



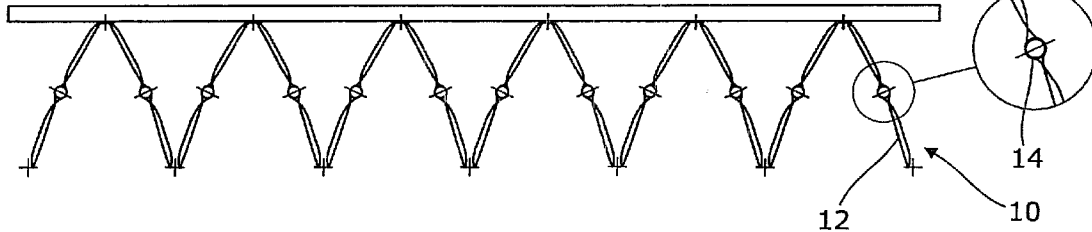
US 20120080174A1

(19) **United States**(12) **Patent Application Publication**
AINLEY et al.(10) **Pub. No.: US 2012/0080174 A1**(43) **Pub. Date: Apr. 5, 2012**(54) **HEAT EXCHANGERS FOR AIR
CONDITIONING SYSTEMS****Publication Classification**(51) **Int. Cl.**
F28F 1/12 (2006.01)(52) **U.S. Cl.** **165/181**(57) **ABSTRACT**(75) Inventors: **Michael AINLEY**, Derby (GB);
Andrew Gaskell, Derby (GB)(73) Assignee: **Frenger Systems Limited**, Derby
(GB)(21) Appl. No.: **13/253,310**(22) Filed: **Oct. 5, 2011**(30) **Foreign Application Priority Data**

Oct. 5, 2010 (GB) 1016750.0

In the field of heat exchangers for air conditioning systems there is a need for an improved heat exchanger which provides improved efficiency in terms of overall packaging and performance. A heat exchanger, for use in an air conditioning system of a building, including an elongate fluid conduit which has first and second elongate heat exchange fins extending laterally therefrom. Opposed faces of the first and second fins define an acute angle therebetween. The fluid conduit defines a discrete conduit body, the first fin defines a first fin body, and the second fin defines a second fin body. The conduit body is thermally coupled to at least one of the first and second fin bodies by a discrete heat exchange member.

