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(54) **Automotive heat exchanger and power take off assembly**

(57) A power take off assembly for a heat exchanger for a vehicle. The assembly includes a rectangular frame having passages all the vertical sides to marry with core tubes from the heat exchanger, a face plate with a hole to position the power take off sleeve, a back plate with a similar hole, and a sleeve to allow the power take off shaft to pass through the assembly when in-

stalled in a heat exchanger for an automobile/truck. The assembly is pieced together and tabs located on the perimeter of the frame lock the front and back plates into place, the sleeve is inserted in the holes, and the entire assembly is brazed in a one shot process.

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## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

**[0001]** The present invention relates to a heat exchanger mounted in front of an engine. More specifically, the present invention relates to circular passage for a power take off shaft through the front face of a heat exchanger/exchangers.

#### 2. Description of related art

**[0002]** In typical engine cooling systems the heat exchangers are mounted together in the front of the engine. Vehicles and other systems that require auxiliary devices to be powered by a power take off have a powered shaft emerging from the engine, through the front end of the vehicle. As a typical result, the shaft protrudes through the cooling system of the engine. In order to accommodate the power take off, the heat exchanger in the path of the shaft must include an opening in the face of the heat exchanger's core in order to provide a passage for the power take off shaft.

**[0003]** Historically, a radiator that is used to cool the cooling jacket of water from the engine occupies a majority of the cooling system area. Therefore, such a radiator must contain a power take off hole through which the power take off shaft is housed. The charge air coolers used to cool the hot compressed air from the turbo charger previously has been sized so as not to interfere with the power take off shaft. Similarly, air conditioning condensers, oil coolers and other auxiliary heat exchangers did not interfere with the power take off shaft. The emergence of higher engine power requirements, lower emissions, smaller packaging area, and therefore higher cooling requirements, are dictating the need for power take off holes in more of the cooling system components, namely charge air coolers.

**[0004]** The radiator heat exchangers currently fabricated with power take off holes are made primarily from copper/brass and/or aluminum. The radiators then require extensive handwork after baking or brazing of the core. The handwork must be completed manually and is time consuming. Additional parts are also required to complete this process. The overall effect is a significant increase in the cost of production.

**[0005]** FIG 1. depicts a traditional heat exchanger 1 in the form of a heat exchanger with a power take off hole 5, the hole is characteristically rectangular in shape. The traditional power take off hole 1 in a heat exchanger 1 consists of two small manifolds 3 on either side of the opening 5. The manifolds are connected to each other with two to four large bypass tubes 7. Fluid, indicated by the arrows in FIG. 1, flowing through the power take off portion 5 of the heat exchanger 1 flows from the core tubes 9 into the first manifold 3a, through

the large tubes 7, into the second manifold 3b, and finally back into the core tubes 9. Located between the core tubes 9, are a series of fins 10. The fins 10 properly position the core tubes for structural support and provide an adequate surface for cooling as well.

**[0006]** The rectangular nature of the power take off hole 5 creates sharp angles and changes in flow direction of the internal fluid. Such a design shape restricts the flow of the internal fluid caused by radical flow changes during flow.

**[0007]** As is typical, anywhere from two to four rows of core tubes are blocked off due to design constraints. Blocking off of these core tubes 11 decreases the heat rejection capacity of the heat exchanger 1.

**[0008]** Airflow must be kept from flowing around the power take off shaft, through the power take off hole and into the engine compartment to maintain proper heat rejection. A seal, not shown, is therefore normally attached to the power take off hole that serves primarily to prevent by pass air from flowing through the opening and not the heat exchanger during operation. Typically, a frame or bracket is attached to the power take off opening 5 to support the seal and will also prevent fingers or hands from pinch points during operation.

