



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.07.2011 Bulletin 2011/29

(51) Int Cl.:
F28D 1/053 (2006.01) F28F 9/02 (2006.01)

(21) Application number: **11250048.3**

(22) Date of filing: **17.01.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **15.01.2010 US 688297**

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(54) **Heat exchanger with extruded multi-chamber manifold with machined bypass**

(57) The present invention heat exchanger with extruded multi-chamber manifolds (16,18) includes at least two panels (22), with each panel having a row of at least one channel which communicates fluid. The heat exchanger includes a first manifold and a second manifold, the first manifold and the second manifold each having at least two manifold chambers (20). Each panel is at-

tached to a manifold chamber of the first manifold and a manifold chamber of the second manifold, with each chamber having an inner wall (40) and outer wall (42). The outer wall has a surface (56) exposed outside the manifold chambers. There is also an opening (62) through the outer wall including a bypass slot. The bypass slot allows fluid communication between the chambers.

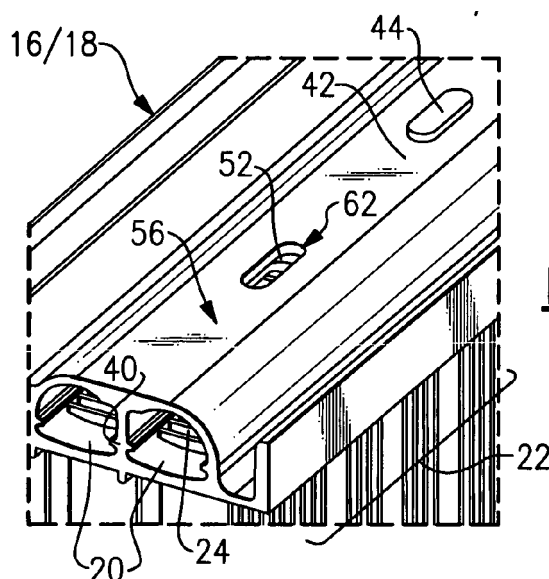


FIG.3

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates generally to heat exchangers, and more particularly, to an extruded multi-chamber manifold with a machined bypass.

[0002] Heat exchanger manifolds must be strong enough to withstand elevated pressures exerted by fluids flowing through the manifold during operation. Many heat exchangers require multiple panels to be put together to allow increased fluid flow. These panels are aligned adjacent to each other and connect to separate chambers. Therefore, there are situations where it is necessary for adjacent chambers of a manifold to be in fluid communication with one another.

[0003] A heat exchanger with a D-shaped manifold has been proposed which has a single chamber manifold typical of that used in automotive and commercial air conditioning applications. The heat exchanger consists of a single row of tubes and fins stacked together to form a panel. The panel is capped with the D-shaped manifold on either end.

[0004] Multi-chamber manifolds can pose a problem when extruded as the manifolds made by the extrusion process do not allow fluid bypass. Where multi-chamber manifolds are necessary, fluid communication between chambers typically requires an external bypass between two or more of the above mentioned D-shaped manifolds. This results in increasing the distance the fluid must travel as well as increasing the pressure to unacceptable levels at the external bypass.

[0005] When heat exchangers have multiple panels, individual headers will not suffice. It is necessary to have a manifold which can accommodate each panel individually, thus requiring multiple manifolds or a multi-chamber manifold.

SUMMARY OF THE INVENTION

[0006] An example heat exchanger with extruded multi-chamber manifolds includes at least two panels, with each panel having a row of at least one channel which communicates fluid. The heat exchanger includes a first manifold and a second manifold, the first manifold and the second manifold each having at least two manifold chambers. Each panel is attached to a manifold chamber of the first manifold and a manifold chamber of the second manifold, with each chamber having an inner wall and outer wall. The outer wall has a surface exposed outside the manifold chambers. There is also an opening through the outer wall including a bypass slot. The bypass slot allows fluid communication between the chambers.

[0007] An example extruded multi-chamber manifold with machined bypass includes at least two manifold chambers. Each of the at least two manifold chambers has a panel attached to it. The manifold chamber further includes an inner wall and outer wall. The manifold also

has at least one bypass slot. There is an opening in the outer wall of the manifold which reaches the bypass slot and is filled with a plug.

[0008] An example method of forming an extruded multi-chamber manifold with internal bypass includes extruding a manifold with at least two manifold chambers. An opening with a seat and a bypass slot is machined in an outer wall and an inner wall of the manifold chamber. A plug is inserted into the seat to seal the manifold chamber.

