40 arranged between the tensioner roller 30 and the molding station 14 is adapted to perforate the strip 10 with microperforations before the molding process.

[0026] With particular reference now to Figs. 2-6, with the method according to the invention the strip 10 in the perforating station 40 is intermittently punched, in synchronism with the operation of the molding station 14, at a desired region R - e.g., the region which will constitute the bottom of the tray - between a punching plate 42 provided with a plurality of needles 44 and a counter plate 46 suitable to be passed through by the needles 44, the pitch between two consecutive perforated regions R, as determined by the above intermittent punching action, corresponding to the length of one portion P of aluminum foil which is used for producing one tray or to a multiple thereof.

[0027] As a person skilled in the art will easily appreciate, if the pitch corresponds to the length of one portion P, all the trays output from the apparatus according to the invention will be perforated in the desired region R. If the pitch corresponds to a multiple of the length of one portion P, the perforated trays will alternate with one or more non-perforated trays, depending on the multiplying factor.

[0028] Advantageously, the counter plate 46 is made of a rigid material and is provided with a plurality of holes 48 aligned to the needles 44. In an alternative embodiment, the counter plate 46 could be made of a yielding material suitable to be perforated by the needles 44.

[0029] According to a preferred embodiment of the invention, the perforating station 40 is arranged at a predetermined distance from the molding station 14, which substantially corresponds to the length of one portion P of aluminum foil which is used for producing one tray or to a multiple thereof. As a result, at the same time as a downstream portion of the strip 10 is separated and molded in the molding station 14, an upstream portion is punched in the perforating station 40.

[0030] However, in an alternative embodiment it would be possible to compensate any position/timing offsets of the perforating station 40 with respect to the molding station 14, e.g., by providing a further tensioning roller (not shown) immediately downstream of the perforating station 40.

[0031] The perforating station 40 comprises a frame 50 provided with a horizontal bottom plate 52 and with a horizontal roofing plate 54 which are interconnected by adjustable columns such as 56, e.g., four columns.

[0032] The punching plate 42 is supported by the bottom plate 52, and is provided with a plurality of through holes 58 for receiving the needles 44. According to an advantageous feature of the invention, the entire surface of the punching plate 42 is provided with through holes 58, so that the needles 44 can be inserted only in those through holes 58 which define a pattern corresponding to the desired region R to be perforated. For instance, if the region R to be perforated is the bottom of a tray having a circular profile (as shown in Fig. 7), the needles 44 should have a disc-shaped arrangement as shown in Fig. 6; if the region to be perforated is the peripheral wall of the same tray, the needles 44 should have an annular arrangement, and so on.

[0033] The above feature improves the flexibility of the system, allowing the perforation to be easily customized based on the circumstances, e.g., depending on the shape of the tray, on the desired effect of the perforations on the baking process, and the like.

[0034] The needles 44 are provided with tips 44a protruding upwards from the punching plate 42 and, at their opposite ends, with enlarged heads 44b. The needles 44 are retained in the respective through holes 58 by a blocking plate 60 which is sandwiched between the bottom plate 52 and the punching plate 42 and abuts against the enlarged heads 44b.

[0035] Advantageously, the tips 44a have an elongated tapered profile (Fig. 5) - preferably an elongated conical profile - for the scopes that will be described in more detail below.

[0036] Preferably, the needles 44 may be 0.3 to 2.5 mm in diameter, more preferably 1.2 mm.

[0037] A pressing plate 62 is supported by the punching plate 42 in front of the counter plate 46 via first elastic means, preferably, a series of first compression springs 64, and is provided with a plurality of through openings 65 which are aligned to the needles 44 and can be passed through by the latter.

[0038] The counter plate 46 is supported by a pair of vertical rods 66 which are slidably received in respective guiding bores 68 of the roofing plate 54. The vertical rods 66 are provided with enlarged terminals 70 at their upper ends, which define the lowermost stroke end for the counter plate 46. Sets of spacers 72 are fitted on vertical rods 66, between the enlarged terminals 70 and the roofing plate 54, in order to reduce the downward stroke of the counter plate 46 with respect to the above-mentioned lowermost stroke end, for the scopes that will be disclosed in more detail below.

[0039] The counter plate 46, which is normally biased to its uppermost position by second elastic means, can be pushed downwards by a set of pneumatic actuators 74, e.g., three actuators, which are functionally arranged between the counter plate 46 and the roofing plate 54.

[0040] The second elastic means preferably comprise a series of second compression springs 76, which are fitted on respective vertical guiding bars 78 that are slidably inserted in respective through holes 80 of the roofing plate 54. The guiding bars 78 have a threaded lower end 78a which is screwed to the counter plate 48 and an enlarged upper end 78b, the second compression springs 76 being operatively arranged between the enlarged upper end 78b and the roofing plate 54 in such a way as to bias the counter plate 46 upwards.