**[0009]** The prior art also does not presently have a means to connect any additional accessories.

**[0010]** The prior art design is not easily adaptable to aluminum radiators or to charge air coolers.

**[0011]** The need exists for a power take off assembly having a passage for power take off shaft through the front face of a heat exchanger. With this arrangement, handwork is minimized and completed prior to brazing/baking. Similarly, this design will eliminate any hand welding, brazing or soldering, as the assembly should have the individual parts joined during a single brazing operation rather than multiple attempts at brazing. Such a design would be self-contained and adaptable to aluminum radiators and charge air coolers. Such an improved power take off assembly would reduce the internal flow restrictions created by the prior art by increasing flow area and providing contoured surfaces that gradually change the flow direction. The extended closure tube option design would allow power take off air seals to be mounted directly to the heat exchanger's power take off assembly.

**[0012]** There exists a need to reduce the number of components necessary to seal the opening. Additionally, the use of a commercially available seal to reduce the costs associated with the assembly of a power take off assembly is also required.

**[0013]** The present invention improves on the prior art and achieves the desired results described above.

### SUMMARY OF THE INVENTION

**[0014]** It is therefore an advantage of the present invention to provide a power take off assembly having a passage for power take off shaft through the front face

of a heat exchanger, whereby handwork is minimized and completed prior to brazing/baking. There is no need for any hand welding, brazing or soldering, as the individual parts are joined during the brazing operation, allowing for a one shot braze of the power take off assembly. The design of the present invention is self-contained and adaptable to aluminum radiators, charge air coolers, and other heat exchangers. The power take off assembly will reduce the internal flow restrictions created by the prior art by increasing flow area and providing contoured surfaces that gradually change the flow direction. Power take off air seals are mounting directly to the power take off assembly's tube housing, thus eliminating special bracket and fasteners. The preferred embodiment utilizes a power take off hole that is generally circular in shape.

**[0015]** Thus, the present invention is primarily directed toward a heat exchanger for a vehicle, comprising a heat rejection source including an inlet port and an outlet port. The internal combustion engine has a core portion operably connected to the heat source including a plurality of tubes through which fluid flows and a plurality of fins each of which is disposed between adjacent tubes for facilitating heat exchange of a fluid. A power take off assembly is disposed within the core portion and includes a rectangular frame having a plurality of passages along two parallel sides thereof, a sleeve, a face plate and a back plate.

#### BRIEF DESCRIPTIONS OF THE DRAWINGS

**[0016]** A better understanding of the present invention will be had when reference is made to the accompanying drawings, wherein identical parts are identified by identical reference numbers and wherein:

FIG. 1 is a plan view of the prior art.

FIG. 2a is an isometric view of the preferred embodiment.

FIG. 2b is a profile view of the one-piece frame.

FIG. 3 is an exploded perspective view of the preferred embodiment.

FIG. 4 is an exploded view of the preferred embodiment.

#### DETAILED DESCRIPTION OF THE PRESENT INVENTION

**[0017]** The features of the invention as explained above provide power take off assembly having a power take off hole designed for inclusion with a heat exchanger.

**[0018]** According to Figure 2a, the assembly of the one-shot braze power take off assembly in the preferred embodiment begins with the one-piece frame 15. The one-piece frame 15 is constructed generally in a box shape. The one-piece frame 15 maybe constructed of any material compatible with the system in which the

one-piece frame 15 is to be inserted, for example, aluminum or brass. The one-piece frame 15 has a lattice work or passages 20 compatible with the core tubes 9 found on the heat exchanger whereon the one-piece frame is to be connected.

**[0019]** When assembled, the one-piece frame 15 is essentially a hollow structure. As seen in FIG. 2b, the one-piece frame 15 is constructed from a single sheet of material. The one-piece frame 15 is cut and formed in stamping press operations, or another method known to those skilled in the art. The one-piece frame 15 is formed with four main sections that make up the side walls 34 and horizontal walls 36 of the one-piece frame 15. In the present description of the preferred embodiment, certain terminology will be used for descriptive purposes only and is not intended to be limiting. The terms "side" and "horizontal" designate directions in the drawings to which reference is made. Said definitions apply to the terms specifically mentioned above, derivatives thereof and words of similar import.