[0009] These and other features of the present invention can be best understood from the following specification and drawings, the following of which is a brief description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Figure 1 is a perspective view of a heat exchanger with extruded multi-chamber manifold.

Figure 2 is a cross-section of the extruded multi-chamber manifold.

Figure 3 is a top view of the extruded multi-chamber manifold with both plugged and unplugged openings.

Figure 4 is a sectional, top view of the extruded multi-chamber manifold showing the machined seat and bypass slot.

Figure 5 is a sectional, top view of the extruded multi-chamber manifold showing the bypass slot and a plug filling the seat.

Figure 6A is a front view of the heat exchanger showing a second example of fluid movement between a first extruded manifold and a second extruded manifold.

Figure 6B is a front view of the heat exchanger showing a first example of fluid movement between a first extruded manifold and a second extruded manifold.

Figure 7A is a step in a first example method for forming an extruded multi-chamber manifold with machined bypass.

Figure 7B is another step in the first example method for forming an extruded multi-chamber manifold with machined bypass.

Figure 7C is another step in the first example method for forming an extruded multi-chamber manifold with machined bypass.

Figure 8A is a step in a second example method for forming an extruded multi-chamber manifold with machined bypass.

Figure 8B is another step in the second example method for forming an extruded multi-chamber manifold with machined bypass.

Figure 8C is another step in the second example method for forming an extruded multi-chamber manifold with machined bypass.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0011] Referring to Figure 1, a heat exchanger system 26 includes panels 22, a first extruded multi-chamber manifold 16, a second extruded multi-chamber manifold 18, an inlet chamber 12, an outlet chamber 14, and a fluid source 10. The fluid source 10 provides fluid to the inlet chamber 12. The fluid can be, but is not limited to, water, coolant or refrigerant. The panels 22 connect to both the first extruded multi-chamber manifold 16 and the second extruded multi-chamber manifold 18, communicating fluid between them. Fluid can be communicated through the panels in one direction, or single pass, or in multiple directions, or multiple pass.

[0012] Referring to Figures 2-5, with continuing reference to Figure 1, an extruded multi-chamber manifold 16 (18 will be similar) is shown having an inner wall 40 and an exposed, outer wall 42. At least two chambers 20 are present in the manifold 16, with an inner wall 40 separating the chambers 20. The inner wall 40 is formed through extrusion such that there is no fluid communication between chambers 20 without further machining. Openings 62 are machined into the outer surface 56 of the outer wall 42 and include seats 52 and bypass slots 54. The openings 62 can be spaced a predetermined distance apart from each other down the length of the manifold 16. The bypass slot 54 sits inward of the seat 52 in the manifold 16. The bypass slot 54 is machined out of the inner wall 40 and extends to the seat 52 in the outer wall 42. The bypass slot 54 allows for fluid communication between chambers 20 of the manifold 16. The bypass slot 54 can be a different size than the seat 52 to allow for various configurations of chambers 20 and necessary levels of fluid communication. After the bypass slot 54 is created, a plug 44 is inserted into each seat 52. The plug 44 can be welded, or otherwise secured using brazing, epoxy adhesives, or other known means, in place to seal the opening 62. Once in the seat 52, the plug 44 seals the chamber 20. The plug 44 can be larger than the bypass slot. The plug 44 may create an even surface with the outer wall 42. Alternatively, the plug 44 may sit above or below the outer wall 42, creating an uneven surface. Figures 3-5 show one configuration of the seats 52, bypass slots 54, and plugs 44. Other configurations are also possible.

[0013] Referring to Figures 6A and 6B, fluid flow between the extruded multi-chamber manifolds 16,18 is shown. Figure 6A shows a single pass configuration, where fluid flows within the panels 22 in one direction, from the second extruded multi-chamber manifold 18 to the first extruded multi-chamber manifold 16. Fluid can be communicated between the chambers 20 of each manifold through the bypass slots 54. Figure 6B shows a multi-pass configuration where fluid flows within the panels 22 in multiple directions and is able to communicate between chambers 20 through bypass slots 54. These embodiments show manifolds 16 having three

chambers 20 with slots found as above.