16



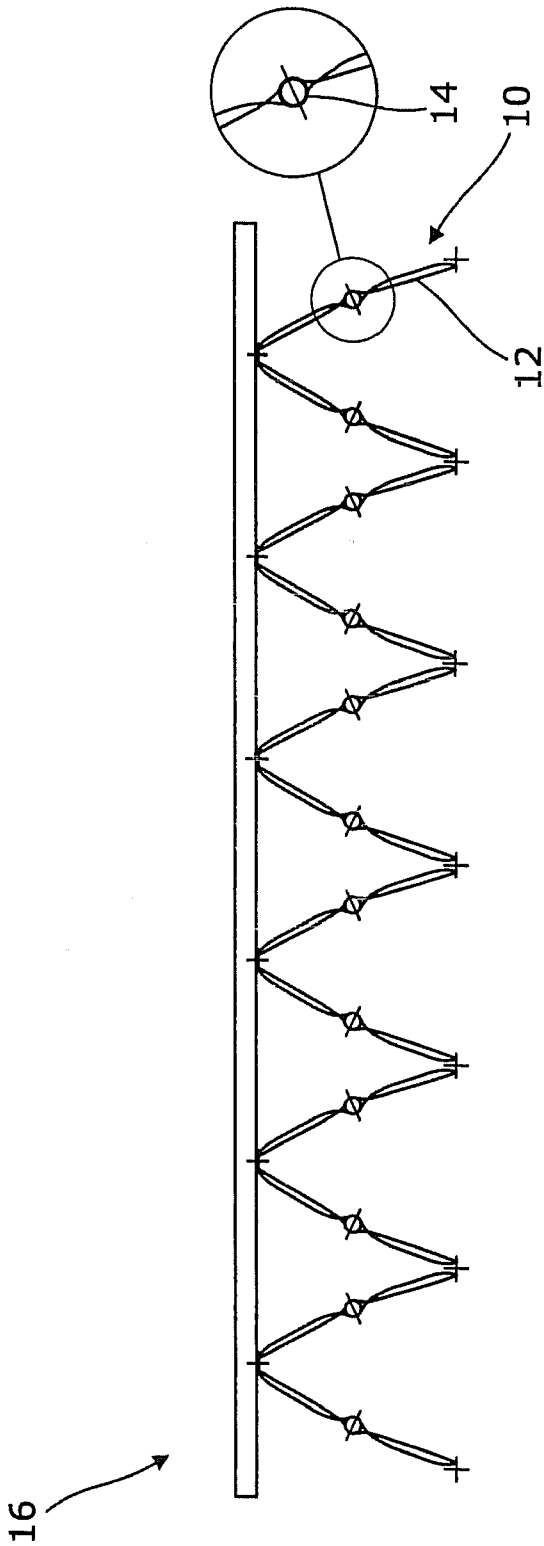


Figure 1

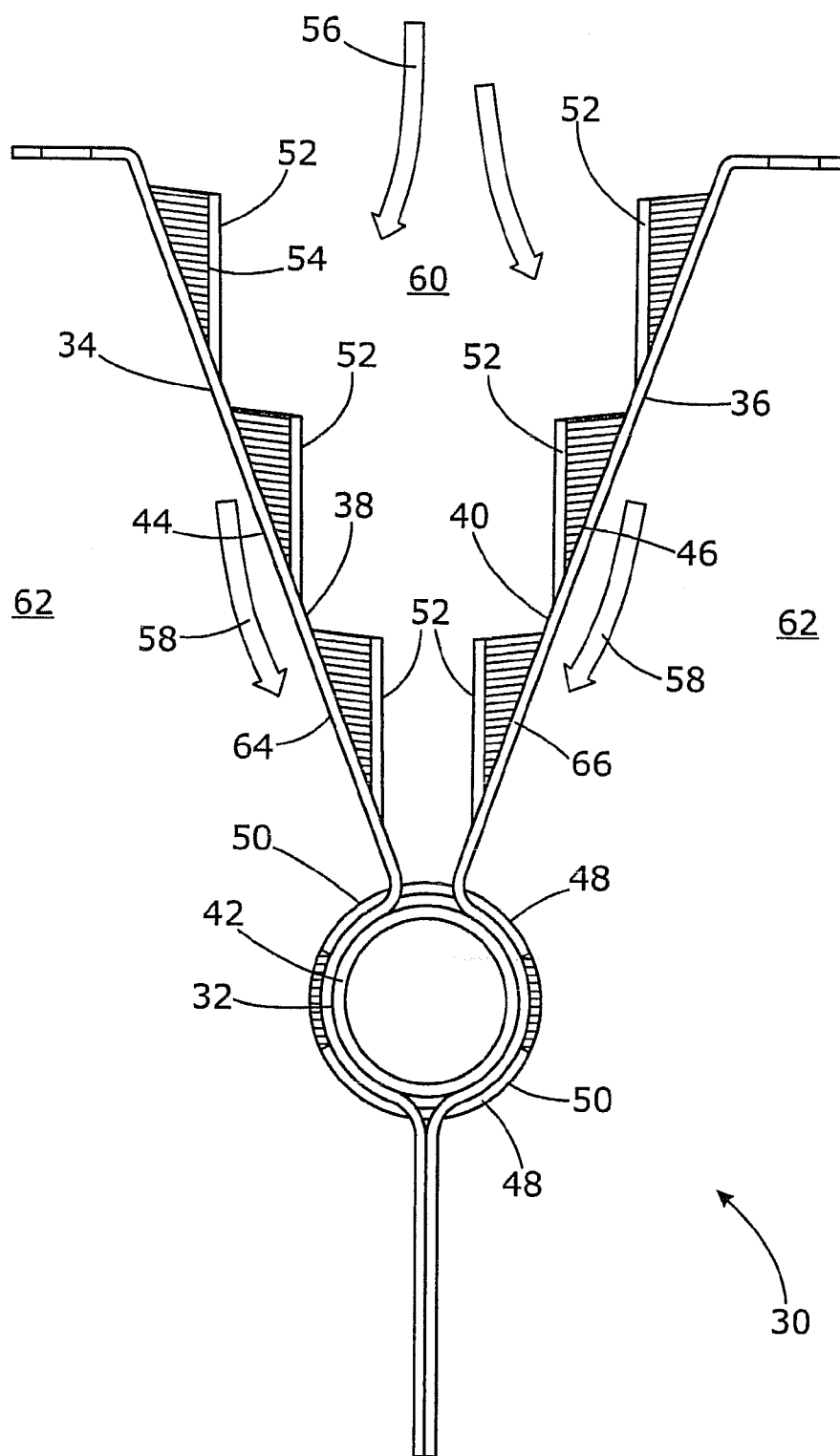


Figure 2

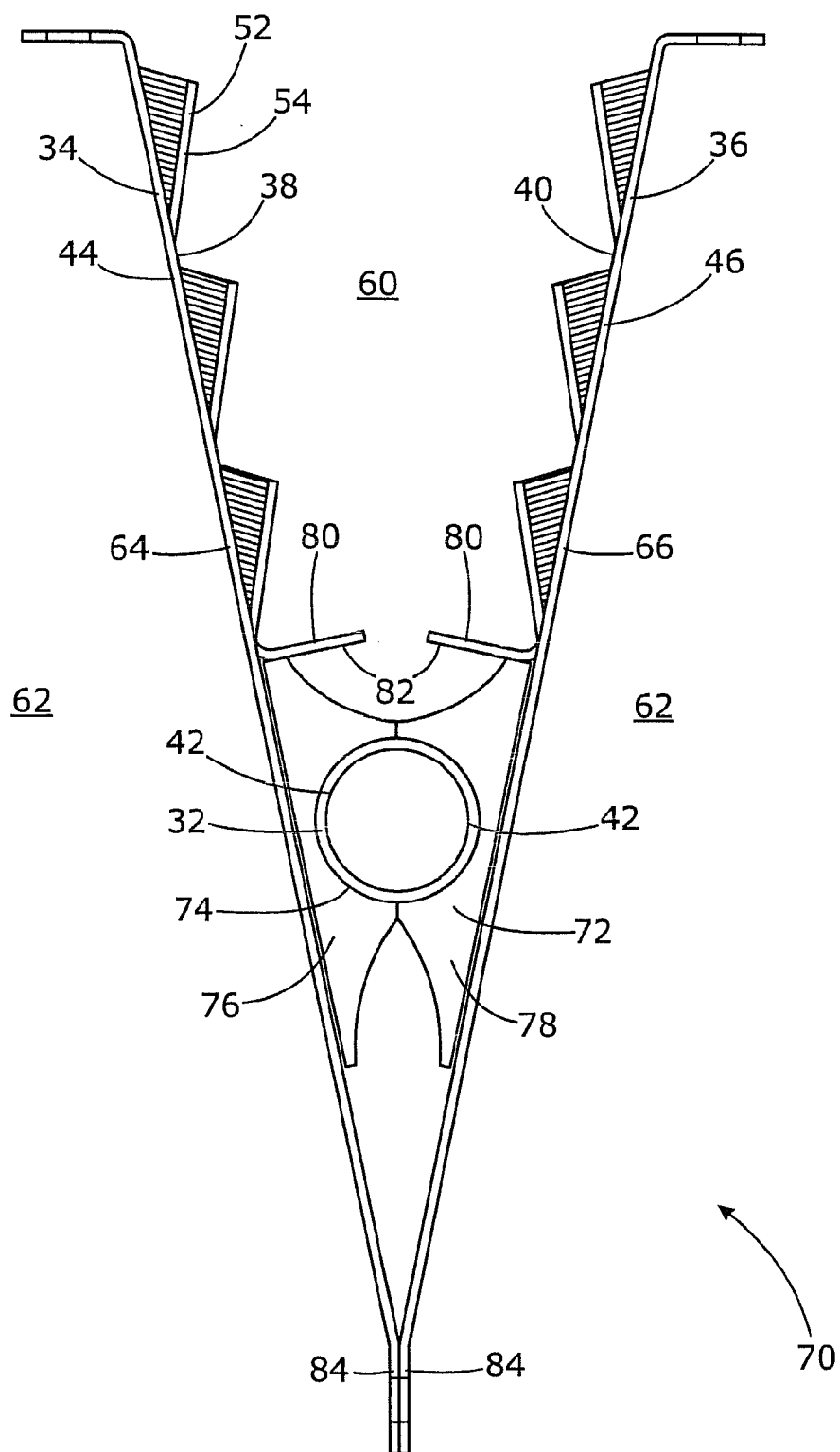


Figure 3(a)

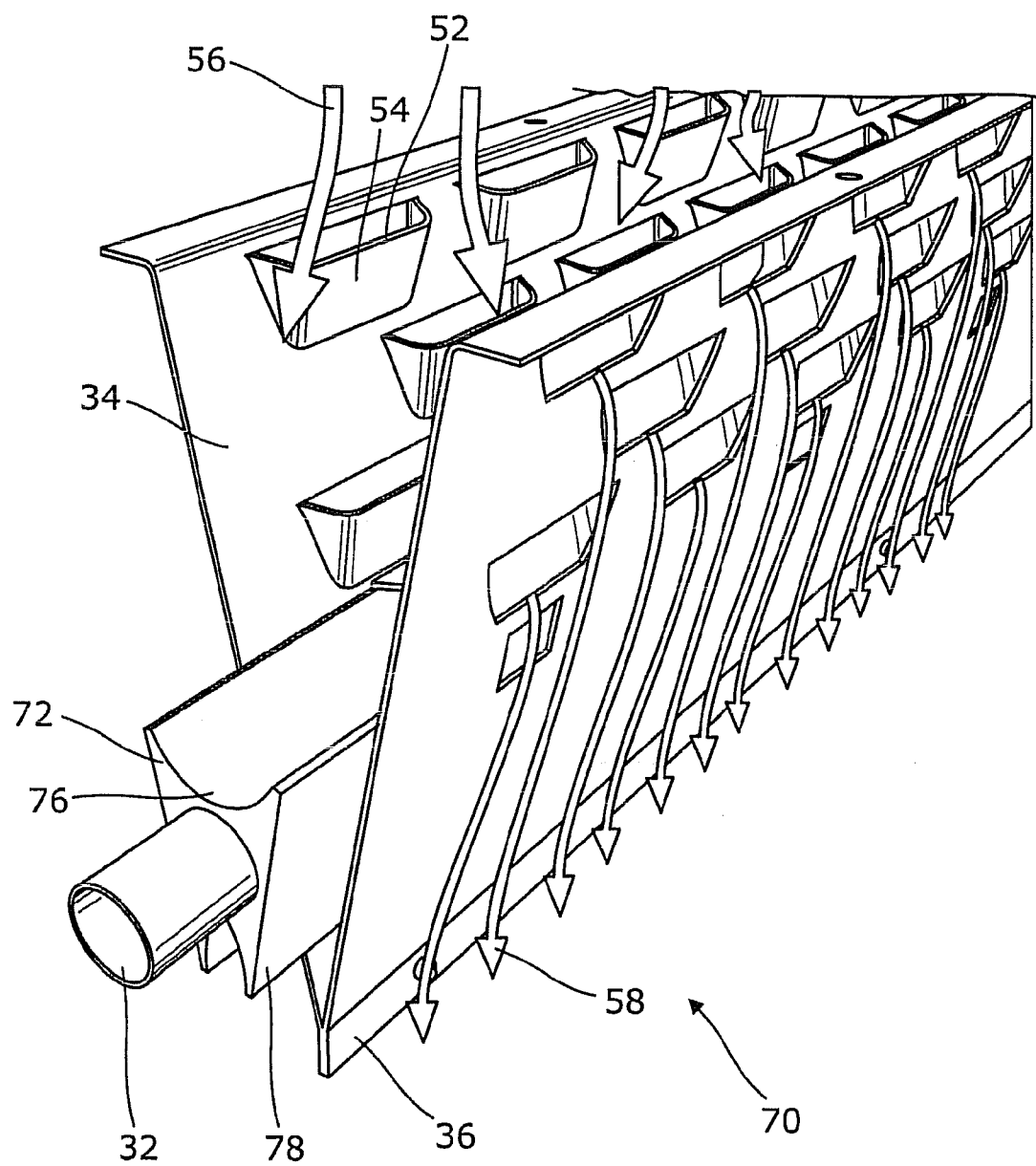


Figure 3(b)

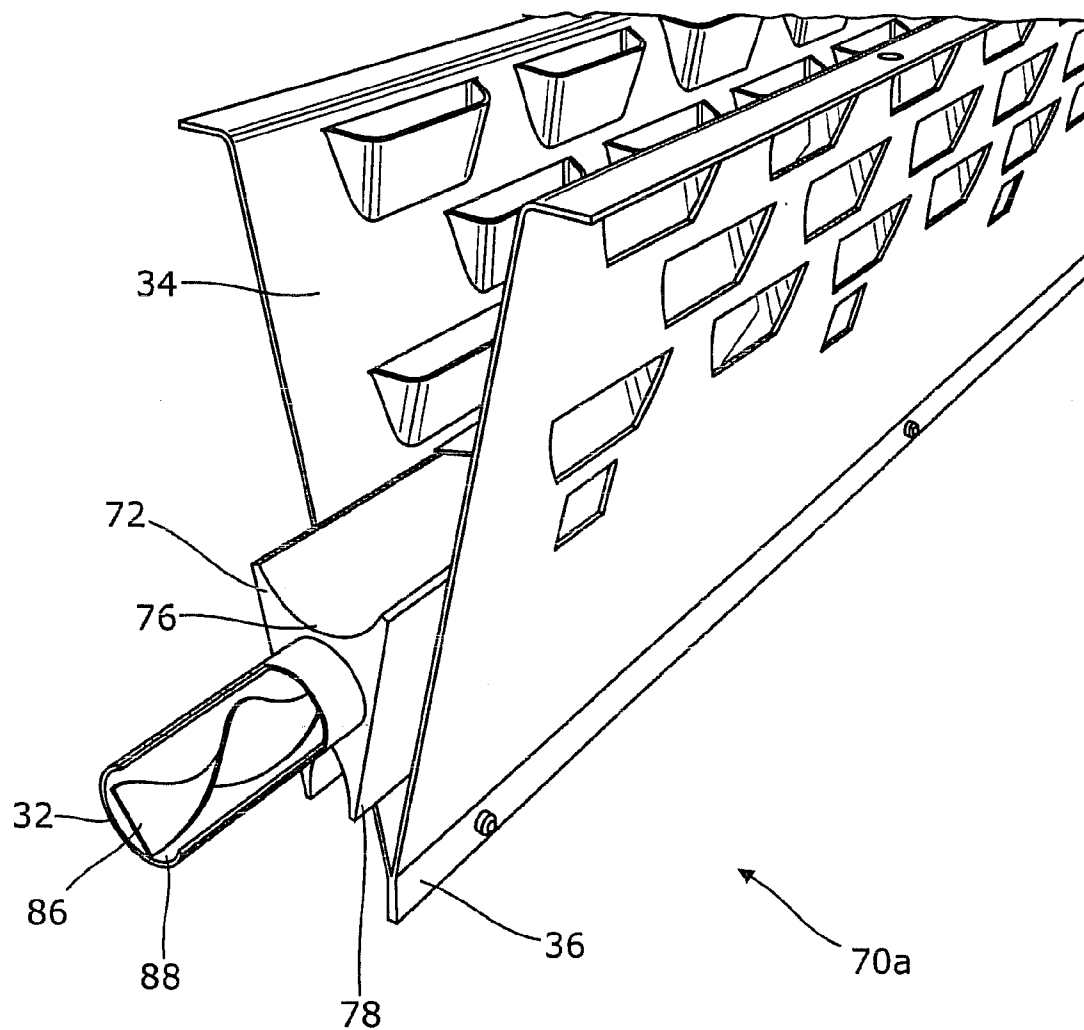


Figure 3(c)