[0041] The operation of the pneumatic actuators 74, the molding station 14 and the feeding rollers 36, 38 is managed by a control unit CU (Fig. 1) which is programmed to operate them in sync as mentioned above. The programming of control unit CU falls within the normal knowledge of the person skilled in the art and, therefore, will be no discussed in more detail herein.

[0042] The operation of the apparatus according to the invention will be now described.

[0043] Likewise the conventional process for the production of non-perforated aluminum trays, the strip 10 is unrolled from the roll 12 and delivered to the molding station 14, where a portion P of aluminum foil is separated from the strip 10 and molded into a tray, in a way known per se.

[0044] During the molding cycle, when the strip 10 is stationary in the molding station, the upstream material that is unrolled in excess is temporarily stored by the tensioner roller 30, in order to be returned in the next cycle upon request from the feeding rollers 36, 38.

[0045] In the perforating station 40, the counter plate 42 is driven to move with respect to the punching plate 42 with a reciprocating motion synchronized with the operation of the molding station 14.

[0046] In particular, during the punching cycle the counter plate 46 is pushed against the pressing plate 62 by the pneumatic actuators 74, with the strip 10 that remains sandwiched between the counter plate 46 and the pressing plate 62 (Fig. 3). Then, the counter plate 46 continues its downward stroke and pushes the pressing plate 62 towards the punching plate 42, against the action of the first compression springs 64. As a result, the tips 44a of the needles 44 enter the through openings 64 of the pressing plate 62 and finally emerge from the upper surface of the latter, thereby perforating the aluminum foil in the desired region R (Fig. 4).

[0047] Since the tips 44a of the needles 44 have an elongated conical profile, the diameter of the perforations may be adjusted by varying the depth of penetration of the needles into the aluminum foil. The depth of penetration is determined by the end of the downward punching stroke of the counter plate 46, which, in turn, may be adjusted by varying the number/thickness of spacers 72 fitted on the vertical rods 66. For instance, with needles 1.2 mm in diameter, the diameter of the perforations may be easily adjusted between 0.2 and 1.20 mm.

[0048] It has been found in practice that the method and the apparatus according to the invention fully achieve the intended aim and objects. In particular, by perforating only a desired region of the tray, e.g., the bottom, undesired weakening of the tray is prevented along with the other drawbacks resulting from the perforation of the whole tray, particularly in the area of the curled, cut-safe frame as discussed at the beginning of the present description.

[0049] In addition, the method and the apparatus according to the invention, in compliance with another stated aim, can be easily applied to existing lines for production of conventional (i.e., non-perforated) aluminum trays for foodstuff, by simply adding a perforating station as described above.

[0050] Furthermore, the diameter of the perforations can be adjusted easily and quickly, without requiring a long stop of the production line, by simply varying the number/thickness of spacers which determine the end of the punching stroke.

[0051] A preferred embodiment of the invention has been described herein, but of course many changes may be made by a person skilled in the art within the scope of the claims.

[0052] For instance, as mentioned above, the shape of the perforated region may be varied depending, e.g., on the profile of the tray and/or on the desired effect of the perforations on the baking process. For instance, in case of a trays having a rectangular bottom, a corresponding rectangular region of the aluminum foil can be perforated. Alternatively, or in addition, also the peripheral wall can be partially or entirely perforated, by an alternative or added set of needles arranged in such a way as to perforate a region of the aluminum foil which surrounds the area of the bottom of the tray.

[0053] Moreover, different methods may be envisaged by a skilled person for varying the end of the punching stroke. For instance, the spacers may be replaced by an annular flange acting as a mechanical stop, which can be fixed to the vertical rod at a predetermined level, e.g., by means of a set screw. Alternatively, the pneumatic actuators may be replaced by electric actuators controlled by position in closed loop or open loop, e.g., electric servo drives.

[0054] Nevertheless, it should be understood that, al-though in the present embodiment the punching stroke is determined by the counter plate 46 moving towards the punching plate 42, of course an inverted configuration would be possible, or both the counter plate 46 and the punching plate 42 could be movable.

[0055] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A method for manufacturing microperforated aluminum trays for foodstuff, comprising the steps of:

    - in a perforating station (40), perforating a strip (10) of aluminum foil unrolling from a roll (12) with a plurality of microperforations,
    - in a molding station (14), separating a portion (P) of aluminum foil from the strip (10) output from said perforating station (40) and molding it into the shape of a tray (20),

    characterized in that, in said perforating station (40), the strip (10) is intermittently punched, in synch with the operation of said molding station (14), at a desired region (R) between a punching plate (42) provided with a plurality of needles (44) and a counter plate (46) suitable to be passed through by said needles (44), the pitch between two consecutive perforated regions (R), as determined by the intermittent punching action, corresponding to the length of said portion (P) or to a multiple thereof.

2. The method according to claim 1, **characterized in that** said strip (10) is punched at a predetermined distance from said molding station (14), which substantially corresponds to the length of said portion (P) of aluminum foil or to a multiple thereof, whereby, at the same time as a downstream portion of the strip (10) is separated and molded in the molding station (14), an upstream portion is punched in the perforating station (40).