[0014] Referring to Figure 7A, a method of creating an extruded multi-chamber manifold 16 with internal bypass is shown. An extruded multi-chamber manifold 16 with chambers 20 is created with a solid, inner wall 40. Referring to Figure 7B, an opening 62 including a bypass slot 54 and seat 52 is cut out of the inner wall 40 by machining through the outer wall 42 and into the inner wall 40 using a cutting tool 80. The seat 52 can be machined again to be a different size than the bypass slot 54. Referring to Figure 7C, a plug 44 is then inserted into the opening 62 to seal the manifold chambers 20. The plug 44 can be welded, or attached by other means, after insertion.

[0015] Alternatively, referring to Figure 8A, the method of creating an extruded multi-chamber manifold 16,18 with internal bypass is shown. An extruded multi-chamber manifold 16,18 with chambers 20 is created with a solid, inner wall 40. An opening 62 including is machined into outer wall 42 using a cutting tool 80. The machined opening 62 first includes a seat 52. Referring to Figure 8B, a bypass slot 54 is cut out of the inner wall 40 by machining into the inner wall 40 inside each seat 52 using a cutting tool 80. The bypass slot 54 extends to the seat 52. The bypass slot 54 can be a different size than the seat 52. Referring to Figure 8C, a plug 44 is then inserted into the seat 52 to seal the manifold chambers 20. The plug 44 can be welded into place after insertion.

[0016] Although a preferred embodiment of this invention has been disclosed, a worker of ordinary skill in this art would recognize that certain modifications would come within the scope of this invention. For that reason, the following claims should be studied to determine the true scope and content of this invention.

Claims

1. A method of forming an extruded multi-chamber manifold with internal bypass comprising:
 - creating an extruded manifold with at least two manifold chambers;
 - machining at least one opening in an outer wall and an inner wall of the manifold chambers, the opening including a bypass slot and a seat; and
 - inserting a plug into the bypass slot to seal the at least two manifold chambers, the plug being located in the seat.
2. The method of claim 1, wherein the method further comprises welding the plug.
3. The method of claim 1 or 2, wherein an additional step is included comprising machining the seat to be wider than the bypass slot.
4. The method of claim 1, 2 or 3, wherein the bypass

slot and the seat are machined separately.

5. An extruded multi-chamber manifold comprising:

a manifold having at least two manifold chambers, each of the at least two manifold chambers including an inner wall between the two chambers, and an outer wall; and
an opening in the outer wall which extends to a bypass slot formed in the inner wall, the opening being filled with a plug.

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6. The extruded multi-chamber manifold of claim 5, wherein the bypass slot allows fluid communication between at least two manifold chambers.

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7. The extruded multi-chamber manifold of claim 6, wherein the manifold includes at least three manifold chambers, with at least one manifold chamber lacking a bypass slot.

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8. A heat exchanger comprising:

at least two panels, each panel comprising at least one channel;
a first manifold and a second manifold as claimed in claims 5, 6 or 7, each panel being attached to a manifold chamber of the first manifold and of the second manifold; and
the bypass slot allowing fluid communication between two manifold chambers and two panels.

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9. The heat exchanger of claim 8, wherein panels connected to the first manifold and the second manifold allow fluid flow in only one direction.

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10. The heat exchanger of claim 8 or 9, wherein the bypass plug is sealed to the manifold by welding.