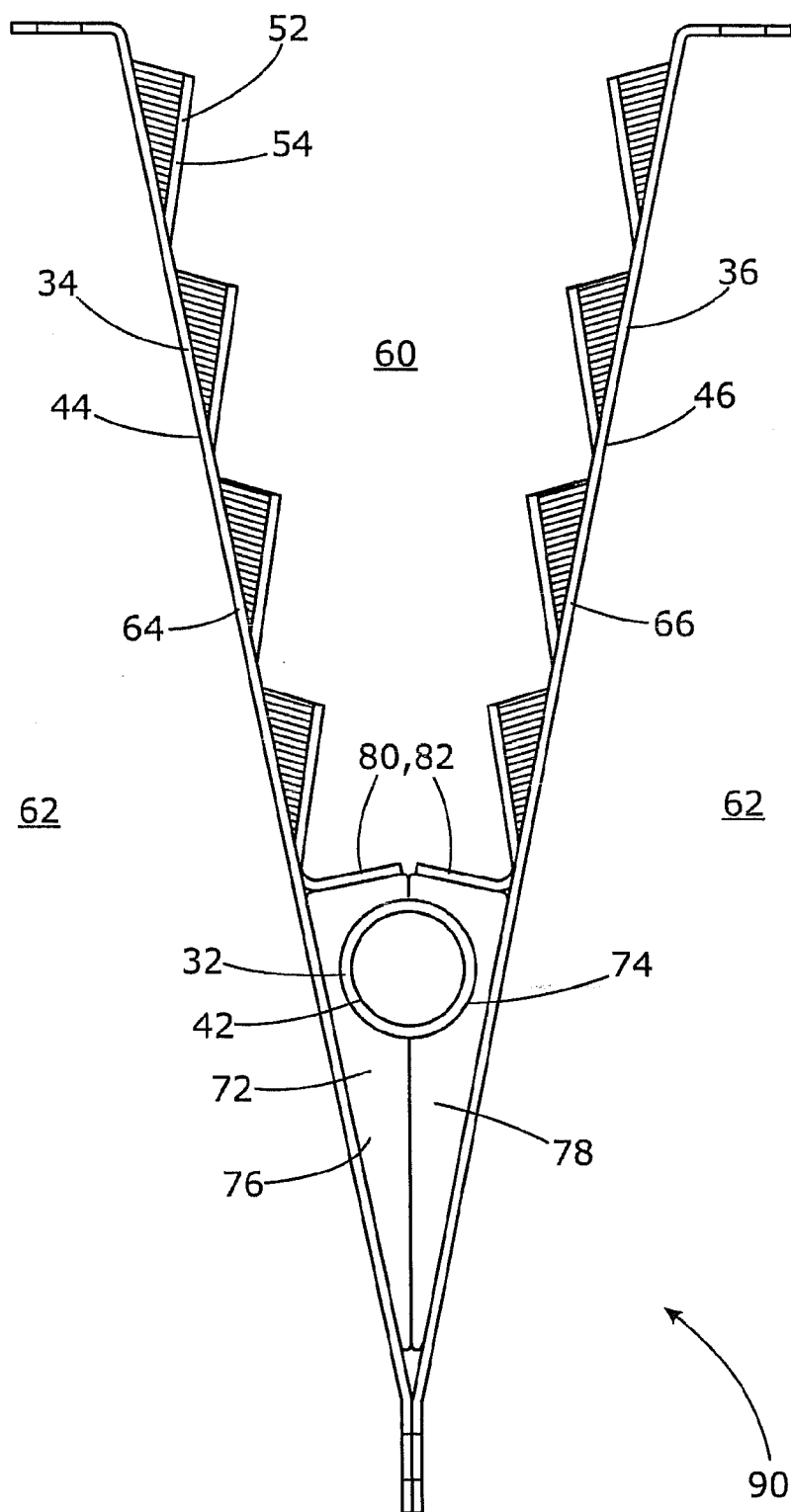


Figure 4

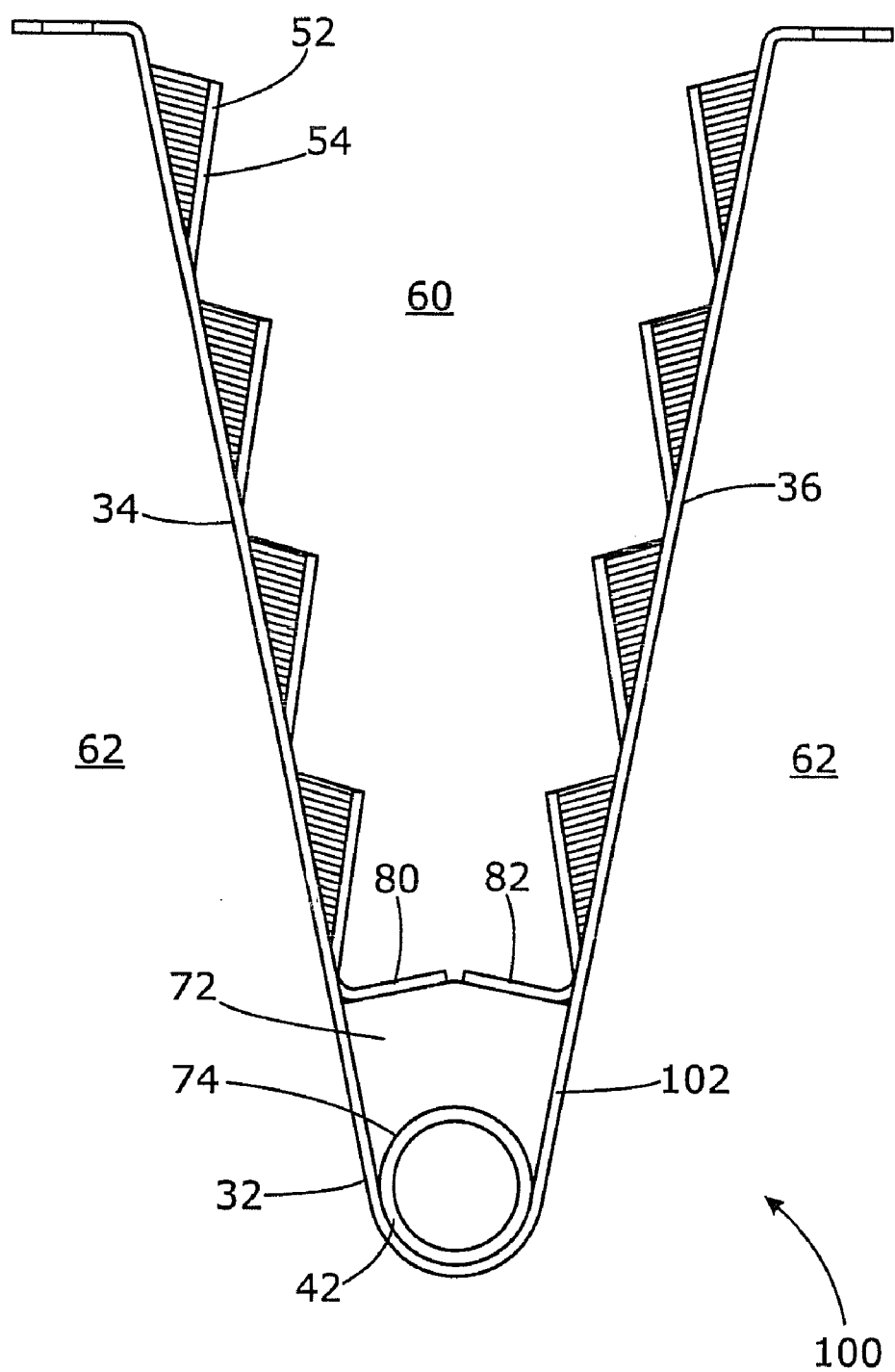
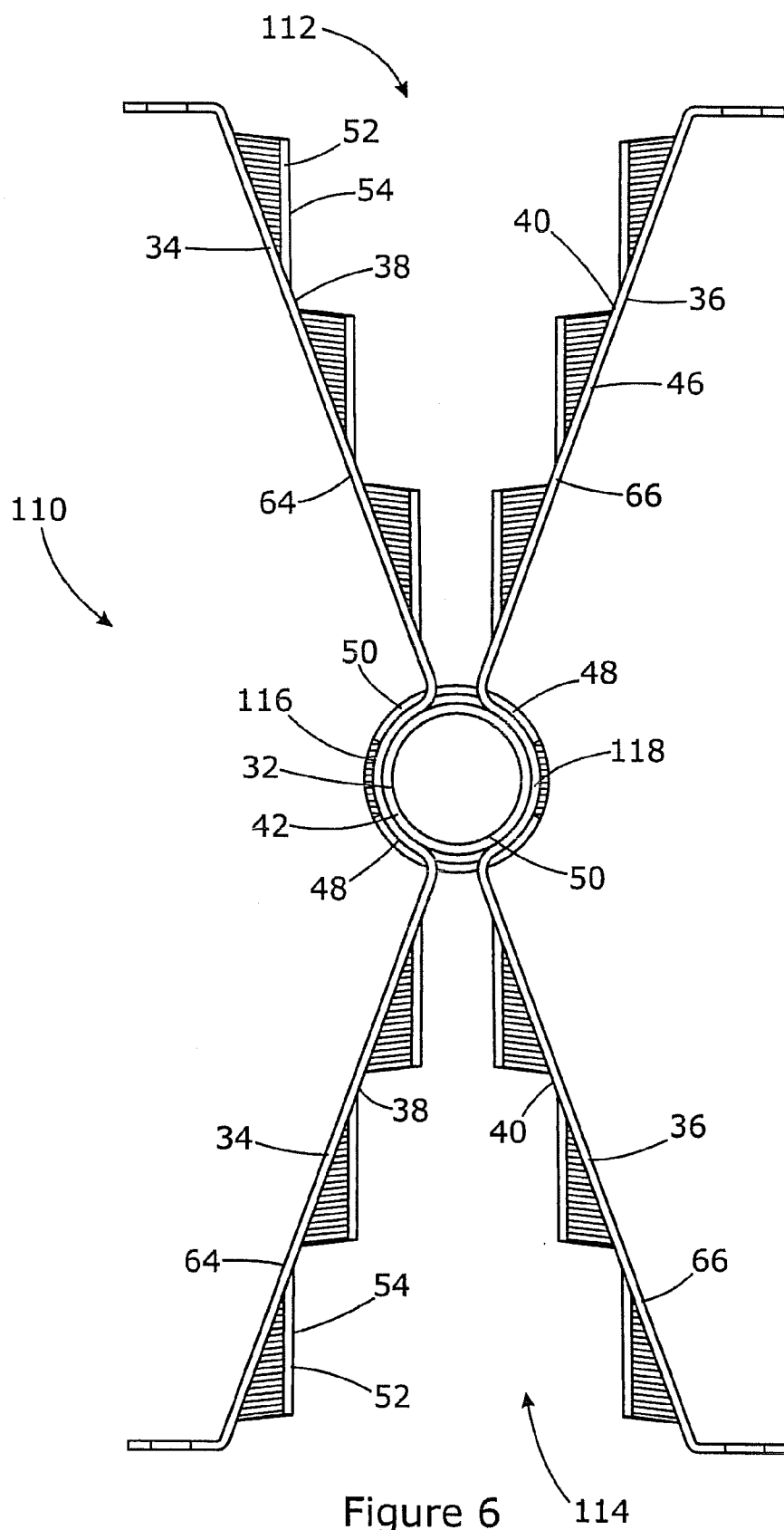