3. The method according to claim 1 or 2, **characterized in that**, before being perforated by said punching plate (42), the strip (10) is pressed between said counter plate (46) and a pressing plate (62) which is supported by said punching plate (42) in front of the counter plate (46) via first elastic means (64), and is provided with a plurality of through openings (65) which are aligned to said needles (44) and can be passed through by the latter.

4. The method according to any of claims 1 to 3, **characterized in that** said needles (44) are provided with tips (44a) having an elongated tapered profile, the size of the perforations being consequently adjustable by varying the depth of penetration of the needles into the aluminum foil.

5. An apparatus for manufacturing microperforated aluminum trays for foodstuff, comprising

    - a perforating station (P) which is adapted to perforate a strip (10) of aluminum foil unrolling from a roll (12) with a plurality of microperforations,
    - a molding station (14), which is adapted to separate a portion (P) of aluminum foil from the strip (A) output from said perforating station (40) and to mold it into the shape of a tray (20),

    characterized in that said perforating station (40) comprises a punching plate (42) provided with a plurality of needles (44) and a counter plate (42) suitable to be passed through by said needles (44), at least one of which is driven to move with respect to the other along a punching stroke, with a reciprocating motion synchronized with the operation of said molding station (14), in such a way as to punch said strip (10) at a desired region (R), the pitch between two consecutive perforated regions (R), as determined by said reciprocating motion, corresponding to the length of said portion (P) or to a multiple thereof.

6. The apparatus according to claim 5, **characterized in that** said perforating station (40) is arranged at a predetermined distance from said molding station (14), which substantially corresponds to the length of said portion (P) of aluminum foil or to a multiple thereof.

7. The apparatus according to claim 5 or 6, **characterized in that** it comprises a pressing plate (62) which is supported by said punching plate (42) in front of the counter plate (46) via first elastic means (64), and is provided with a plurality of through openings (65) which are aligned to said needles (44) and can be passed through by the latter, whereby, before being perforated by said punching plate (42), the strip (10) is pressed between said counter plate (46) and said pressing plate (62).

8. The apparatus according to any of claims 5 to 7, **characterized in that** said needles (44) are provided with tips (44a) having an elongated tapered profile, and **in that** adjusting means (72) are provided for varying the depth of penetration of said needles (44) into the aluminum foil and, consequently, the size of the perforations.

9. The apparatus according to claim 8, **characterized in that** it comprises a set of spacers (72) adapted to limit said punching stroke.