11. A heat exchanger comprising:

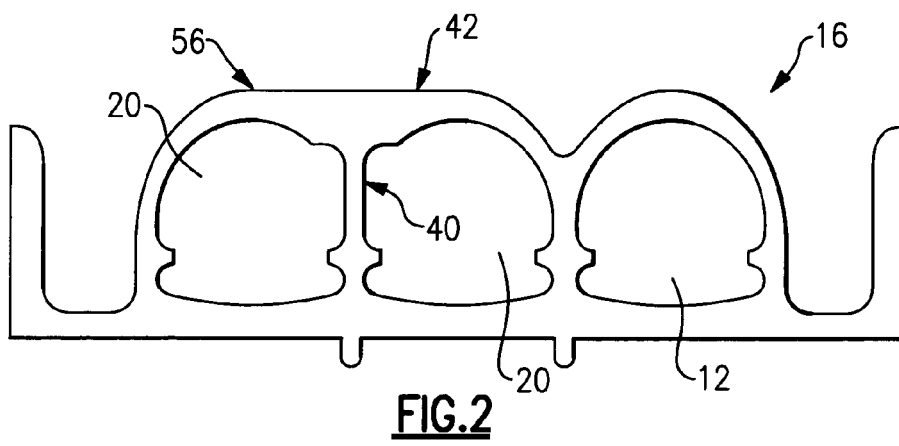
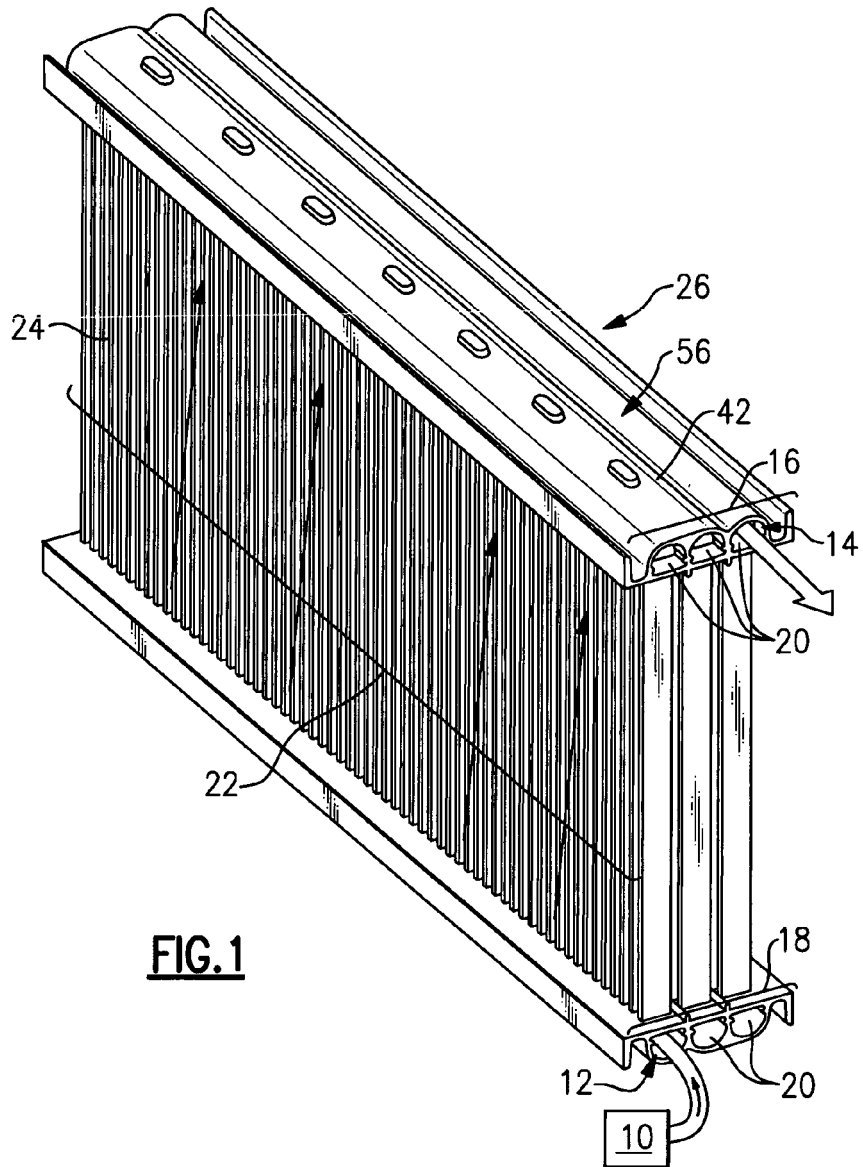
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at least two panels, each panel comprising at least one channel;
a first manifold and a second manifold, the first manifold and second manifold each having at least two manifold chambers, each panel attached to a manifold chamber of the first manifold and of the second manifold, the first manifold chambers and second manifold chambers including an inner wall and outer wall, the outer wall having a surface exposed outside the manifold chambers; and
an opening in the outer wall, the opening including a bypass slot, the bypass slot allowing fluid communication between two manifold chambers.