**[0020]** It is important to mention that while the reference to the frame 15 indicates a single sheet of material is used, it should be appreciated that use of multiple sheets or components to create the frame would also encompass the scope of the invention.

**[0021]** Passages 20 are formed in the side walls 34. The passages 20 align with core tubes 9 once the assembly is installed within a charge air cooler or similar device.

**[0022]** Located along the peripheral edges of the one-piece frame 15 are a series of tabs 25 and 26. Once folded over, tabs 26 allow for the face plate 16 to be located into position prior to the brazing step. Tabs 26 are folded at approximately right angles to the face portion of the side walls 34. Once formed, the tabs 26 provide a contact surface for the brazing step once the face plate 16 is assembled.

**[0023]** In order to secure the face plate 16 prior to brazing, tabs 25 fold over during the assembly of the one-piece frame 15 creating a groove as best scene in FIG. 3. More specifically, the face plate 16 or the grill side front cover plate 16 is inserted into the frame 15 as the last wall of the frame 15 is closed squaring the 90° corners giving the frame 15 a box shape. The face plate 16 is slid from the side, the tabs 25 also provide a contact surface between the face plate 16 and the one-piece frame 15 for brazing.

**[0024]** With reference to Figs. 3 and 4, the face plate 16, one-piece frame 15 and a back plate 17 are formed with tabs 25 that prevent the various elements from misaligning during the assembly process, as well as acting as temporary locks prior to braze.

**[0025]** The assembly of the face plate 16 and the frame 15 is best seen in Figure 3. The face plate 16 is slid into the slots made by tabs 25. A sleeve 13 is fit into a hole 30 in the face plate 16. The face plate 16 has flange 31 located around the hole 30 to guide the sleeve into position during assembly. The flange 31 that guides

the round sleeve 13 into place also provide surface area for improving the integrity of the braze junction. The sleeve 13 is cylindrical in nature and can vary in length depending on the spatial requirements within the engine compartment. The sleeve 13 diameter may also vary depending upon the power take off shaft's required clearance. Thus, the sleeve 13 must have a diameter large enough to receive a power take off shaft, not shown in the drawing. While the preferred embodiment indicates the sleeve is cylindrical, the sleeve may also be oval or any other shape to accommodate a power take off shaft, while maintaining smoothly contoured surfaces.

**[0026]** In an alternate embodiment, the tabs located on the periphery edges of the frame and fold down over the face plate temporarily to lock the sleeve 13 into position before brazing.

**[0027]** In an alternate embodiment indicated in Figure 4, the assembly containing the back plate 17, sleeve 13, and one-piece frame 15 is inserted into the heat exchanger's core during the stacking operation. At this point, an inner support ring 40 is added onto the sleeve and the back plate 17 is slid into place. It should be observed that the inner ring 40 is not an essential item to the present invention. It is possible to complete the stacking of the assembly into the core without the need for a support ring. The flanges or tabs 25 of both the front and back plates 16 and 17 face the same direction in order to guide the sleeve when inserted into the assembly. The back plate 17 is finally pressed against the one-piece frame 15 and the tabs 25 along the rear of the one-piece frame 15 are used to locate the back plate into position before brazing. The assembly is now ready for brazing.

**[0028]** Contact surfaces are formed via the tabs 25 and 26 to provide sufficient surface area for brazing. In other words, the flanges 31 that guide the round sleeve 13 into place also provide surface area for improving the integrity of the braze junction.