Figure 5



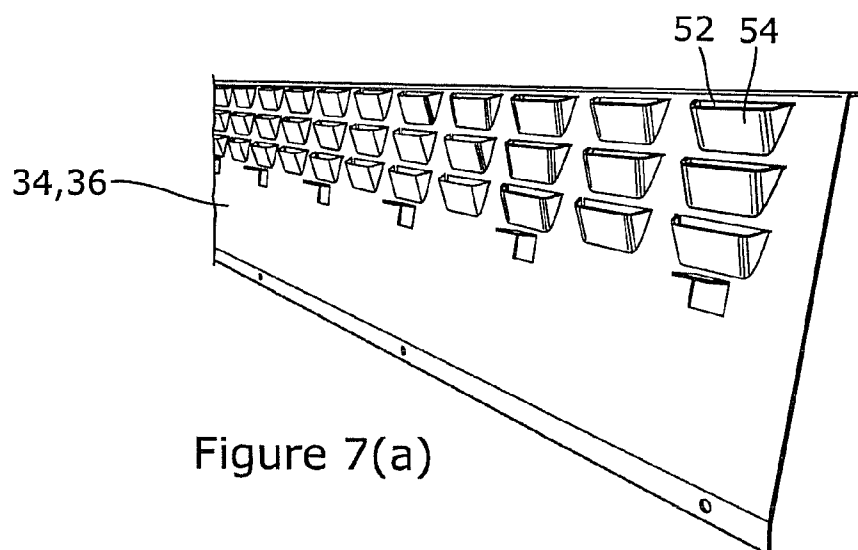


Figure 7(a)

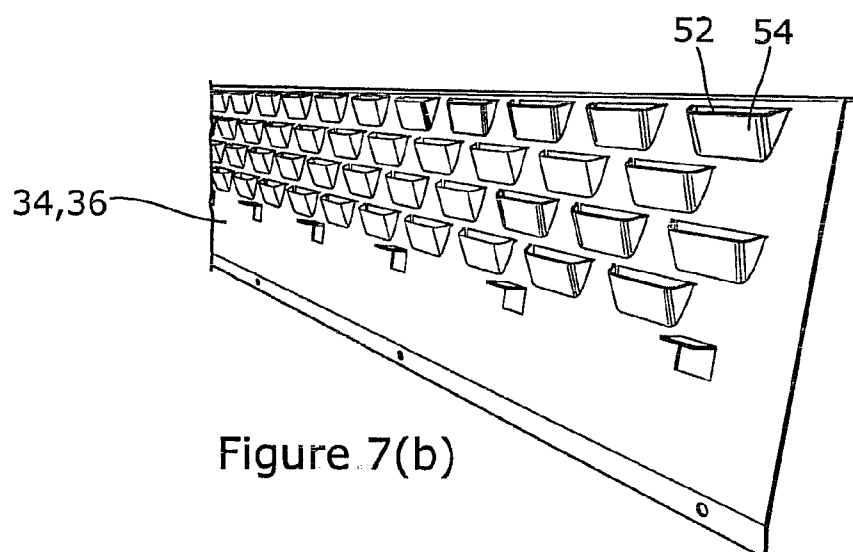


Figure 7(b)

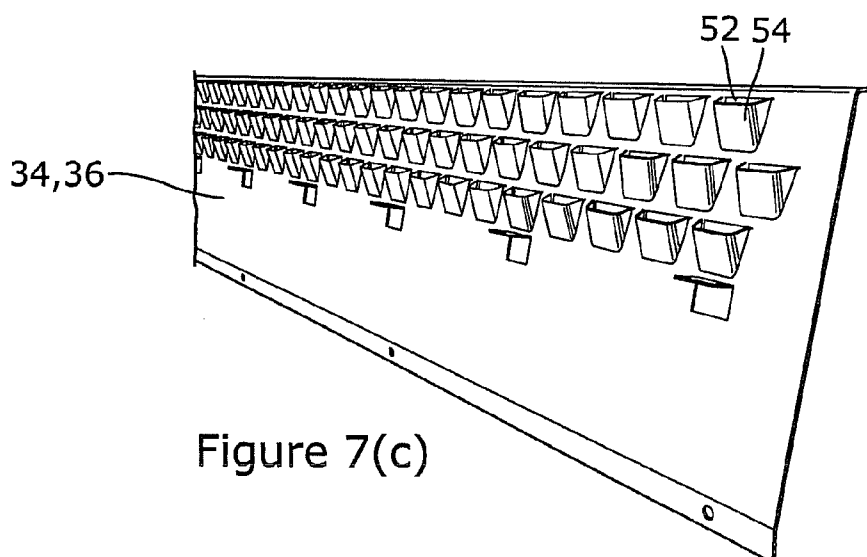


Figure 7(c)

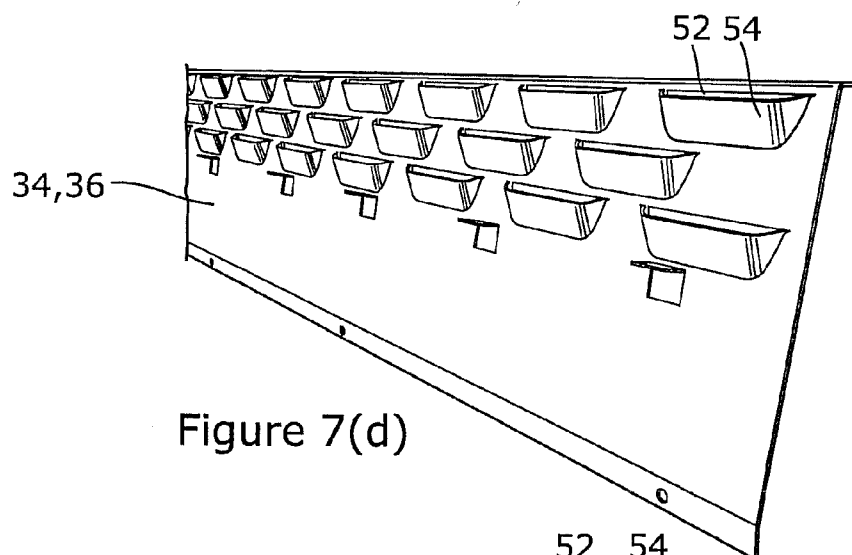


Figure 7(d)

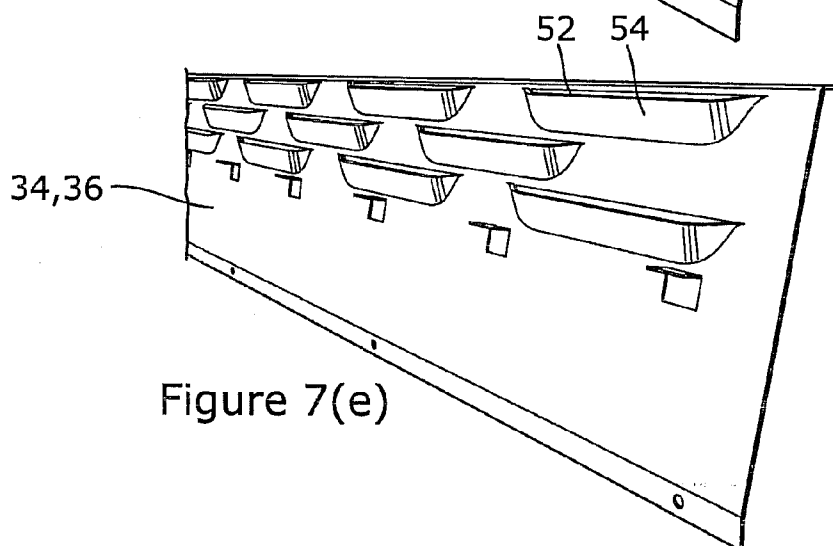


Figure 7(e)

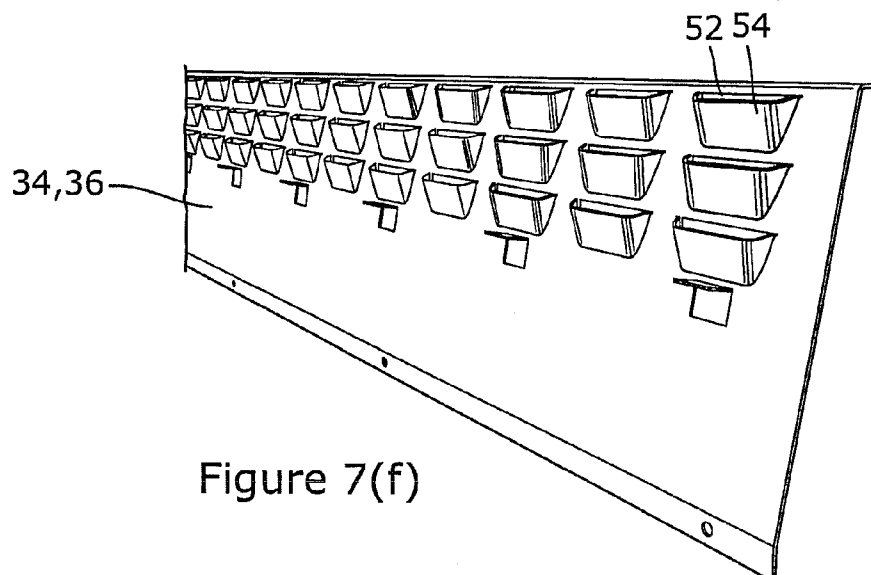


Figure 7(f)