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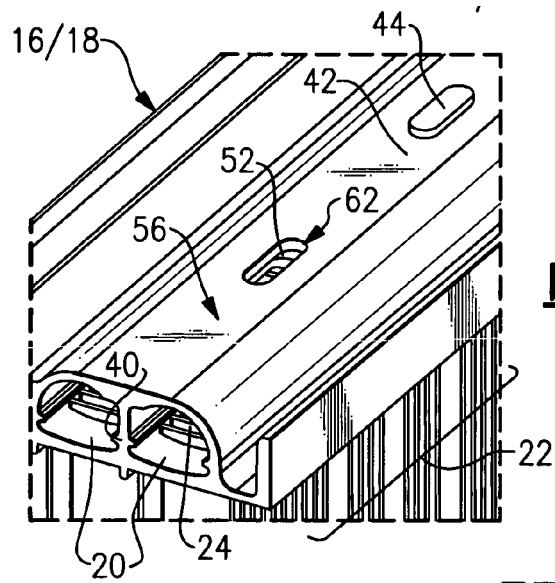


FIG. 3

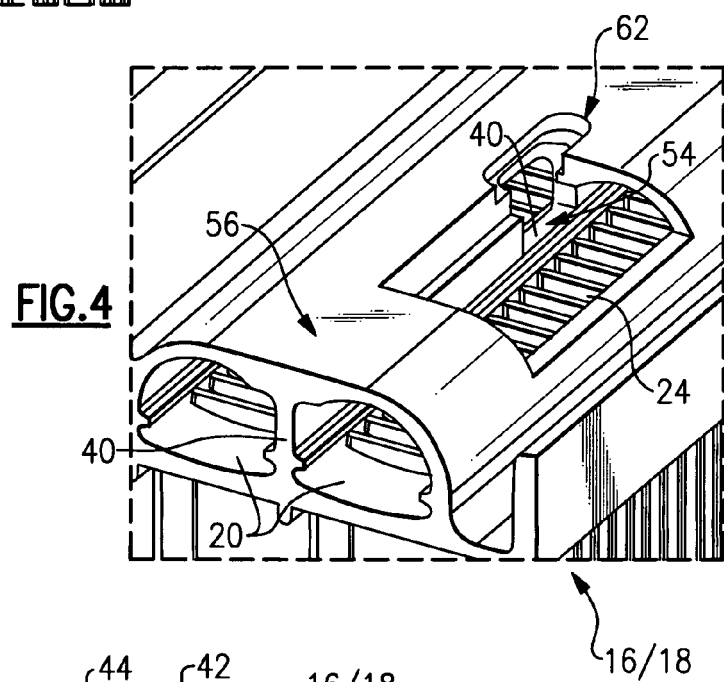


FIG. 4