**[0029]** After the brazing process, the completed power take off hole 30 has a clean smooth appearance. The resistance to internal fluid flow within the assembly comprised of the one-piece frame 15, the face plate 16 and the back plate 17 is minimal due to the increased internal flow area when compared to the prior art. The power take off assembly's internal flow path indicated by the arrows is smooth without any sudden direction changes in Figure 5. The round opening of the sleeve 13 is the optimum physical shape for structural integrity and resistance to damage. As seen in Figure 5, the shape allows for external forces exerted on the assembly to deflect and minimize any impact damage. Thus, fluid traverses, or circumvents, the arcuate body referred to above as the sleeve 13 from the passage 20 serving as inlet ports to the passage 20 serving as outlet ports. Air seal attachment is inherent to the design. The sleeve 13 permits attachment of an air seal attachment, not shown in the drawings, to be installed on the assembly after braze.

**[0030]** While the foregoing invention has been shown and described with reference to several preferred embodiments, it will be understood that various changes in form and detail may be made without departing from the spirit and scope of the present invention. For example, while the above described embodiment utilizes a radiator or a charged air cooler system. The present invention may also be used for stationary engines as well, an example of which includes a stationary engine driven pumping station. Similarly, the sleeve need not be circular and can be oval to accommodate a variety of shafts therethrough. The sleeve may also have radii forming corners with curves to facilitate fluid flow therearound.

## Claims

1. A heat exchanger for a vehicle, comprising:

a heat source including at least one inlet port and at least one outlet port;  
a core portion operably connected to said heat source including a plurality of tubes through which fluid flows and a plurality of fins each of which is disposed between adjacent tubes for facilitating heat exchange of the fluid; and  
a power take off assembly disposed in said core portion, said power take off assembly having inlet ports and outlet ports in fluid communication with said plurality of tubes, wherein fluid flowing from said inlet ports traverses an arcuate body.

2. The heat exchanger according to claim 1, wherein said power take off assembly further comprises:

a rectangular frame having a plurality of passages defining said inlet port and outlet port along two vertical sides thereof, a sleeve defining said arcuate body, a face plate and a back plate.

3. The heat exchanger according to claim 2, wherein said arcuate body passed through said core portion.

4. The heat exchanger according to claim 2, wherein plurality of passages are operably connected with said plurality of tubes allowing the flow of fluid there-through.

5. The heat exchanger according to claim 2, wherein said rectangular frame has at least one flange along a perimeter for holding said face plate and said back plate in place during a manufacturing process.

6. The heat exchanger according to claim 2, wherein said face plate has a first hole proximate a center of said front plate and said back plate has a second

hole proximate a center of said pack plate, wherein said first and second holes are substantially equal in diameter.

7. The heat exchanger according to claim 6, wherein said face plate and said back plate have at least one of a flange located along the circumference of said first and second holes for guiding said sleeve into position. 5
- 10
8. The heat exchanger according to claim 6, wherein said first hole is circular. 10
9. The heat exchanger according to claim 6, wherein said first hole is oval. 15
10. The heat exchanger according to claim 6, wherein said sleeve is tubular having a circumferential geometry equal to that of said first hole in said face plate and said second hole in said back plate. 20
11. The heat exchanger according to claim 10, wherein said sleeve is secured to said front plate and said back plate via one of welding, brazing, and soldering. 25
12. The heat exchanger according to claim 2, wherein said assembly is assembled and bonded during a one shot brazing process. 30
13. The heat exchanger according to claim 2, wherein fluid enters and leaves an internal environment defined by said assembly exclusively through said plurality of passages. 35
14. The heat exchanger according to claim 1, wherein said heat source is an internal combustion engine. 40