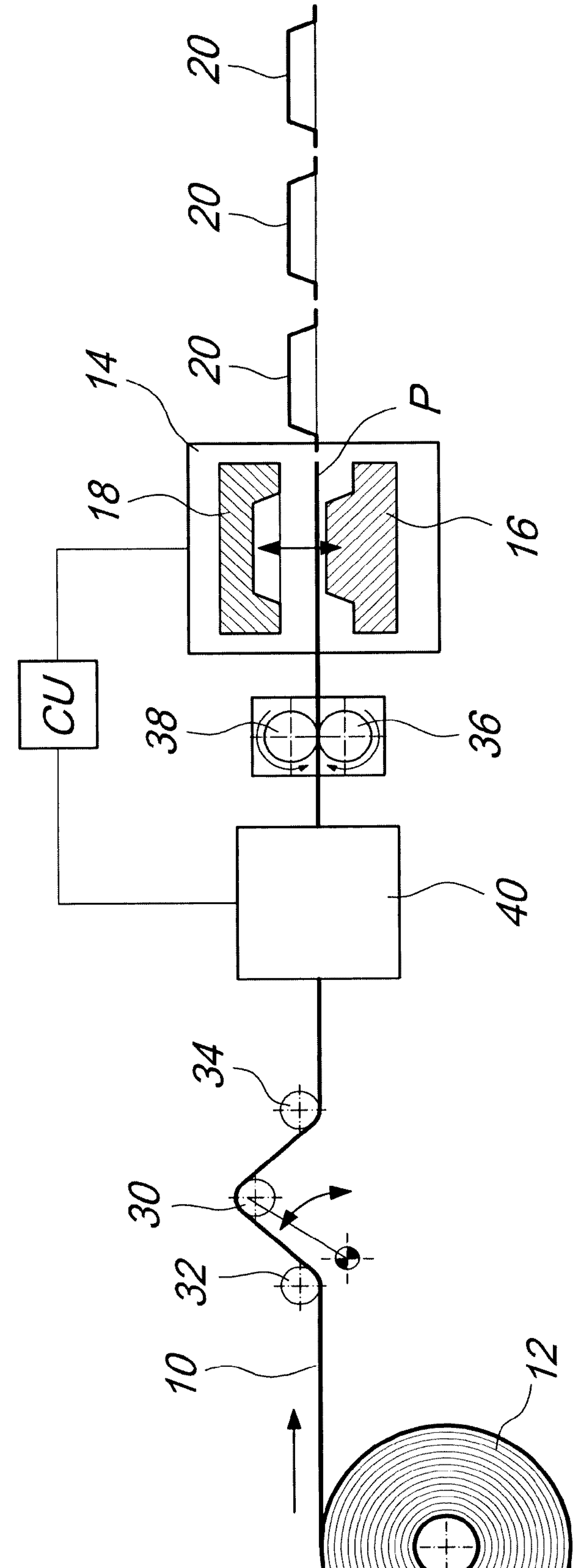

Fig. 1

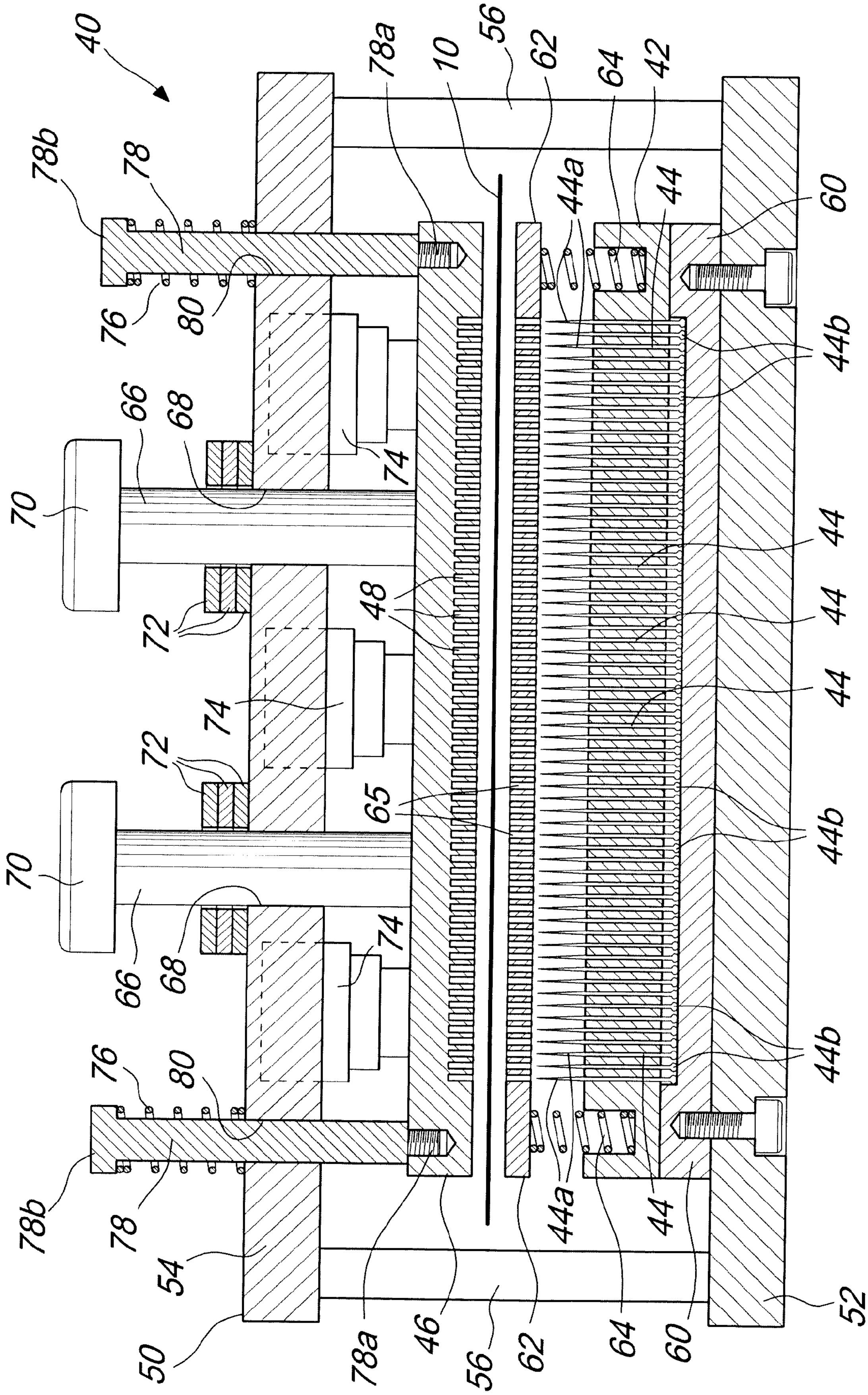
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Fig. 2

