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(54) High efficency heat exchanger for a refrigeration system

(57) The heat exchanger includes an elongated housing (12) defining a generally cylindrical space through which one of the media is passed. The housing (12) has an inside wall surface (20) thereof which has a given diameter. An elongated heat exchange pipe (26) defining a tortuous path for the other of the media is adapted to be disposed within the housing (12). The heat exchanger pipe (26) has an effective outer diameter (27)which is less than that of the given diameter of the housing (12). A spacer (34) is provided for engaging the inside wall surface (20) and the heat exchange pipe (26) for supporting the pipe (26) in a predetermined spaced relationship with the inside wall surface.

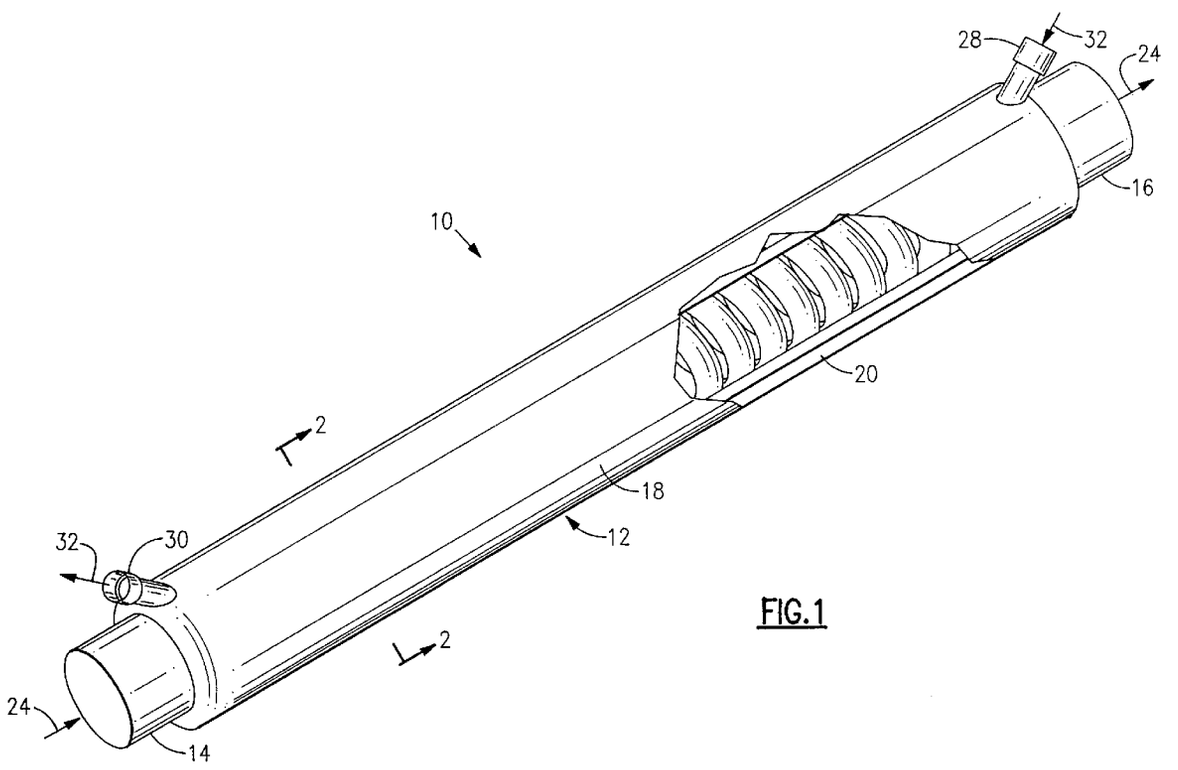

FIG.1

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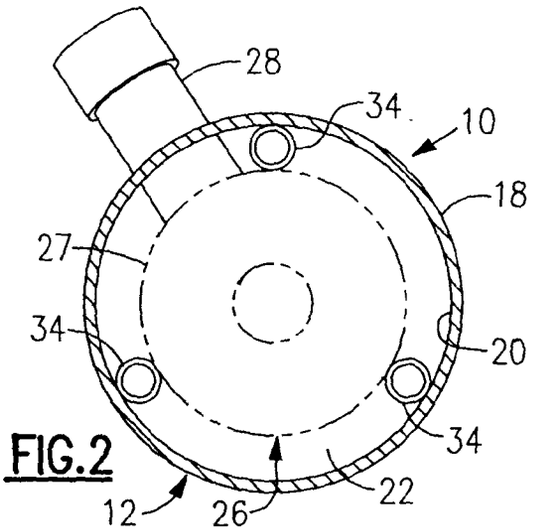

FIG.2

Description

Technical Field

[0001] The present invention relates to a heat exchanger for exchange of heat between two media, especially a gas and a liquid, and particularly relates to a relatively small high efficiency heat exchanger.

Background Art

[0002] Heat exchangers are known in the art which consist generally of a cylindrical casing opposite ends of which are provided with an inlet and outlet for one medium, preferably a gas, and a helical pipe coil arranged in the space in the casing and through which the other medium, preferably a liquid, is allowed to flow. Such a heat exchanger is shown in U.S. 4,697,636 "Heat Exchanger With Helical Fluid Flow". One application for such a heat exchanger is as a liquid suction heat exchanger ("LSHX")in an air conditioning or refrigeration unit, which is used to improve system performance and efficiency. The prime purpose of a LSHX is to subcool liquid refrigerant leaving the condenser at the expense of super heated vapor exiting the evaporator coil. The more subcooling that is gained at the heat exchanger outlet, the more system performance is improved. Accordingly, there exists a need for an improved heat exchanger which will maximize heat transfer therein while minimizing gas side pressure drop through the heat exchanger.

Disclosure of the Invention