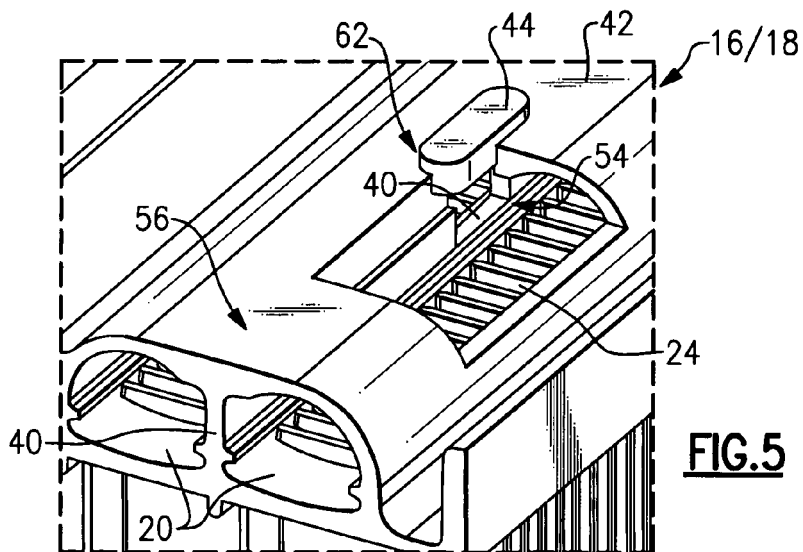


FIG. 5

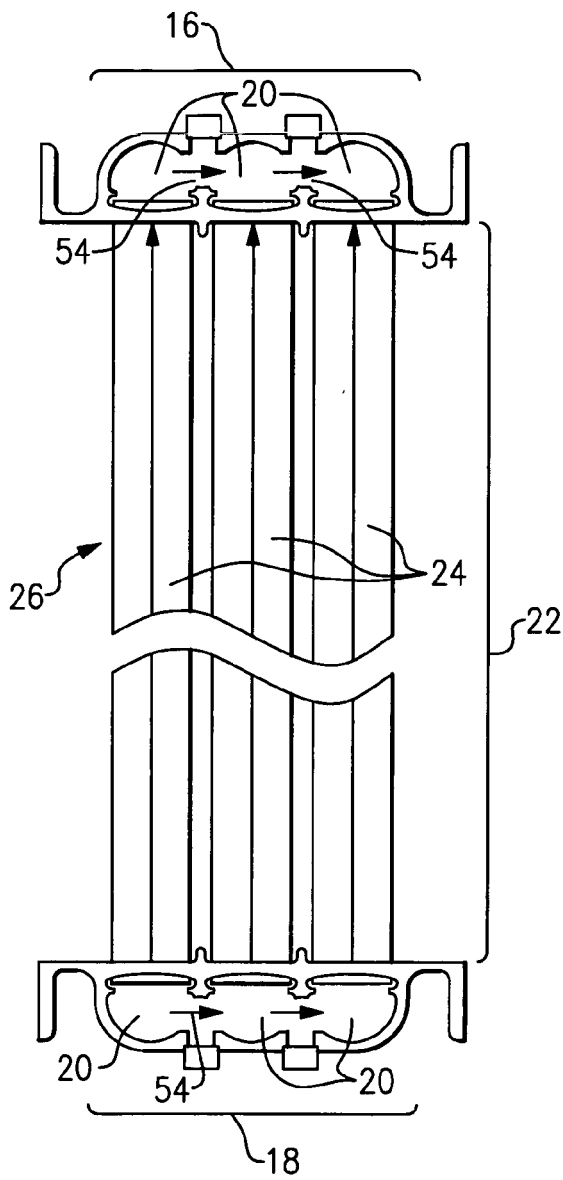


FIG. 6A

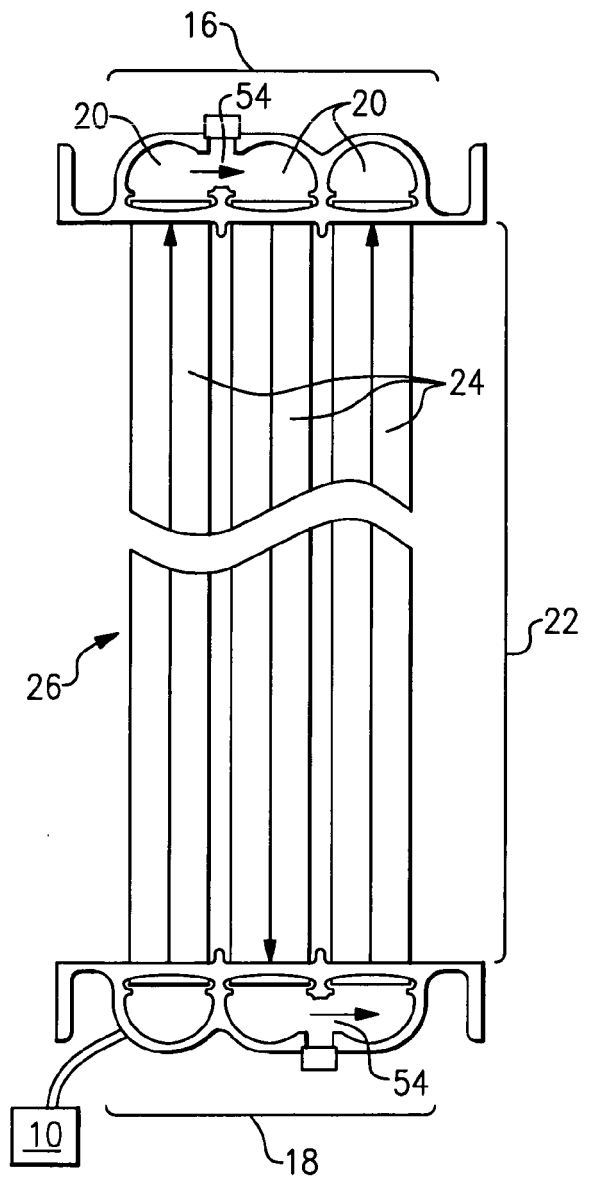


FIG. 6B