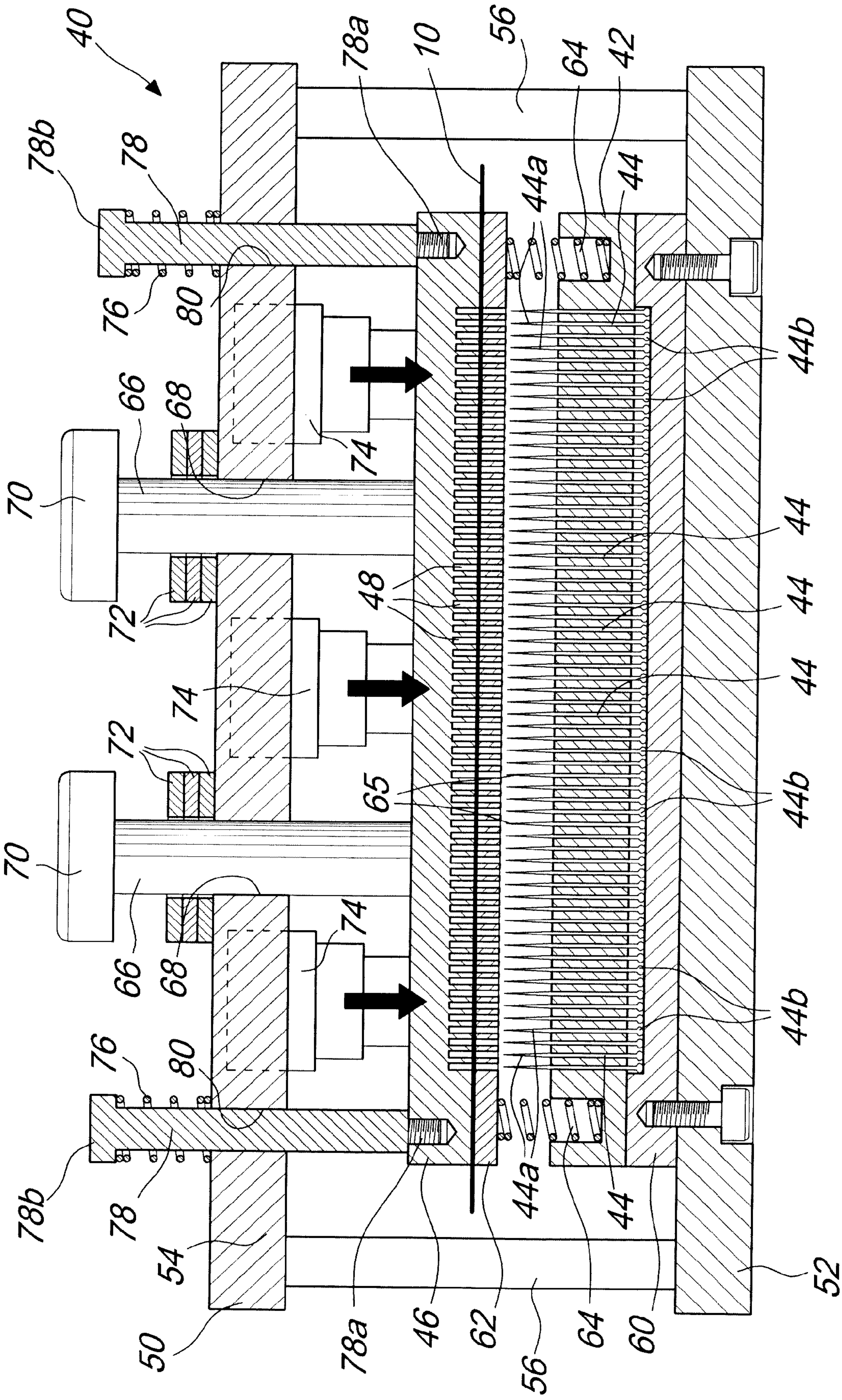
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Fig. 3