[0003] The primary object of this invention is to provide a heat exchanger of the type having a cylindrical housing through which a gas flows in one direction, and a heat exchanger defining a tortuous path conducts a liquid therethorugh in another direction. The heat transfer surface and heat transfer coefficient are maximized and gas side pressure drop are minimized by spacing the tube defining the tortuous path from the inside of the shell.

[0004] According to the present invention, a heat exchanger for exchanging heat between two fluid media is provided. The heat exchanger includes an elongated housing defining a generally cylindrical space through which one of the media is passed. The housing has an inside wall surface thereof which has a given diameter. An elongated heat exchange pipe defining a tortuous path for the other of the media is adapted to be disposed within the housing. The heat exchanger pipe has an effective outer diameter which is less than that of the given diameter of the housing. A spacer is provided for engaging the inside wall surface and the heat exchange pipe for supporting the pipe in a predetermined spaced relationship with the inside wall surface.

[0005] In a preferred embodiment, the elongated heat exchange pipe comprises a helical pipe coil which is concentrically supported within the housing. Further, in the preferred embodiment, the means for engaging and supporting includes three elongated tubes disposed within the housing between the helical pipe coil and the inside wall surface.

Brief Description of the Drawings

[0006] The invention may be better understood and its objects and advantages will become apparent to those skilled in the art by reference to the accompanying drawings, in which:

Figure 1 is a perspective partially broken away view of a heat exchanger which embodies the features of this invention;

Figure 2 is a cross-sectional view taken along the lines 2-2 of Figure 1;

Figure 3 is a cross-sectional view similar to Figure 2 of an altemative embodiment of the invention;

Figure 4 is a cross-sectional view similar to Figure 2 of another altemative embodiment of the invention;

Figure 5 is a cross-sectional view similar to Figure 2 of another alternative embodiment of the invention; and

Figure 6 is a simplified sectional view of a heat exchanger similar to Figure 1 showing yet another altemative embodiment to the invention.