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Fig. 1  
Prior Art

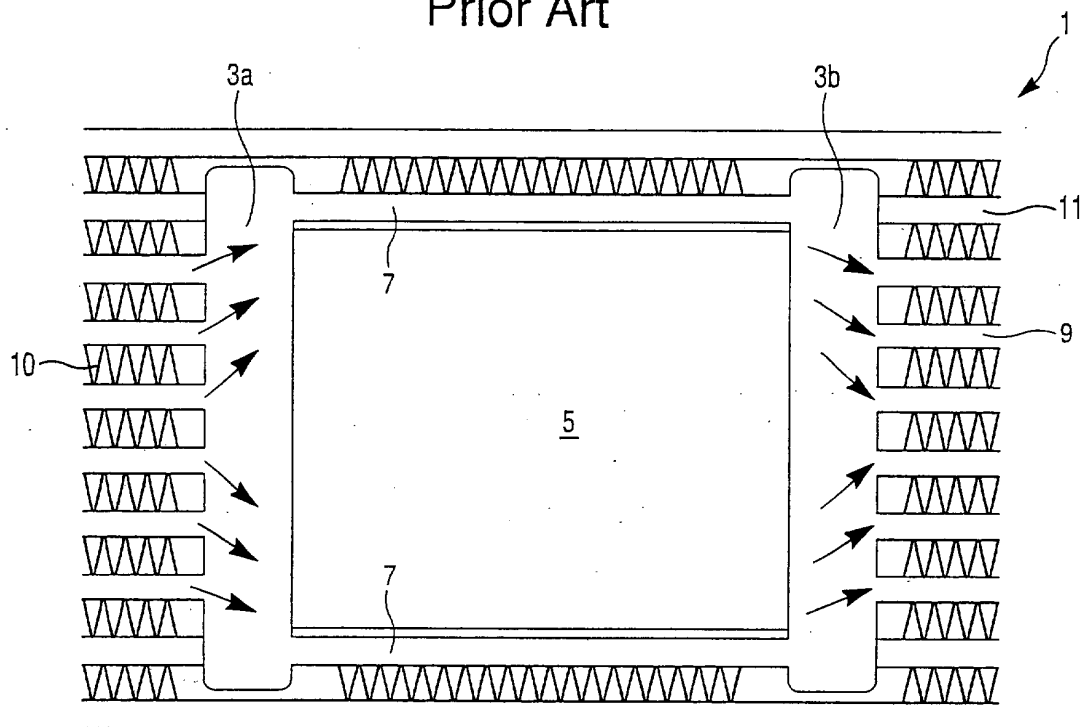


Fig. 5