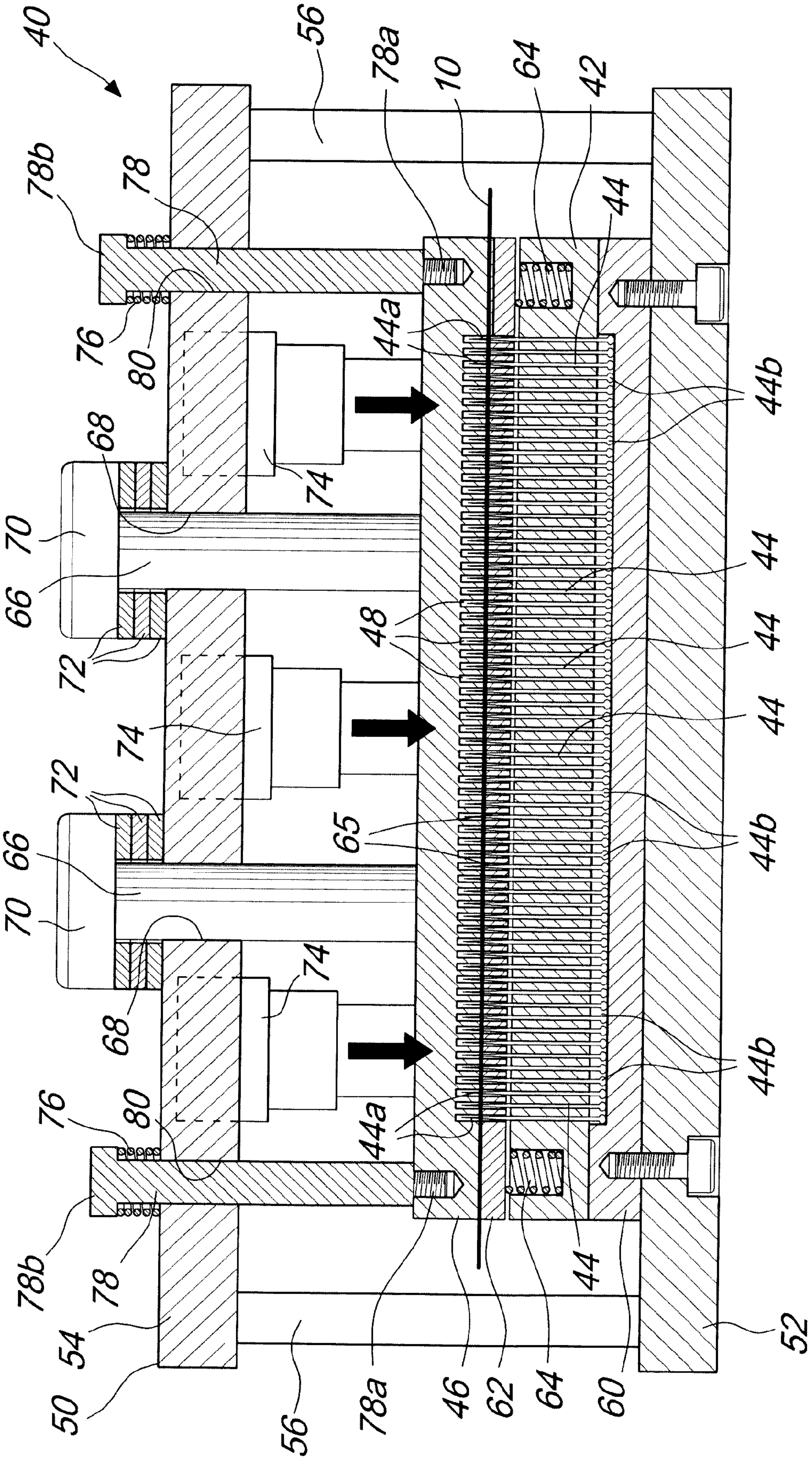
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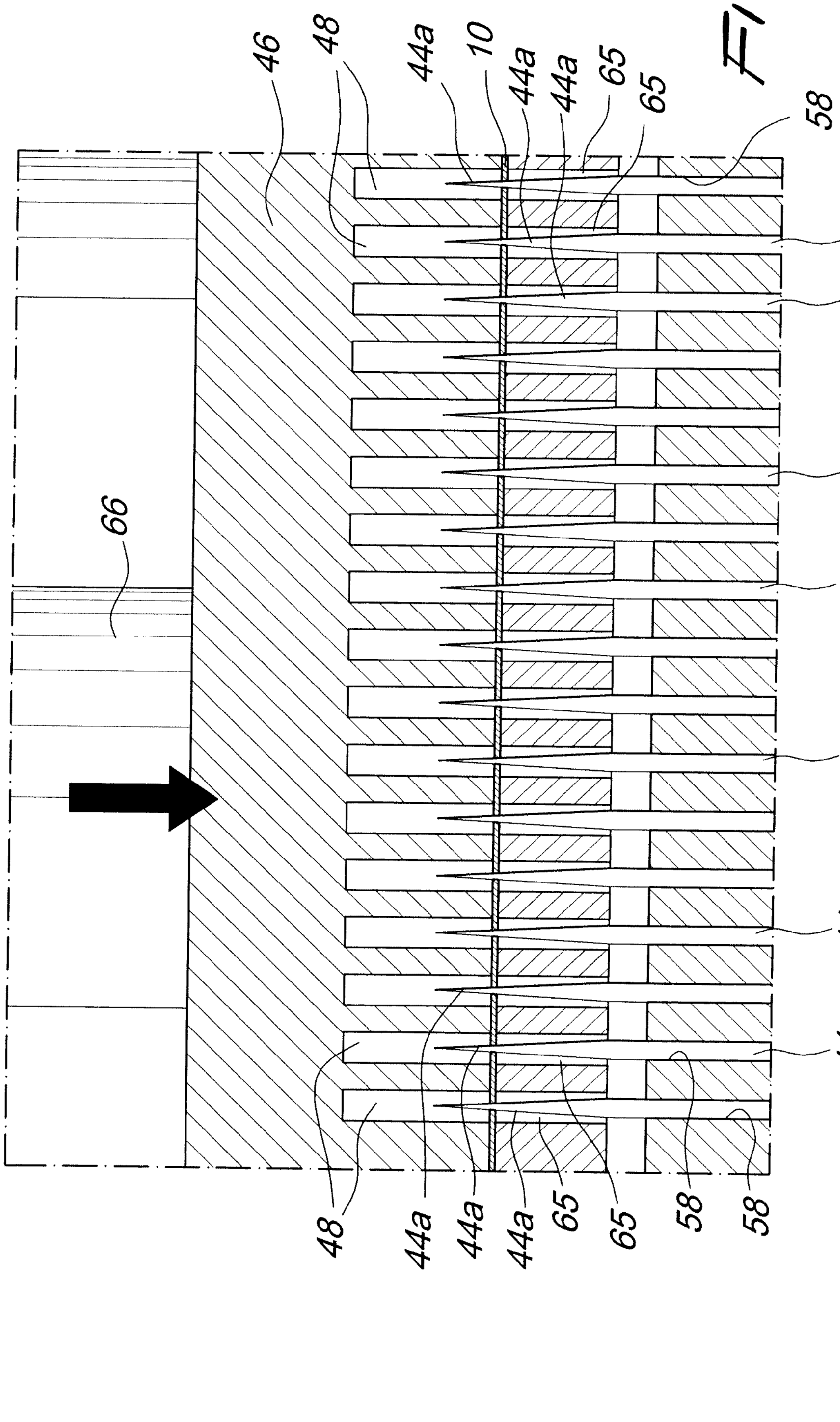
Fig. 4