Description of the Preferred Embodiment

[0007] Looking now at Figures 1 and 2, a high efficiency heat exchanger 10 according to the present invention is shown. The heat exchanger 10 comprises an elongated cylindrical housing 12 having a reduced diameter inlet fitting 14 at one end and a reduced diameter outlet fitting 16 at the other end thereof. The cylindrical housing 12 includes a cylindrical outer wall 18 and a cylindrical inner wall 20 which defines a generally cylindrical space 22 therein through which a gaseous media such as a superheated vapor exiting an evaporator coil is adapted to flow in a direction as indicated by arrows 24.

[0008] Located within the space 22 inside the cylindrical housing 12 is an elongated heat exchanger coil 26. The coil comprises a long length of copper tubing wound into a spiral coil and has an inlet end 28 and an outlet end 30 which extend outwardly through and are attached to the wall of the housing 12 at opposite ends thereof. The coil 26 is adapted to preferably have a liquid refrigerant leaving a condenser coil flowed therethrough to be subcooled by the gaseous medium flowing through

the interior of the cylindrical housing 12. The flow of the liquid refrigerant through the coil 26 is in the opposite direction from the flow of the gas through the cylindrical housing 12, as indicated by the arrows 32.

[0009] The effective outer diameter of the coil 26 (as indicated by dotted lines 27 in Figures 2 through 5) is less than the inside diameter of the inner wall 20 of the cylindrical housing 12. The coil is optimally located within the housing 12 by positioning tubes 34. The positioning tubes extend substantially the entire length of the housing 12 and are sized to engage the inner wall 20 of the housing as well as the outside of the coils of the elongated heat exchange coil 26. The tubes are preferably equidistantly spaced from one another as illustrated in Figure 2 and are brazed to the inner wall 20 at the contact point therewith as well as to the elongated coil 26 at contact points therewith.

[0010] As a result, the elongated heat exchange coil 26 is rigidly supported within the housing 12, concentrically therewith, in a manner which will maximize heat transfer between the fluid in the coil 26 and the gas flowing through the cylindrical housing in the space surrounding the coil 26. Such positioning further minimizes the pressure drop of the gas flowing through the housing as it passes through the center of the elongated heat exchange coil 26 and in the concentric space defined between the coil and the inner wall 20 of the housing 12.

[0011] The positioning tubes 34 have been shown in the drawing figure as hollow tubes which in a typical application are one-quarter inch diameter hollow copper tubes. It should be appreciated that other shaped tubes or solid rods could also be used to serve the spacing function.

[0012] Figure 3 illustrates another embodiment of the invention where the wall of the cylindrical housing 12 has been deformed at three locations to form indentations 36 which serve the function of the positioning tubes 34 as described in connection with the embodiment of Figures 1 and 2.

[0013] Figure 4 illustrates yet another embodiment wherein only two positioning tubes 34 are utilized. In this embodiment, the two tubes are brazed to the inner wall 20 and the outside surface of the elongated heat exchange coil 26 as in the previously described embodiment. The third support, however, in this case is carried out by the inlet nozzle 28 at one end thereof and the outlet nozzle 30 at the other end. The nozzles 28 and 30 form an integral part of the elongated heat exchange coil 26 and serve to support the coil as the third support and positioning point by virtue of their rigid attachment to the cylindrical housing 12.

[0014] Figure 5 illustrates an embodiment where no positioning tubes or indentations are used. In this embodiment. and the elongated heat exchange coil 36 is excentrically mounted within the cylindrical housing 12 with a surface thereof 37 brazed to the inner wall 20 of the housing.

[0015] Looking now at Figure 6, a simplified showing of yet another embodiment of the invention is shown. The cylindrical housing 12 and inner and outer walls are as described in connection with Figure 1. However, reference numeral 38 represents an elongated heat exchange coil 26 similar to that illustrated in connection with Figure 1 which has been formed into what may be described into a modulated wave. As thus formed, the coil 38 defines numerous contact points 40 with the inner wall of the housing 12 along the length of the heat exchanger. The modulated wave coil 38 is brazed to the inner wall 20 at each of these contact points 40.