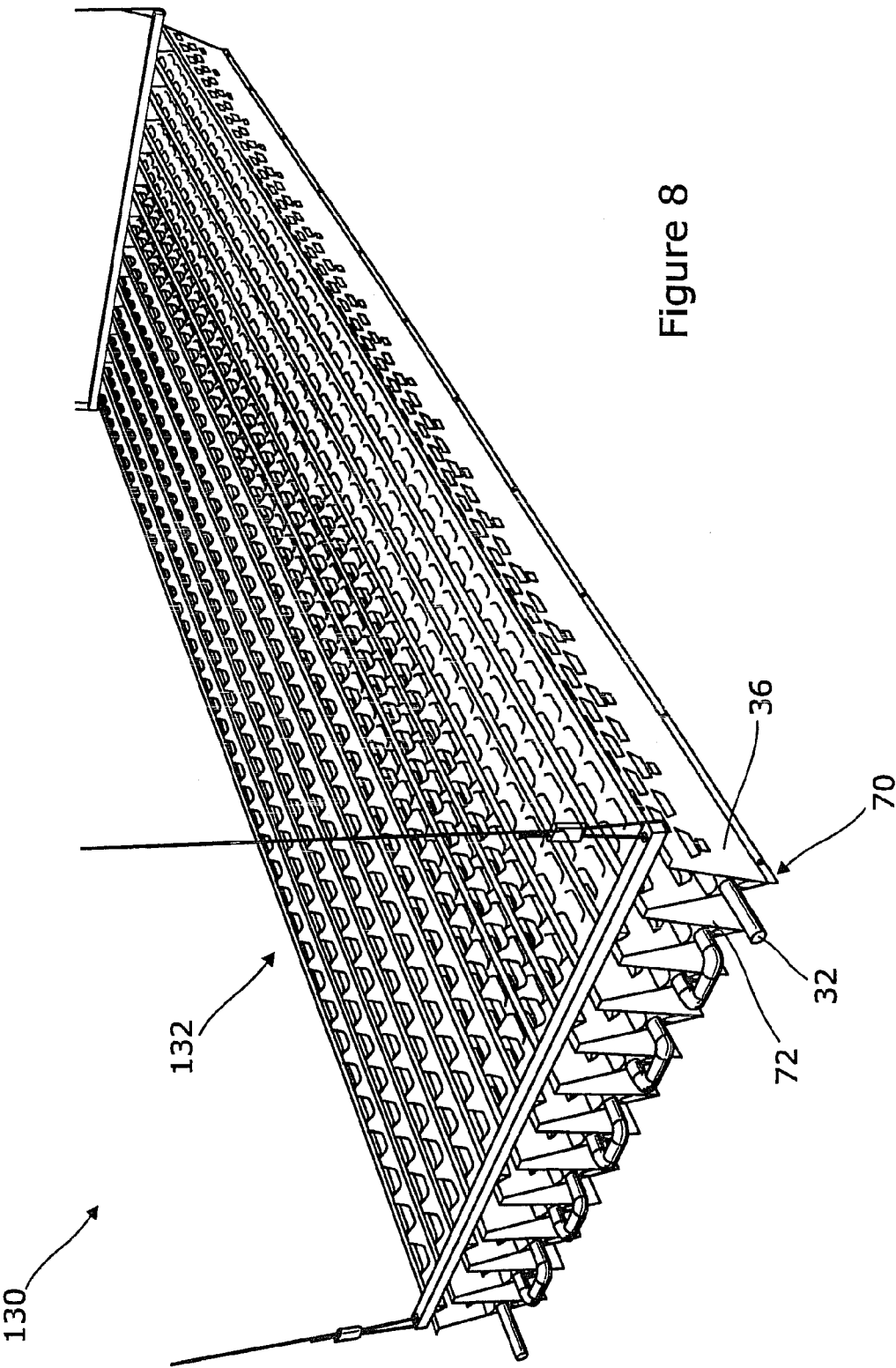


Figure 8

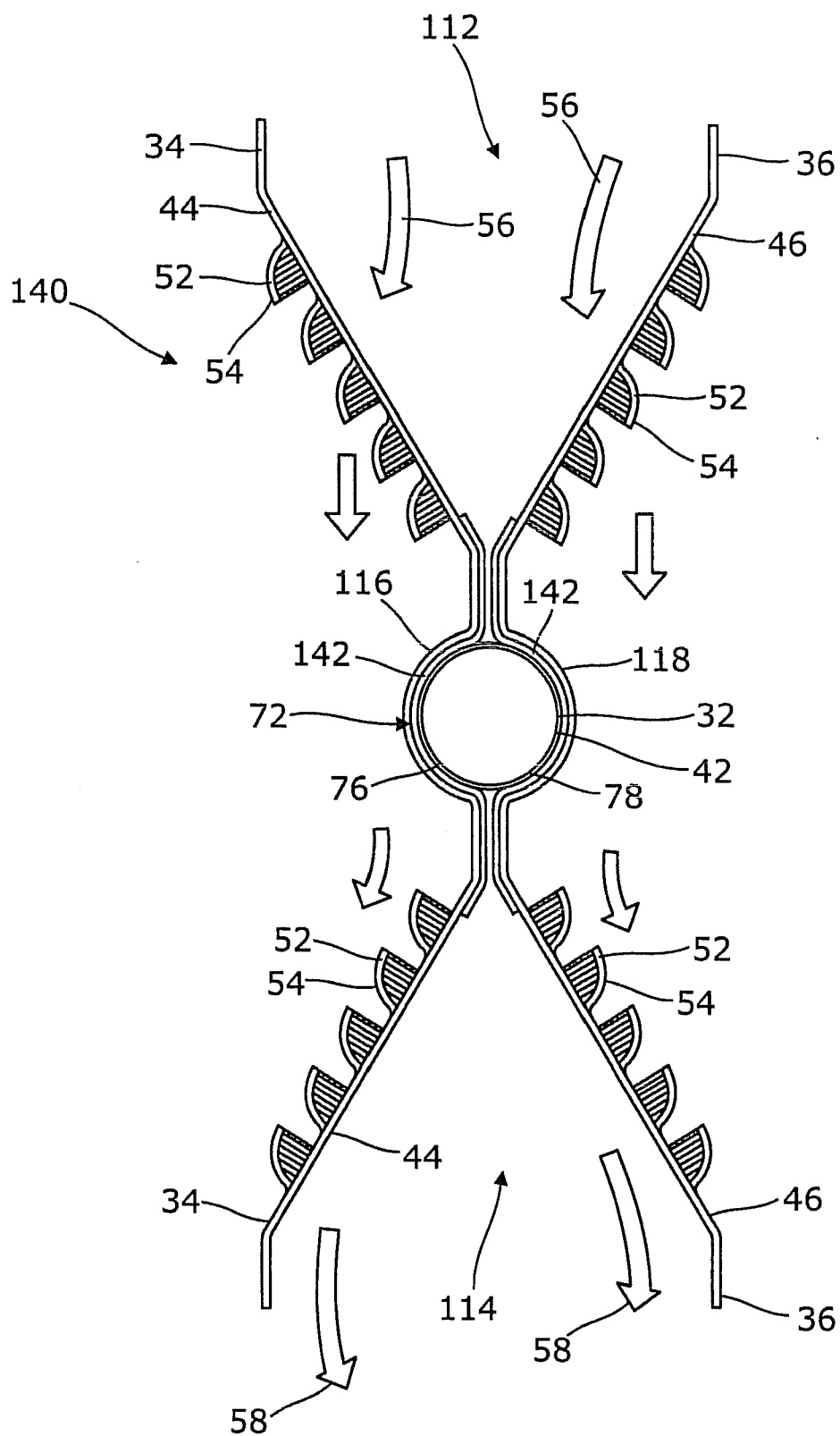


Figure 9

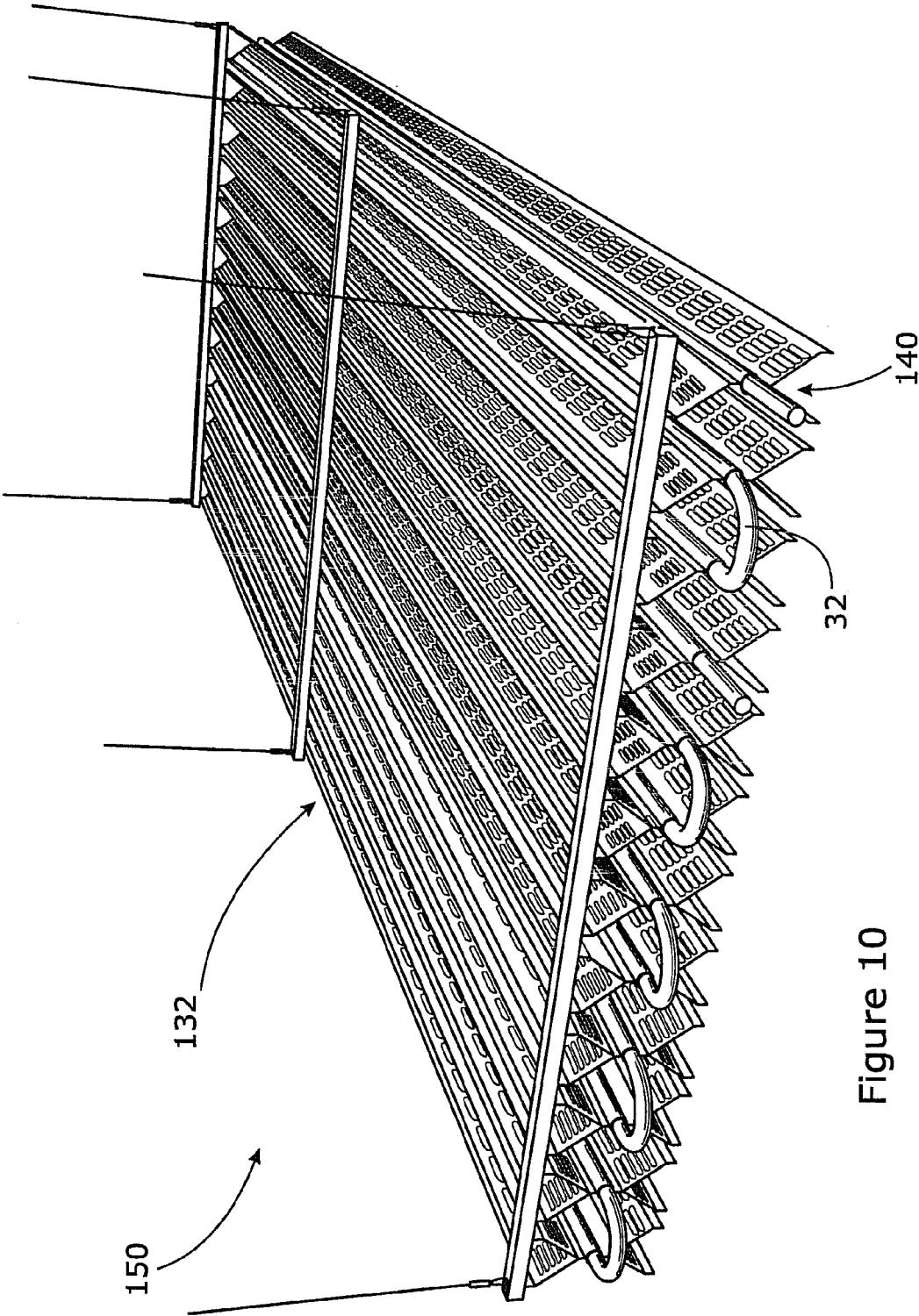


Figure 10

HEAT EXCHANGERS FOR AIR CONDITIONING SYSTEMS

[0001] This invention relates to a heat exchanger for use in an air conditioning system of a building, and a heat exchanger assembly including a plurality of such heat exchangers.

[0002] A conventional heat exchanger **10** typically includes a planar baffle **12** within which is located a fluid conduit **14** to convey heating or cooling fluid through the baffle **12**. Such heat exchangers **10** are able to provide both convective and radiant heat transfer.

[0003] Normally a plurality of such heat exchangers **10** are integrated into a heat exchanger assembly **16**, as shown in FIG. 1.

[0004] One drawback of the conventional heat exchanger **10** is that when incorporated into a heat exchanger assembly **16** the resulting packing efficiency is low, and so the conventional heat exchanger **10** offers poor efficiency.

[0005] There is, therefore, a need for an improved heat exchanger which provides improved efficiency in terms of overall packaging and performance.

[0006] According to a first aspect of the invention there is provided a heat exchanger, for use in an air conditioning system of a building, comprising an elongate fluid conduit having first and second elongate heat exchange fins extending laterally therefrom, opposed faces of the first and second fins defining an acute angle therebetween, the fluid conduit defining a discrete conduit body, the first fin defining a first fin body and the second fin defining a second fin body, the conduit body being thermally coupled to at least one of the first and second fin bodies by a discrete heat exchange member.

[0007] The inclusion of first and second fins which have opposed faces that define an acute angle between them means that for a given effective surface area the heat exchanger has a smaller maximum dimension than a conventional heat exchanger. As a result, for a given effective surface area, a heat exchanger assembly including the heat exchanger of the invention is smaller in at least one dimension than a conventional heat exchanger assembly having the same effective surface area.

[0008] Having the fluid conduit define a discrete conduit body, and the first and second fins define respective fin bodies provides the option of separating the conduit body from the fin bodies, e.g. if the conduit body requires repair or maintenance.

[0009] Thermally coupling of the conduit body to at least one fin body by a heat transfer member allows for an increased surface area of the fluid conduit to be utilised for heat transfer, thereby improving the cooling/heating performance of the heat exchanger.

[0010] Meanwhile the inclusion of a discrete such heat transfer member provides the option of forming the heat transfer member from a different material from that of the conduit body and/or the or each of the first and second fin bodies, e.g. a highly thermally conductive material, to further improve the performance of the heat exchanger.

[0011] Optionally the discrete heat exchange member extends at least partially around the conduit body. Such an arrangement increases the rate of heat transfer between the conduit body and the or each heat exchange fin.

[0012] The conduit body may be removably retained between the first and second fin bodies. Removably retaining the conduit body between the first and second fin bodies

provides the heat exchanger with a desired degree of structural integrity during normal use but facilitates ready repair and/or maintenance of one or more of the conduit body and the fin bodies.

[0013] In a preferred embodiment of the invention the first and second fin bodies are integrally formed with one another. Such an arrangement simplifies manufacture of the heat exchanger since it minimises the number of components that an assembly operative needs to handle, i.e. the operative needs only to handle a conduit body and integrally formed first and second fins.

[0014] In a preferred embodiment of the invention the heat exchanger includes a second pair of first and second elongate heat exchange fins extending laterally from the fluid conduit. The inclusion of an additional pair of heat exchange fins further increases the effective surface area of the heat exchanger.

[0015] Preferably the respective first heat exchange fins are integrally formed with one another to define a unitary first fin body and the respective second heat exchange fins are integrally formed with one another to define a unitary second fin body. Such an arrangement further assists in the efficient manufacture and assembly of the heat exchanger.

[0016] In another preferred embodiment of the invention the first and second fin bodies are selectively separable from one another. The ability to separate the first and second fin bodies from one another assists in assembling the heat exchanger of the invention and/or the selective removal of the fluid conduit for repair or maintenance.

[0017] Optionally the first and second fin bodies are secured to one another by at least one selectively removable fastener. The use of such a fastener ensures a desired degree of structural integrity while facilitating ready separation, as desired.

[0018] Preferably the heat transfer member is or includes an elongate member having a uniform cross-sectional profile. Such a heat transfer member may be readily manufactured, e.g. by extrusion, and may be slidably coupled with the elongate fluid conduit.