Fig. 5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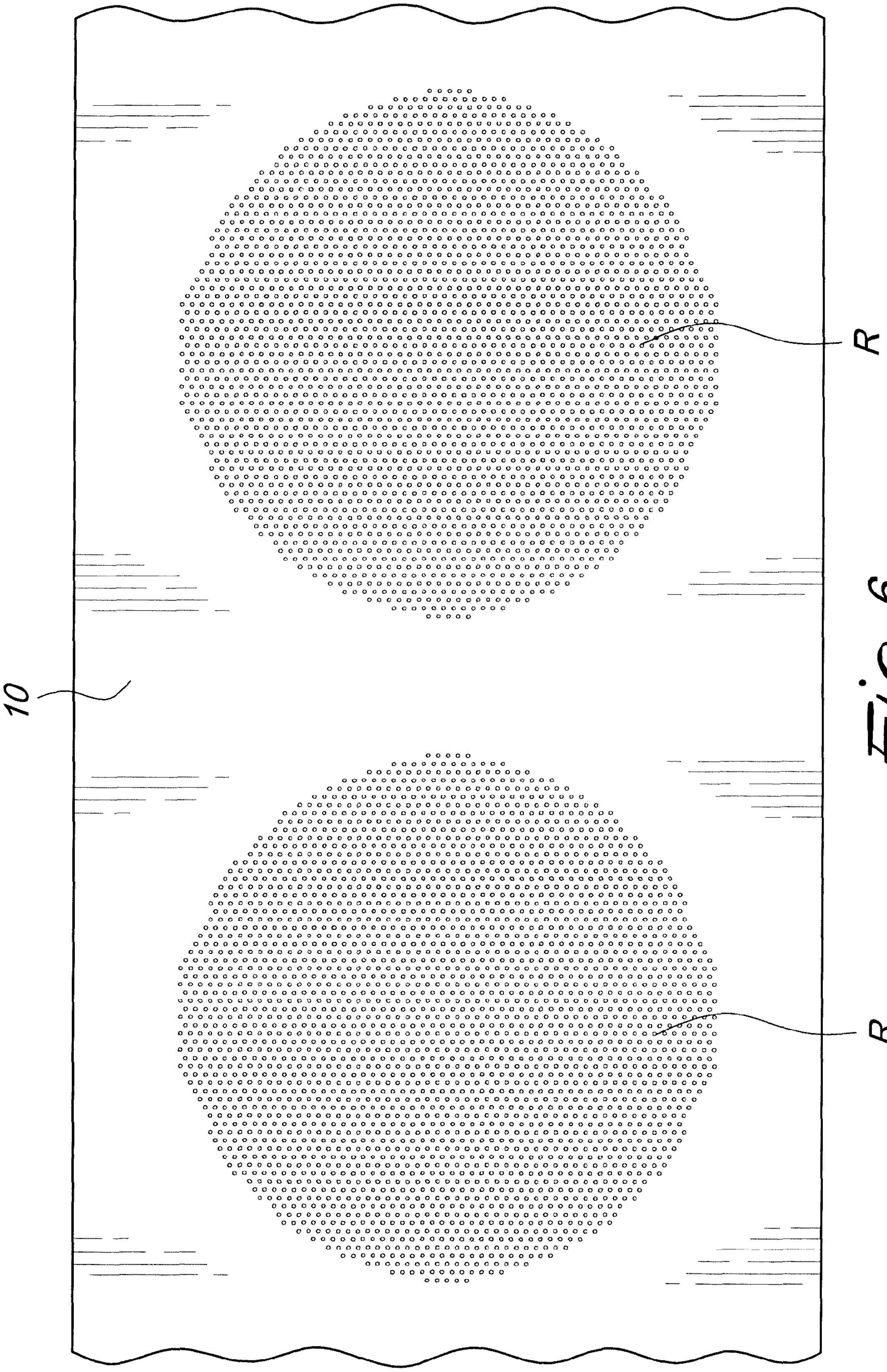