[0016] The coil 26 could be provided with various convolutions or surface enhancements in order to improve the heat exchange characteristics thereof. It is also contemplated that an elongated heat exchange tube having a configuration other than a coil could be used in practicing the present inventions.

[0017] Accordingly, it should be appreciated that a compact high efficiency heat exchanger has been provided, which provides for a maximum contact of two heat exchange media flowing therethrough in opposite directions while also minimizing pressure drop of the media flowing therethrough.

Claims

1. A heat exchanger for exchanging heat between two fluid media comprising:

   an elongated housing defining a generally cylindrical space through which one of said media is passed, said housing having an inner wall surface thereof having a given diameter;
   an elongated heat exchange pipe for carrying the other of said media, said pipe being adapted to be disposed within said housing and having an outer diameter less than that of said given diameter of said housing; and
   means for engaging said inside wall surface and said heat exchange pipe and for supporting said pipe in a predetermined spaced relationship with said wall.

2. The apparatus of claim 1 wherein said predetermined spaced relationship is a concentric relationship.

3. The apparatus of claim 2 wherein said means for engaging and supporting comprises two or more elongated cylindrical elements longitudinally disposed within said housing between said pipe and said inside wall surface.

4. The apparatus of claim 3 wherein said cylindrical elements are rigidly attached to both said pipe and said wall.

5. The apparatus of claim 4 wherein said cylindrical elements are brazed to both said pipe and said wall.

6. The apparatus of claim 5 wherein said cylindrical elements are hollow tubes.

7. The apparatus of claim 6 wherein there are three of said tubes.

8. The apparatus of claim 6 wherein said cylindrical elements are solid rods.

9. The apparatus of claim 2 wherein said means for engaging and supporting compnses a plurality of longitudinally, internally extending indents in said wall of said housing.

10. The apparatus of claim 1 wherein said predetermined spaced relationship is an eccentric relationship, and said means for engaging and supporting comprises a brazed connection between said inner wall and said pipe.

11. The apparatus of claim 1 wherein said elongated heat exchange pipe comprises a helical pipe coil and wherein said predetermined spaced relationship is concentric.

12. The apparatus of claim 11 wherein said means for engaging and supporting comprises two or more elongated cylindrical elements longitudinally disposed within said housing between said helical pipe coil and said inside wall surface.

13. The apparatus of claim 12 wherein there are three of said elongated cylindrical elements and said elements are brazed to both said coil and said inside wall surface.

14. The apparatus of claim 13 wherein said elongated elements are hollow tubes.

15. The apparatus of claim 1 wherein said elongated heat exchange pipe comprises a helical pipe coil, said coil being further formed longitudinally into a wave shape, and wherein said predetermined spacing is variable, and further wherein said means for engaging and supporting comprises brazing said wave shaped coil to said inner wall at locations where said coil contacts said inner wall.