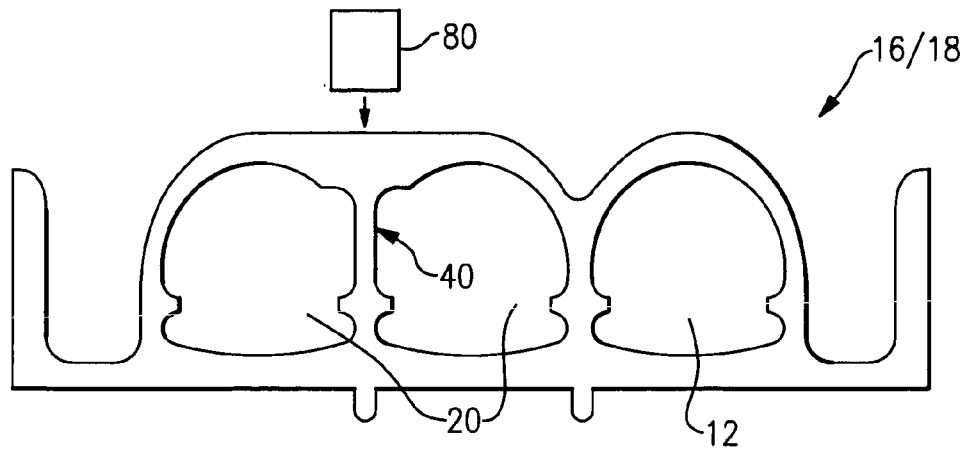


FIG. 7A

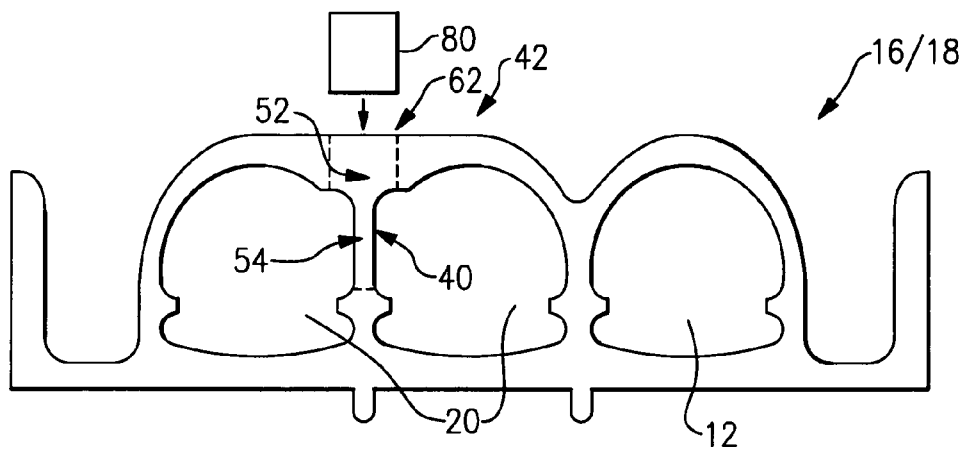


FIG. 7B

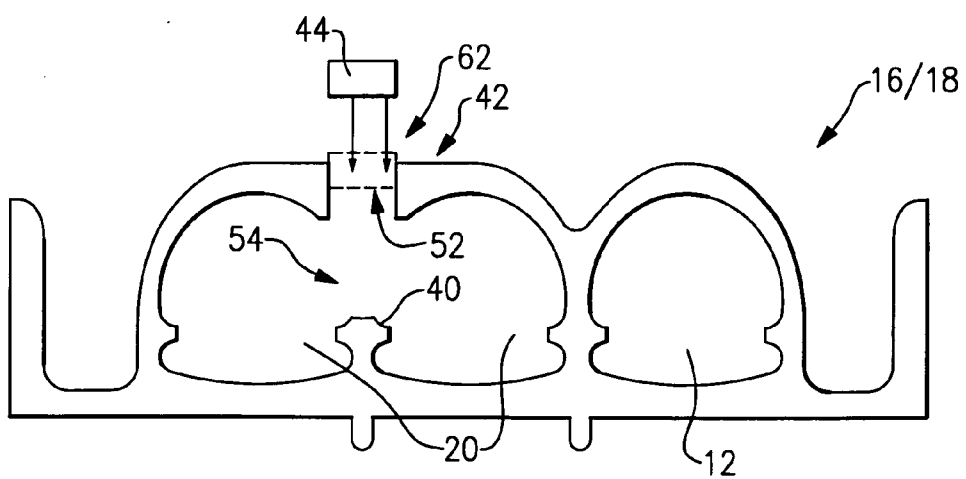


FIG. 7C