[0019] The heat transfer member may define a receiving formation to receive at least a portion of the fluid conduit. Having the heat transfer member define such a receiving formation helps to ensure that the heat transfer member abuts directly with a maximum external surface area of the fluid conduit so as to maximise the rate of heat transfer between the fluid conduit and the heat transfer member.

[0020] In a preferred embodiment of the invention the heat transfer member cooperates with the first and second fin bodies to removably retain the conduit body between the first and second fin bodies. Such an arrangement obviates the need for any other fastening or securing means between the fin bodies and the fluid body while allowing ready removal of the fluid conduit as may be desired from time to time.

[0021] Optionally the heat transfer member includes first and second heat transfer member portions. Such an arrangement assists in the assembly of the heat exchanger while providing a desired increase in the rate of thermal transfer between the fluid conduit and the or each heat exchange fin.

[0022] Each heat transfer member portion may define a part of the receiving formation and may be separable from the other heat transfer member portion. The inclusion of separable heat transfer member portions assists, for example, in the removal of the fluid conduit for repair and/or maintenance.

[0023] Preferably the first and second heat transfer member portions lie spaced from one another. Spacing the first and second heat transfer member portions from one another helps to ensure a uniform distribution of heat transfer capability between the first and second heat exchange fins.

[0024] In a still further preferred embodiment of the invention at least one of the first and second fin bodies includes a retention element to maintain the heat transfer member in cooperation with the first and second fin bodies.

[0025] The inclusion of a retention element simplifies assembly of the heat exchangers and reduces the need for specialist tools in the assembly process.

[0026] Preferably at least one heat exchange fin includes at least one fluid deflector to direct fluid from one face of the heat exchange fin to another, opposite face of the heat exchange fin, the or each fluid deflector extending lengthwise along the heat exchange fin. The inclusion of one or more fluid deflectors improves the convective heating or cooling effect of the heat exchanger by allowing fluid, e.g. air, to pass through the corresponding fin.

[0027] In another preferred embodiment of the invention each of the first and second fins in a respective pair of fins includes at least one fluid deflector, the fluid deflectors in each pair of heat exchange fins cooperating to direct fluid between a first region lying between opposed faces of the first and second fins and a second region lying outside the opposed faces of the first and second fins. Such an arrangement allows fluid, e.g. air, to move between warm and cool regions adjacent to the heat exchanger, thereby further improving the convective heat transfer effect of the invention.

[0028] In a still further preferred embodiment of invention the or each fluid deflector includes a deflector element inclined at an angle relative to the remainder of the fin body of the corresponding fin to entrain fluid against a face of the fin. Entraining fluid against a face of a fin increases the heat transfer coefficient between the fluid and the fin, and so further improves the efficiency of the heat exchanger.

[0029] According to a second aspect of the invention there is provided a heat exchanger assembly including a plurality of heat exchangers as mentioned hereinabove arranged side by side one another in a heat exchange matrix, the fluid conduit of one heat exchanger being fluidly connected with the fluid conduit of at least one adjacent heat exchanger. Such a heat exchanger assembly offers a large effective surface area for a given maximum external dimension, e.g. maximum width or maximum depth, and is highly efficient.

[0030] There now follows a brief description of preferred embodiments of the invention, by way of non-limiting examples, with reference to the accompanying drawings in which:

[0031] FIG. 1 shows a conventional heat exchanger assembly;

[0032] FIG. 2 shows an end elevational view of a heat exchanger;

[0033] FIG. 3(a) shows an end elevational view of a heat exchanger according to a first embodiment of the invention;

[0034] FIG. 3(b) shows a perspective view of the heat exchanger shown in FIG. 3(a);

[0035] FIG. 3(c) shows a perspective view of a modified version of the heat exchanger shown in FIG. 3(a);

[0036] FIG. 4 shows an end elevational view of a heat exchanger according to a second embodiment of the invention;

[0037] FIG. 5 shows an end elevational view of a heat exchanger according to a third embodiment of the invention;

[0038] FIG. 6 shows an end elevational view of another heat exchanger;

[0039] FIGS. 7(a) to 7(f) show various embodiments of heat exchange fin;

[0040] FIG. 8 shows a perspective view of a heat exchanger assembly according to another embodiment of the invention;

[0041] FIG. 9 shows an end elevational view of a heat exchanger according to a fourth embodiment of the invention; and

[0042] FIG. 10 shows a perspective view of a heat exchanger assembly including a plurality of the heat exchangers shown in FIG. 9.