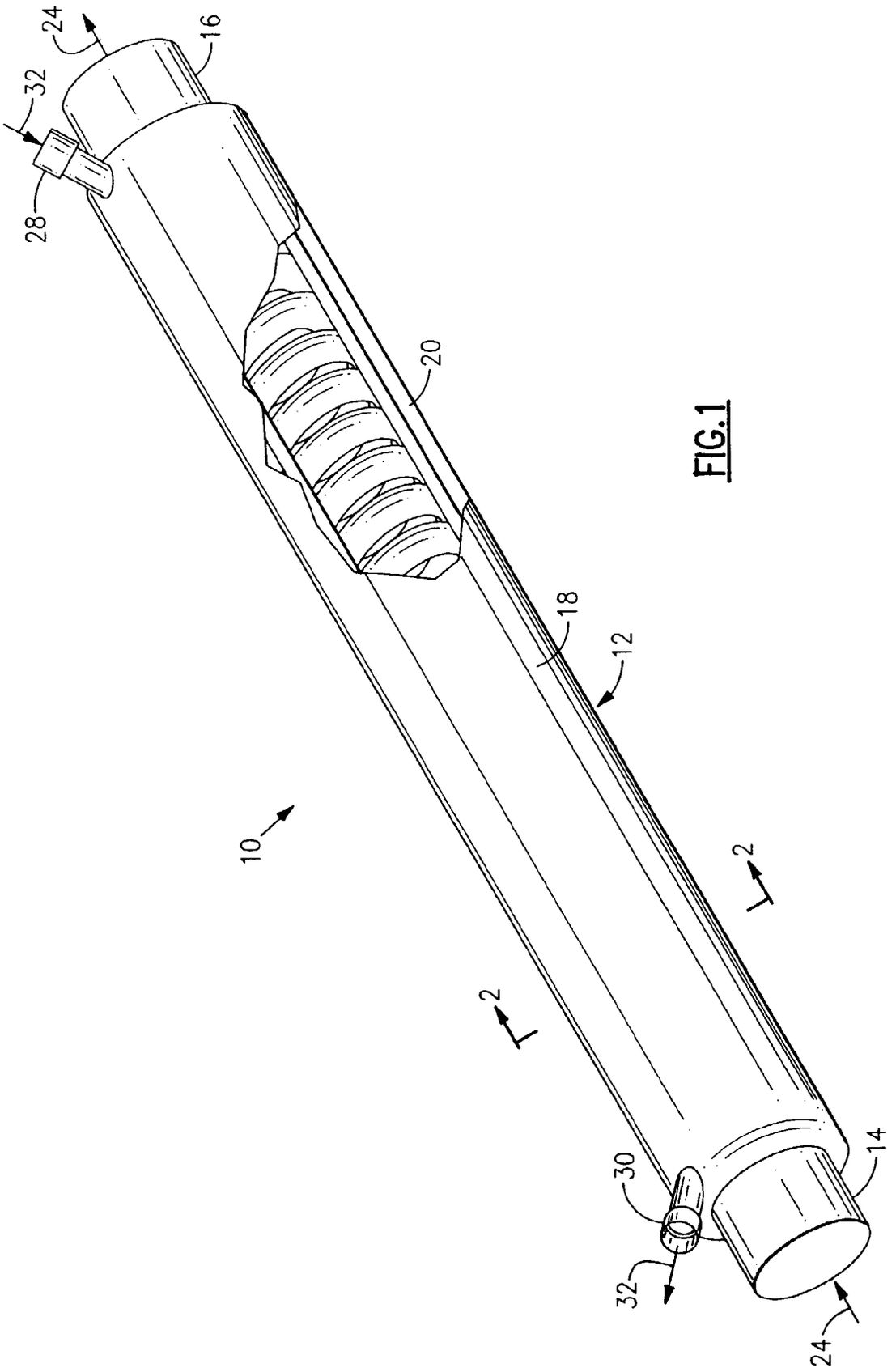

FIG.1

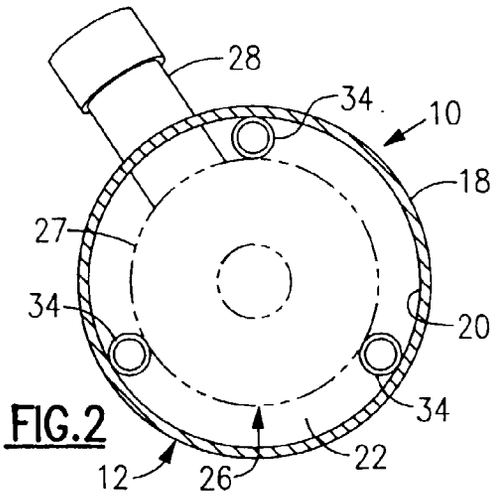

FIG.2

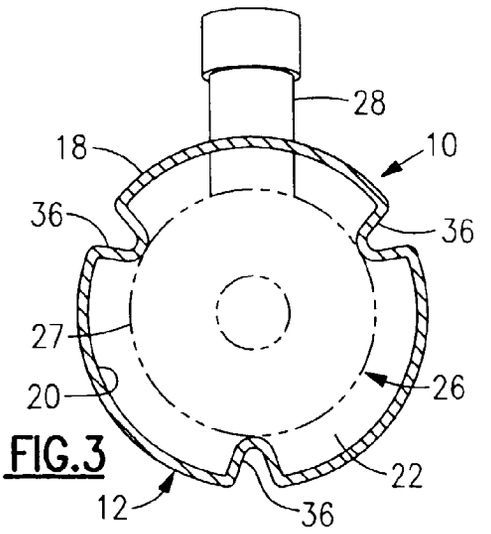

FIG.3