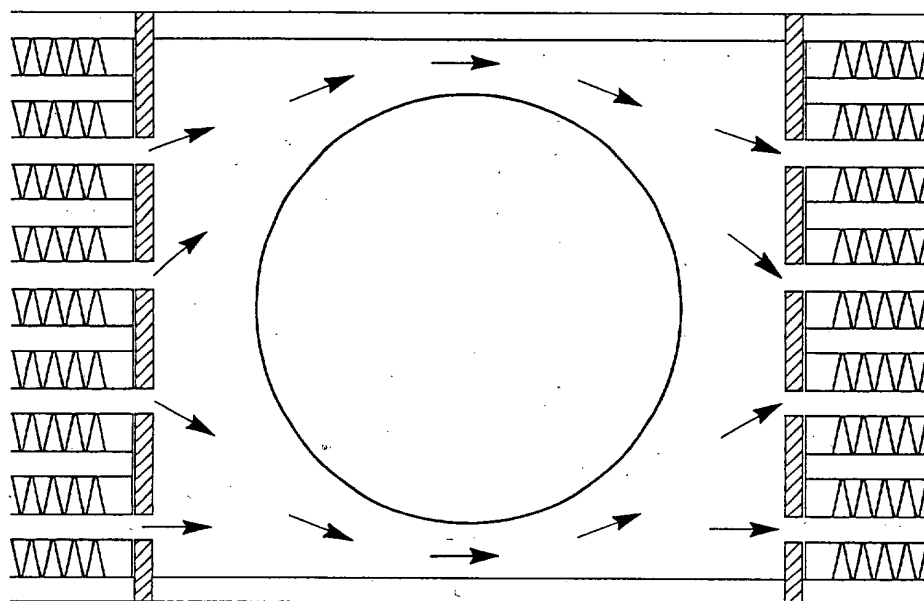


Fig. 2A

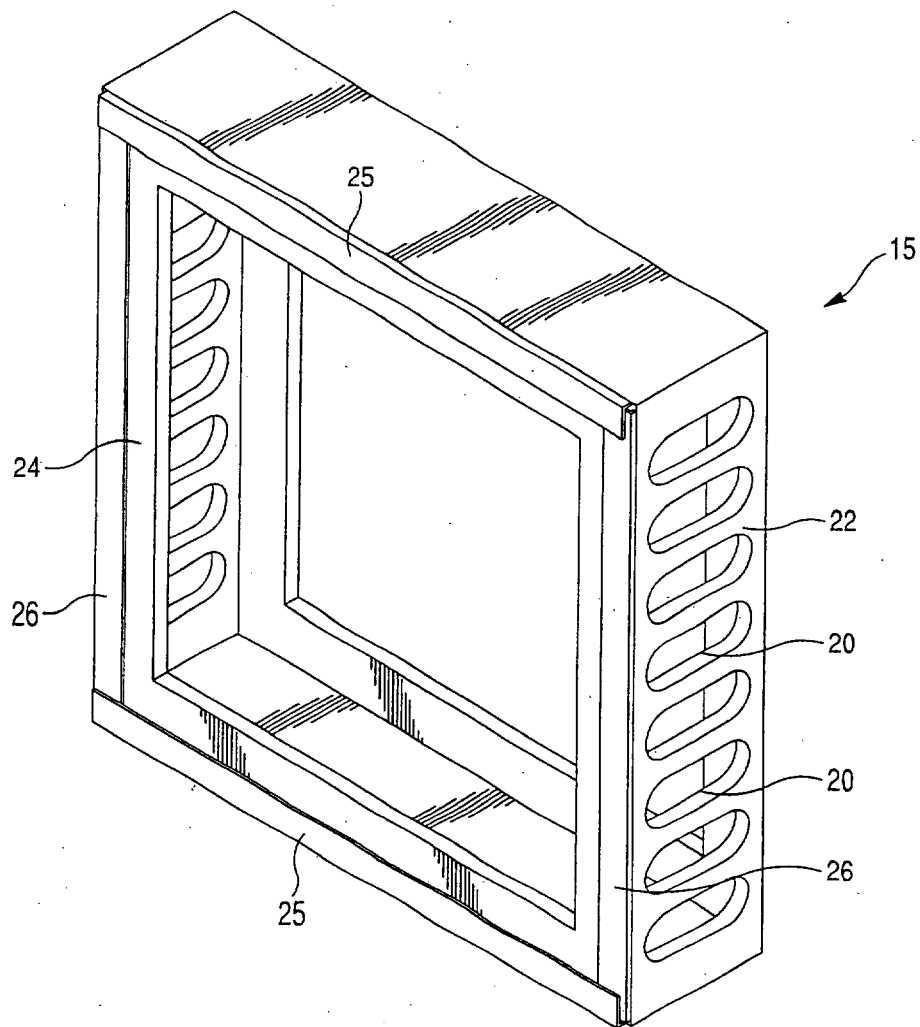
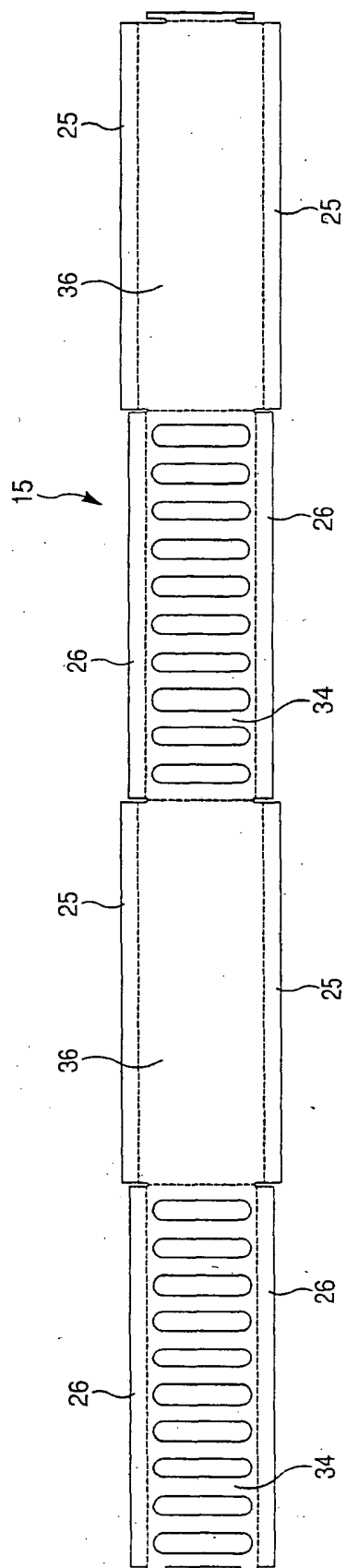