[0043] A heat exchanger is designated generally by the reference numeral 30, as shown in FIG. 2.

[0044] The heat exchanger 30 includes an elongate fluid conduit 32 which has first and second elongate heat exchange fins 34, 36 extending laterally therefrom.

[0045] In the arrangement shown the fluid conduit 32 is a tube, and in particular a copper tube. Copper tubing is readily available together with a variety of standard couplings to permit the fluid connection of one length of tube to another in an easy and reliable manner.

[0046] A single length of such tubing may also be formed into a desired serpentine coil before respective first and second heat exchange fins 34, 36 are fastened thereto. This avoids the need for couplings to interconnect respective lengths of the tubing, and the resulting omission of any joints in the fluid conduit minimises the risk of a leak occurring.

[0047] A first face 38 of the first fin 34 lies opposite a first face 40 of the second fin 36, and the first faces 38, 40 between them define an acute angle. Preferably the angle between the opposed first faces 38, 40 is between 10° and 40°, and more preferably between 20° and 30°.

[0048] In the arrangement shown the fins 34, 36 are made of aluminium. The fins may also be made of another thermally conductive material.

[0049] Optionally the fins 34, 36 are coated to increase radiant heat exchange. The coating could be a paint, a cathodic electro coating of an epoxy polymer/paint, or an anodised layer.

[0050] The fluid conduit 32 defines a discrete conduit body 42, i.e. a conduit body 42 that is distinct from each of the first and second fins 34, 36. In the arrangement shown the conduit body 42 is formed from separate material to the first and second fins 34, 36.

[0051] In turn the first fin 34 defines a first fin body 44 and the second fin 36 defines a second fin body 46. The first and second fin bodies 44, 46 are selectively separable from one another.

[0052] The conduit body 42 is coupled to each of the first and second fin bodies 44, 46 and, in particular, the conduit body 42 is removably retained between the first and second fin bodies 44, 46.

[0053] The first and second fin bodies 44, 46 clamp the conduit body 42 between them and the fin bodies 44, 46 are themselves secured to one another by two selectively removable fasteners 48. In the arrangement shown the removable fasteners 48 are clips 50 which extend at least partially around the conduit body 42.

[0054] Each of the first and second fins 34, 36 includes a plurality of fluid deflectors 52, each of which extends length-

wise along the corresponding fin 34, 36. In the arrangement shown each fin 34, 36 includes three discrete rows of fluid deflectors 52.

[0055] Other arrangements may, however, include fewer or greater than three rows of fluid deflectors 52. Moreover, the relative arrangement of fluid deflectors 52 in adjacent rows may vary, together with the relative proportions of each deflector 52, as shown in FIGS. 7(a) to 7(f). The relative arrangement and proportions of the fluid deflectors 52 may be varied according to the degree of convective heat transfer required.

[0056] Each fluid deflector 52 includes a deflector element 54 which is inclined at an angle relative to the remainder of the corresponding fin body 44, 46.

[0057] In use, to cool air in a room of a building, the heat exchanger 30 is suspended from a ceiling (not shown) with the first and second fins 34, 36 extending towards the ceiling, i.e. in an upwards direction.

[0058] A cooling fluid, e.g. cold water, is passed along the fluid conduit 32. The fluid conduit 32 draws heat from each of the fins 34, 36 and so lowers the temperature of each fin 34, 36.

[0059] Each fin 34, 36 is therefore able to cool the air in the room via a degree of radiant heat transfer.

[0060] At the same time the heat exchanger 30 carries out convective heat transfer by inducing warm air 56 from above and discharging cooled air 58 from below. In particular the fluid deflectors 52 on respective fins 34, 36 cooperate to direct the warm air 56 from a first region 60 between the opposed faces 38, 40 of the fins 34, 36 to a second region 62 lying outside the opposed faces 38, 40.

[0061] The respective deflector elements 54 of each fluid deflector 52 entrain the warm air 56 against a second face 64, 66 of each fin 34, 36 to maximise the cooling effect of the corresponding fin 34, 36.

[0062] If desired the clips 50 may be removed and the first and second fin bodies 44, 46 separated from one another to permit removal of the fluid conduit 32 for repair and/or maintenance.

[0063] A heat exchanger according to a first embodiment of the invention is designated generally by the reference numeral 70, as shown in FIGS. 3(a) and 3(b).

[0064] The first heat exchanger 70 shares a number of features with the heat exchanger 30 described hereinabove and these are designated using the same reference numerals.

[0065] In this regard the first heat exchanger 70 includes an elongate fluid conduit 32 and first and second fins 34, 36. As with the heat exchanger 30 the fluid conduit 32 defines a discrete conduit body 42, and each of the fins 34, 36 defines a corresponding fin body 44, 46.

[0066] In contrast to the heat exchanger 30, however, the conduit body 42 is coupled to each of the first and second fin bodies 44, 46 by a heat transfer member 72.

[0067] In the embodiment shown the heat transfer member 72 is an elongate member which has a uniform cross-sectional profile. As a result the heat transfer member 72 may be readily extruded, e.g. from aluminium, although extrusion from other thermally conductive materials is also possible.

[0068] The heat transfer member 72 defines a receiving formation 74 which, in the embodiment shown, receives and completely encloses the fluid conduit 32. The heat transfer member 72 is further formed of first and second heat transfer member portions 76, 78 each of which defines a portion of the

receiving formation 74. The first and second heat transfer member portions 76, 78 are separable from one another.

[0069] In the embodiment shown the first and second heat transfer member portions 76, 78 are identical mirror images of one another and, as such, define the same amount of the receiving formation 74, i.e. one half. Such an arrangement simplifies the production of the heat transfer member 72 since the first and second heat transfer member portions 76, 78 share the same cross-sectional profile and so only a single extrusion is required. In other embodiments (not shown) the cross-sectional profile of the first and second heat transfer member portions 76, 78 may differ from one another.

[0070] The heat transfer member 72 cooperates with the first and second fin bodies 44, 46 to removably retain the conduit body 42 between the fin bodies 44, 46. In particular the first and second heat transfer member portions 76, 78 lie either side of the conduit body 42 and clamp it between the fin bodies 44, 46.

[0071] Each fin body 44, 46 includes a retention element 80 in the form of a tab 82 which maintains the corresponding heat transfer member portion 76, 78 in cooperation with the associated fin body 44, 46.

[0072] Each fin body 44, 46 also includes a mutually co-operable connection portion 84 which allows mating with the other fin body 44, 46. A removable fastener 48, e.g. in the form of a nut and bolt (not shown), may be used to removably secure the fin bodies 44, 46 to one another.

[0073] In use the first heat exchanger 70 functions in a similar manner to the heat exchanger 30.

[0074] However, the inclusion of a heat transfer member 72 in the second heat exchanger 70 increases the size of heat transfer cross-section between the fluid conduit 32 and the fins 34, 36 to improve further the performance of the second heat exchanger 70.

[0075] FIG. 3(b) illustrates the functioning of the fluid deflectors 52 and associated deflector elements 54 to pass warm air 56 through the fins 34, 36, entrain it against the second face 58, 60 of each fin 34, 36 before discharging cool air 58 from below.

[0076] A modified version of the first heat exchanger 70 is shown in FIG. 3(c).

[0077] The modified second heat exchanger 70a includes a fluid conduit 32 which has a fluid conduit insert 86 lying within the conduit 32 to induce turbulence in the fluid flowing within the conduit 32. This can be advantageous if the fluid has a low flow rate since it helps to prevent the creation of a boundary layer on the inner surface of the conduit 32 which would otherwise inhibit the transfer of heat between the fluid and the conduit 32.

[0078] In the embodiment shown the fluid conduit insert 76 defines a helical spiral 78. In other embodiments of the invention (not shown) the fluid conduit insert 76 could be an elongate wire coil having a generally helical configuration or other swirl-inducing member.

[0079] Moreover, the fluid conduit insert 76 may be located in the fluid conduit 32 of any of the other heat exchangers described herein.

[0080] A heat exchanger according to a second embodiment of the invention is designated generally by reference numeral 90, as shown in FIG. 4.

[0081] The second heat exchanger is very similar to the first heat exchanger 70, and like features share the same reference numerals.

[0082] In the second heat exchanger **90** the fluid conduit **32** has a smaller diameter relative to the size of the fins **34**, **36**, and the heat transfer member has a different overall cross-sectional shape.

[0083] The second heat exchanger functions in exactly the same manner as the first heat exchanger **70**.

[0084] A heat exchanger according to a third embodiment of the invention is designated generally by the reference numeral **100**.

[0085] The third heat exchanger **100** is similar to each of the first and second heat exchangers **70**, **90**.

[0086] However the third heat exchanger **100** differs in that the first and second fin bodies **44**, **46** are integrally formed with one another to define a unitary fin body **102**.

[0087] In addition the heat transfer member **72** defines a receiving formation **74** which extends only part way around the fluid conduit **32**. The remaining external surface of the fluid conduit abuts directly against the unitary fin body **102**.

[0088] Respective retention elements **80**, i.e. tabs **82**, retain the heat transfer member **72** in cooperation with the unitary fin body **102** to removably retain the fluid conduit between the heat transfer member **72** and the unitary fin body **102**.

[0089] In use, e.g. to cool a room in a building, a cooling fluid passing through the fluid conduit **32** draws heat from the unitary fin body **102** directly and via the heat transfer member **72**.

[0090] Each of the heat exchangers **30**; **70**; **90**; **100** described hereinabove can be used in a different orientation to that shown in the figures. In particular, each heat exchanger **30**; **70**; **90**; **100** may be suspended from a ceiling (not shown) with the first and second fins **34**, **36** extending away from the ceiling, i.e. in a downwards direction.

[0091] Such arrangements increase the degree of convective heat transfer while reducing the degree of radiant heat transfer, as compared to the aforementioned "upward" configurations. Such varying of the relative degree of convective and radiant heat transfer can be desirable in certain installations.

[0092] FIG. 6 shows a further heat exchanger **110**.

[0093] The further heat exchanger **110** is similar to the first heat exchanger **30** but includes a first pair **112** of first and second heat exchange fins **34**, **36** and a second pair **114** of first and second fins **34**, **36** arranged opposite the first pair **112**.