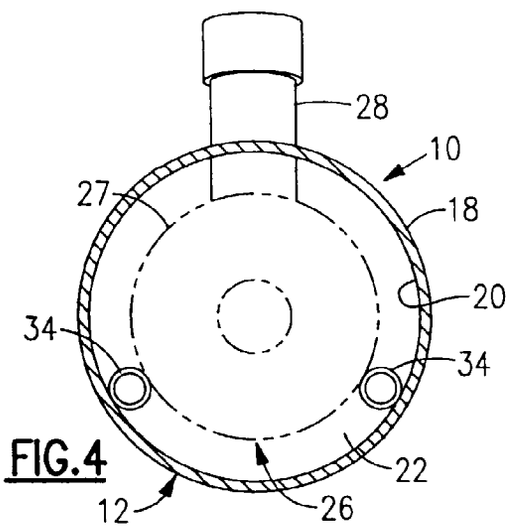

FIG.4

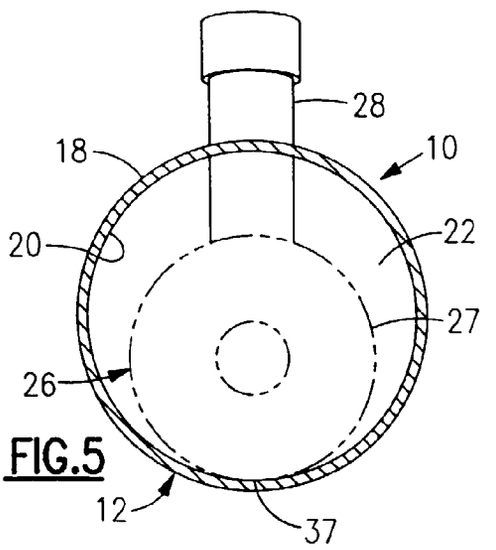

FIG.5

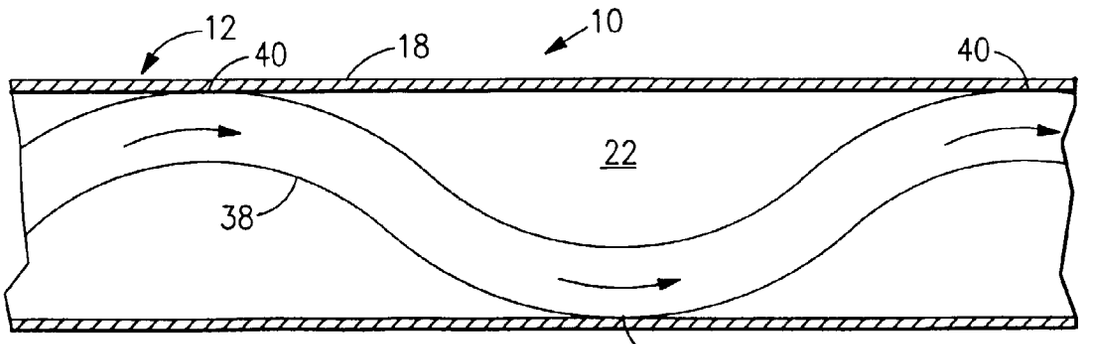

FIG.6