Fig. 2B



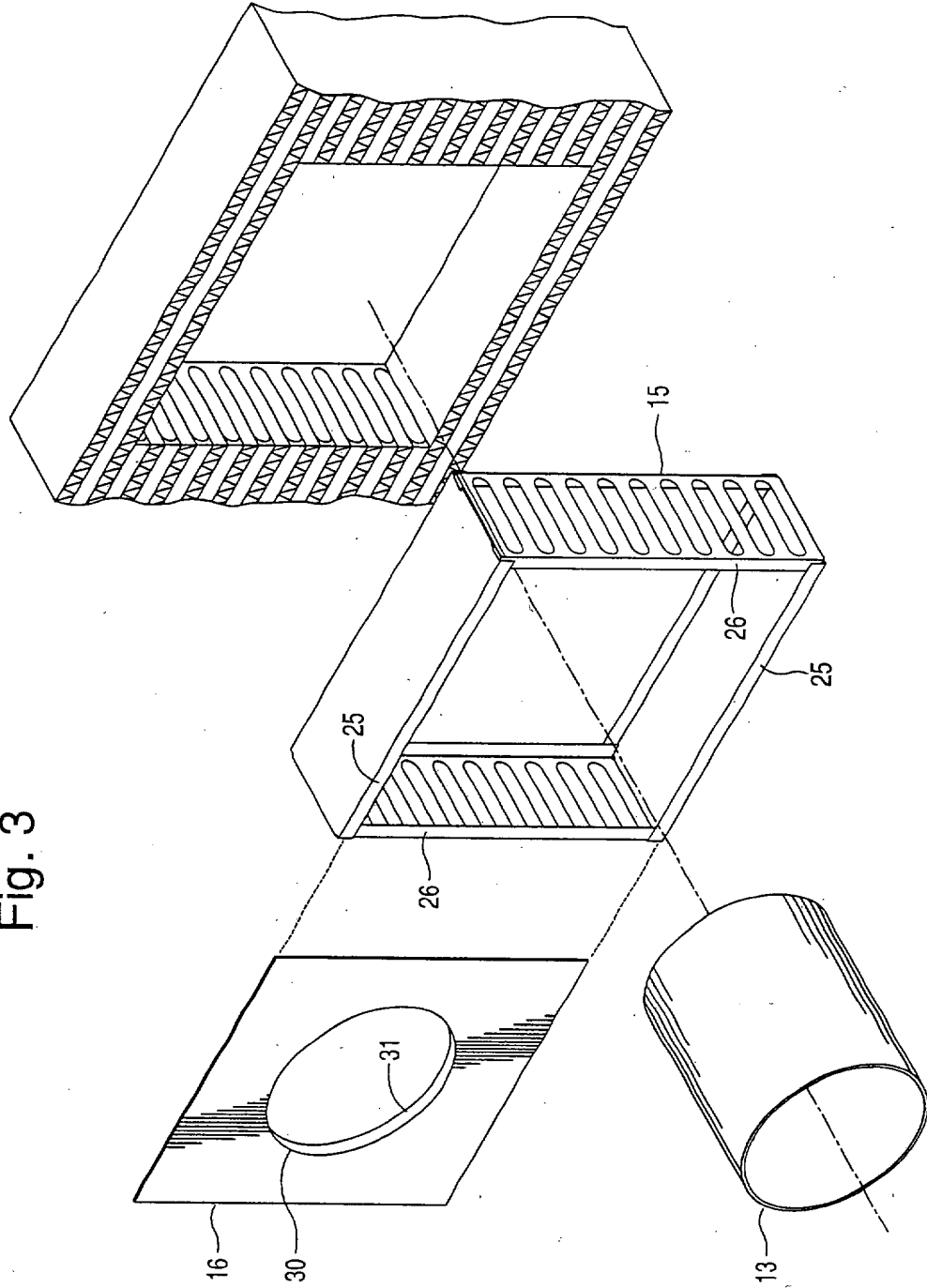