Fig. 6

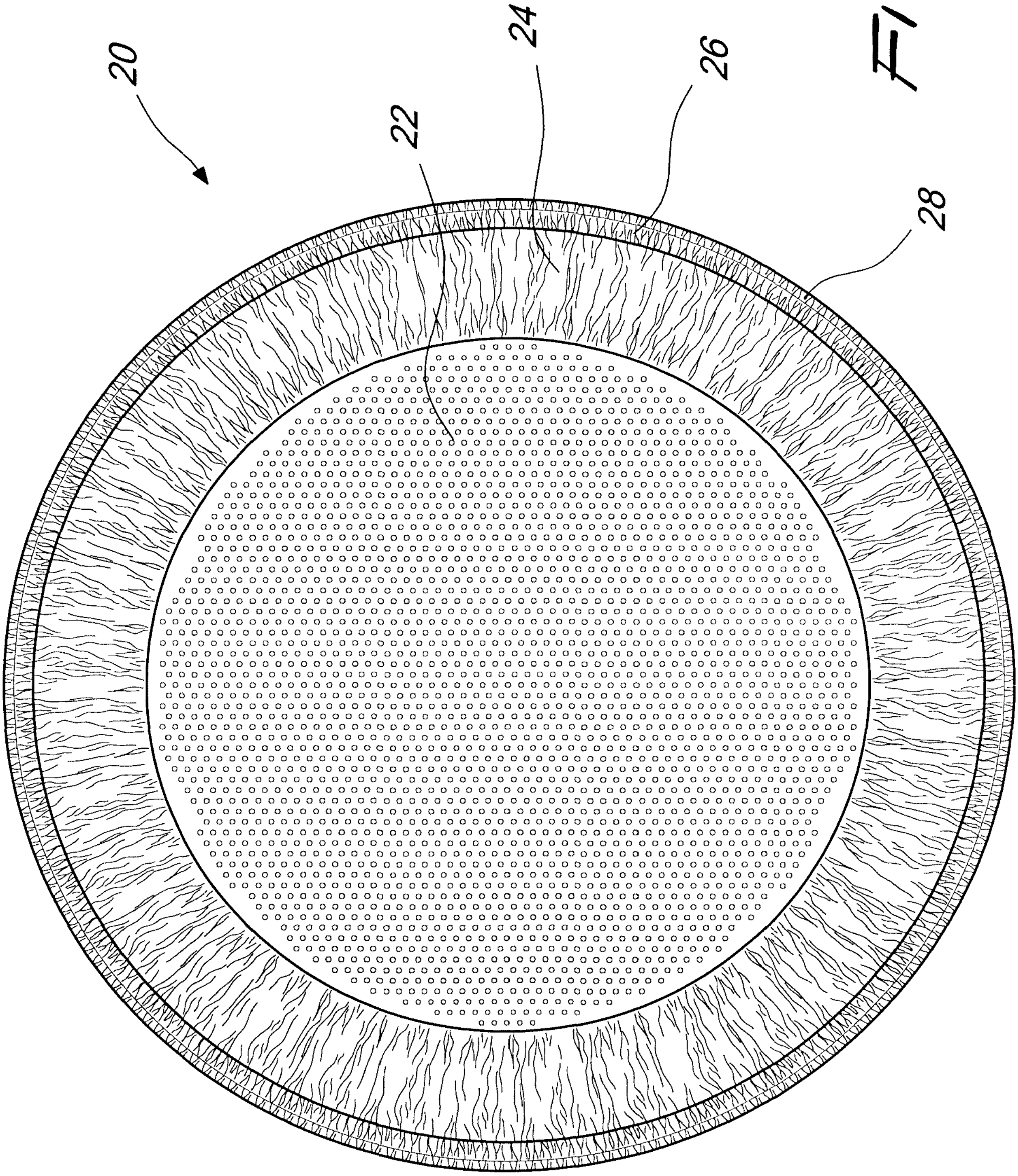

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 19 42 5073

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	GB 2 418 907 A (NICHOLL FOOD PACKAGING LTD [GB]) 12 April 2006 (2006-04-12) * page 5, line 22 - page 6, line 14; figures 1-4 * -----	1-9	INV. B31B50/14 B31B50/16 B31B50/59 B21D28/26 ADD. B31B100/00 B31B110/10 B31B110/20
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A	US 5 720 915 A (JOPPEN HENK [NL] ET AL) 24 February 1998 (1998-02-24) * claim 1; figures 1-6 * -----	1-9	
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A	US 3 608 413 A (BORELLO DOMENIC) 28 September 1971 (1971-09-28) * claim 1; figures 1-6 * -----	1-9	TECHNICAL FIELDS SEARCHED (IPC) B31B B21D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	9 April 2020	Sundqvist, Stefan

CATEGORY OF CITED DOCUMENTS

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