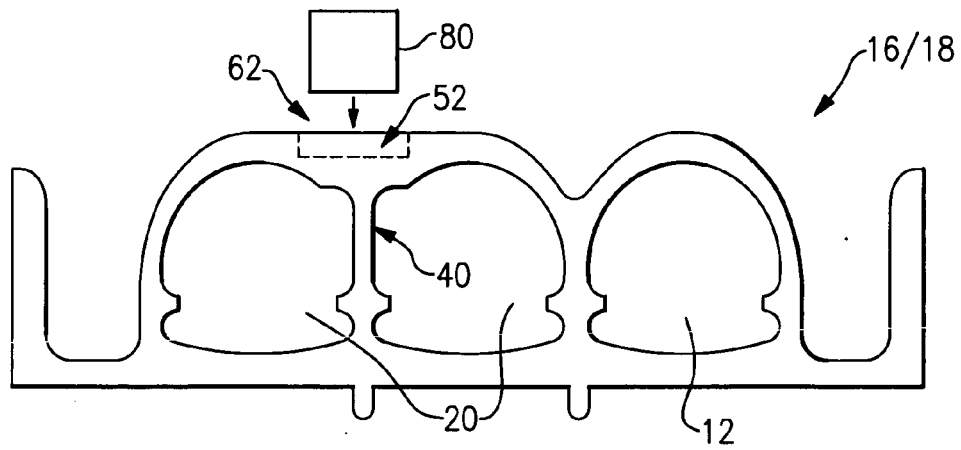


FIG. 8A

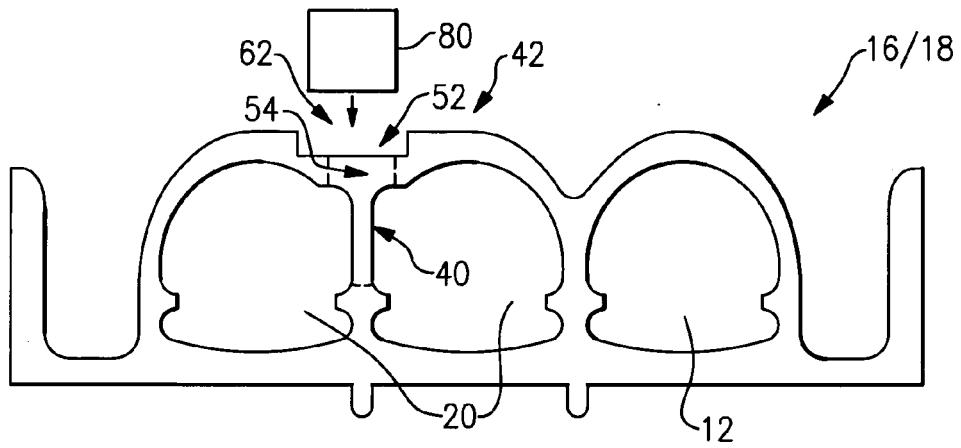


FIG. 8B

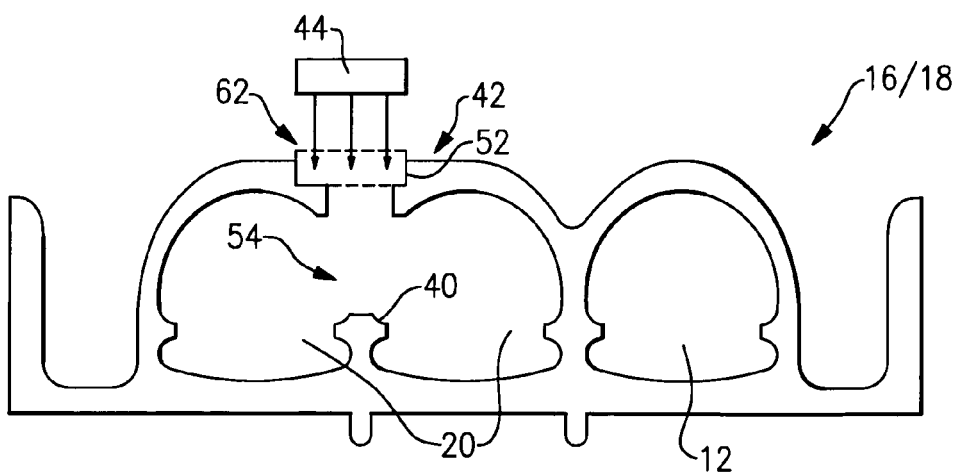


FIG. 8C