Fig. 3

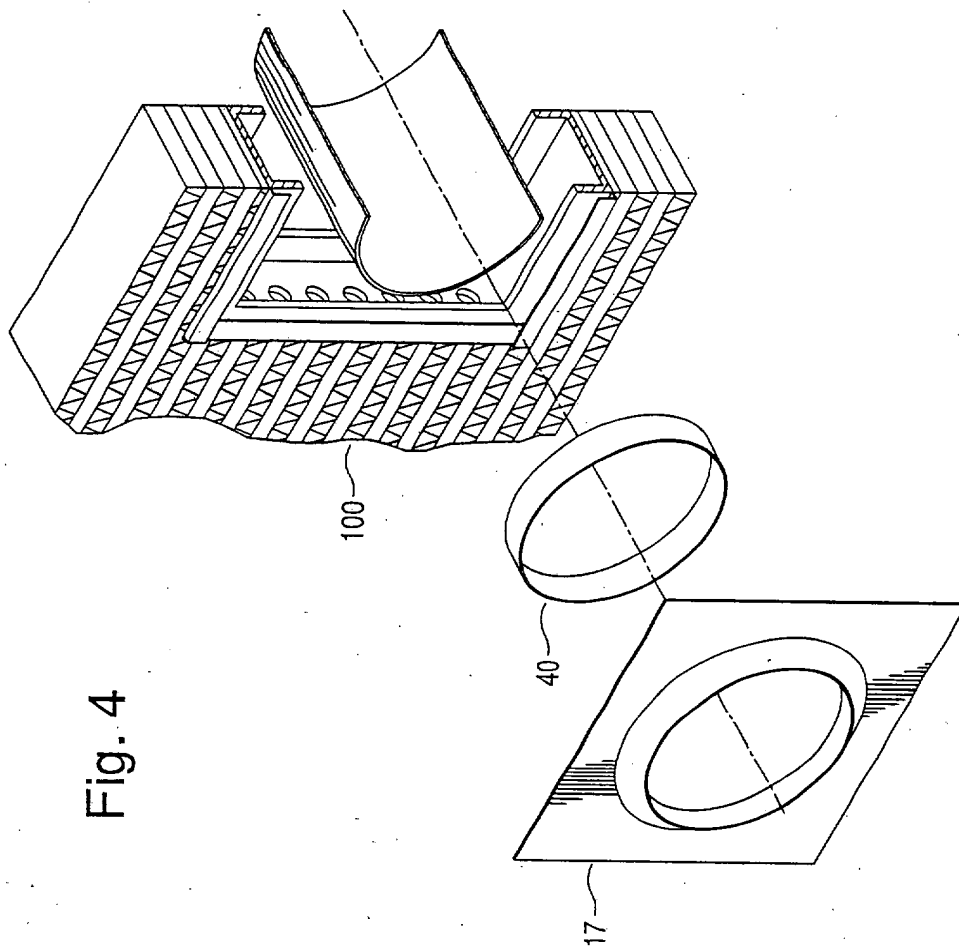


Fig. 4