[0094] Respective first fins **34** in each pair **112**, **114** are integrally formed with one another to define a first unitary fin body **116**, while respective second fins **36** in each pair **112**, **114** are integrally formed with one another to define a second unitary fin body **118**.

[0095] The first and second unitary fin bodies **116**, **118** clamp the conduit body **42** between them and the unitary fin bodies **116**, **118** are themselves secured to one another by two selectively removable fasteners **48** in the form of clips **50** which extend at least partially around the conduit body **42**.

[0096] The further heat exchanger **110** functions in a similar manner to the first heat exchanger **30** but has an increased effective surface area, as provided by the second pair **114** of first and second fins **34**, **36**.

[0097] A heat exchanger assembly according to an embodiment of the invention is designated generally by the reference numeral **130**, and is shown in FIG. 8.

[0098] The heat exchanger assembly **130** includes a plurality of first heat exchangers **70** arranged side by side one another in a heat exchange matrix **132**. The first heat exchang-

ers **70** may be removably secured to one another by one or more selectively removable fasteners (not shown), e.g. nuts and bolts.

[0099] The fluid conduit **32** of one second heat exchanger **70** is fluidly connected with the fluid conduit **32** of the adjacent second heat exchanger **70**. Standard fluid connectors may be utilised for this purpose thereby simplifying construction of the heat exchanger assembly **130**.

[0100] In use, the heat exchanger assembly **130** is suspended from a ceiling (not shown) with the first and second fins **34**, **36** of each first heat exchanger **70** extending towards the ceiling, i.e. in an upwards direction.

[0101] Warm air is able to pass through and over the first and second fins **34**, **36** of each first heat exchanger **70** to be cooled, while the fins **34**, **36** themselves are able to provide a degree of radiant cooling.

[0102] The effective surface area of the heat exchanger assembly **130**, i.e. the surface area which is able to affect heat transfer, is double that of a conventional heat exchanger assembly **16** having the same overall width and depth.

[0103] FIG. 9 shows a heat exchanger **140** according to a fourth embodiment of the invention.

[0104] The fourth heat exchanger **140** is similar to the further heat exchanger **110** in that it includes a first pair **112** of first and second heat exchange fins **34**, **36** and a second pair **114** of first and second fins **34**, **36** arranged opposite the first pair **112**.

[0105] The first fins **34** in each pair **112**, **114** are integrally formed with one another to define a first unitary fin body **116**, while respective second fins **36** in each pair **112**, **114** are integrally formed with one another to define a second unitary fin body **118**.

[0106] The first and second unitary fin bodies **116**, **118** are selectively separable from one another.

[0107] The fourth heat exchanger **140** differs from the further heat exchanger **110** in that the first and second unitary fin bodies **116**, **118** have a heat transfer member **72** lying between them and the fluid conduit **32**. In particular, the first unitary fin body **116** has a first heat transfer member portion **76** lying between it and the fluid conduit **32** and the second unitary fin body **118** has a second heat transfer member portion **78** lying between it and the fluid conduit **32**.

[0108] Each of the first and second heat transfer member portions **76**, **78** is a planar elongate member which has a uniform cross-sectional profile. The respective cross-sectional profiles are identical to one another and each defines a receiving formation to receive the corresponding heat transfer member portion **76**, **78** and a portion of the fluid conduit **32**. More particularly, each heat transfer member portion **76**, **78** includes an elongate recess **142** to receive a portion of the fluid conduit **32**.

[0109] Each of the first and second heat transfer member portions **76**, **78** extends beyond the fluid conduit **32** in abutting engagement with the corresponding unitary fin body **116**, **118** to increase the effective area available for heat transfer between the said heat transfer member portion **76**, **78** and the corresponding fin body **116**, **118**.

[0110] The first and second heat transfer member portions **76**, **78** are spaced from one another to help ensure a uniform distribution of transferred heat between the first and second unitary fin bodies **116**, **118**.

[0111] Each of the first and second heat transfer member portions **76**, **78** cooperates with the corresponding unitary fin body **116**, **118** to removably retain the conduit body **32** ther-

ebetween. In particular, each fin body **116**, **118** includes a receiving portion which has a complimentary cross-sectional shape to the corresponding heat transfer member portion **76**, **78**.

[0112] A secondary fastener (not shown) such as a clip or a nut and bolt is used to selectively secure the first and second unitary fin bodies **116**, **118** to one another to affect the aforementioned retention of the conduit body **32**.

[0113] Each of the first and second fins **34**, **36** includes a plurality of fluid deflectors **52**, each of which extends lengthwise along the corresponding fin **34**, **36**. In the embodiment shown each fin **34**, **36** includes five discrete rows of fluid deflectors **52**.

[0114] Each fluid deflector **52** includes a deflector element **54** which extends at an angle relative to the remainder of the corresponding fin body **44**, **46**. In the embodiment shown each deflector element **54** has a curved shape although this may vary in other embodiments of the invention.

[0115] More particularly, the deflector elements **54** in the first pair **112** of first and second heat exchange fins **34**, **36** extend downwards in use, while the deflector elements **54** in the second pair **114** of first and second heat exchange fins **34**, **36** extend upwards in use.

[0116] In use the fourth heat exchanger **140** is suspended from a ceiling (not shown) with the first pair **112** of first and second fins **34**, **36** extending towards the ceiling, i.e. in an upwards direction.

[0117] A cooling fluid, e.g. cold water, is passed along the fluid conduit **32**. The fluid conduit **32** draws heat from each of the fins **34**, **36** and so lowers the temperature of each fin **34**, **36**.

[0118] Each fin **34**, **36** is therefore able to cool the air in the room via a degree of radiant heat transfer.

[0119] At the same time the heat exchanger **140** carries out convective heat transfer by inducing warm air **56** from above and discharging cooled air **58** from below. In particular the fluid deflectors **52** on the first pair **112** of heat exchange fins **34**, **36** allow warm air entrained along and cooled by an upper inner surface of each fin **34**, **36** to pass through the respective fin **34**, **36**. The upwardly facing fluid deflectors **52** in the second pair **114** of heat exchange fins **34**, **36** capture the cooled air from the first pair **112** of heat exchange fins **34**, **36** and further cool it by entraining it against a lower inner surface of each fin **34**, **36** in the second pair **114**.

[0120] A heat exchanger assembly according to a second embodiment of the invention is designated generally by the reference numeral **150**, and is shown in FIG. **10**.

[0121] The second heat exchanger assembly **150** includes a plurality of fourth heat exchangers **140** arranged side by side one another in a heat exchange matrix **132**. The fourth heat exchangers **140** may be removably secured to one another by one or more selectively removable fasteners (not shown), e.g. nuts and bolts.

[0122] The fluid conduit **32** of one fourth heat exchanger **140** is integrally formed with the fluid conduit **32** of the adjacent fourth heat exchanger **140**. This may be achieved by forming a single fluid conduit **32** into a required serpentine path before respective first and second fluid bodies **116**, **118** are coupled therewith. Standard fluid connectors could also be utilised to interconnect respective lengths of fluid conduit **32**.

[0123] In use, the second heat exchanger assembly **150** is suspended from a ceiling (not shown) with the first pair **112** of

first and second fins **34**, **36** of each fourth heat exchanger **140** extending towards the ceiling, i.e. in an upwards direction.

[0124] Warm air is able to pass through and over the first and second pairs **112**, **114** of first and second fins **34**, **36** in each fourth heat exchanger **140** to be cooled, while the fins **34**, **36** themselves are able to provide a degree of radiant cooling.

[0125] The effective surface area of the heat exchanger assembly **130**, i.e. the surface area which is able to affect heat transfer, is double that of a conventional heat exchanger assembly **16** having the same overall width and depth. Meanwhile, having each fluid conduit **32** lie towards the middle of each fin body **116**, **118** helps to ensure rapid heat transfer between all regions of each fin body **116**, **118**.

1. A heat exchanger, for use in an air conditioning system of a building, comprising:

an elongate fluid conduit having first and second elongate heat exchange fins extending laterally therefrom, opposed faces of the first and second fins defining an acute angle therebetween, the fluid conduit defining a discrete conduit body, the first fin defining a first fin body, and the second fin defining a second fin body, the conduit body being thermally coupled to at least one of the first and second fin bodies by a discrete heat exchange member.

2. A heat exchanger according to claim 1 wherein the discrete heat exchange member extends at least partially around the conduit body.

3. A heat exchanger according to claim 1 wherein the conduit body is removably retained between the first and second fin bodies.

4. A heat exchanger according to claim 1 wherein the first and second fin bodies are integrally formed with one another.

5. A heat exchanger according to claim 1 further comprising a second pair of first and second elongate heat exchange fins extending laterally from the fluid conduit.

6. A heat exchanger according to claim 5 wherein the respective first heat exchange fins are integrally formed with one another to define a unitary first fin body and the respective second heat exchange fins are integrally formed with one another to define a unitary second fin body.

7. A heat exchanger according to claim 1 wherein the first and second fin bodies are selectively separable from one another.

8. A heat exchanger according to claim 7 wherein the first and second fin bodies are secured to one another by at least one selectively removable fastener.

9. A heat exchanger according to claim 1 further comprising a heat transfer member including an elongate member having a uniform cross-sectional profile.

10. A heat exchanger according to claim 9 wherein the heat transfer member defines a receiving formation to receive at least a portion of the fluid conduit.

11. A heat exchanger according to claim 9 wherein the heat transfer member cooperates with the first and second fin bodies to removably retain the conduit body between the first and second fin bodies.

12. A heat exchanger according to claim 9 wherein the heat transfer member includes first and second heat transfer member portions.

13. A heat exchanger according to claim 12 wherein each heat transfer member portion defines a part of the receiving formation and is separable from the other heat transfer member portion.

14. A heat exchanger according to claim **11** wherein the first and second heat transfer member portions lie spaced from one another.

15. A heat exchanger assembly including a plurality of heat exchangers according to claim **1** arranged side by side one another in a heat exchange matrix, the fluid conduit of one heat exchanger being fluidly connected with the fluid conduit of at least one adjacent heat exchanger.

16. A heat exchanger according to claim **2** wherein the conduit body is removably retained between the first and second fin bodies.

17. A heat exchanger according to claim **12** wherein the first and second heat transfer member portions lie spaced from one another.

* * * * *