

高效微分冷谷管空调器

技术领域

本发明涉及一种空气调节设备，特别是一种以空气能量为制冷热循环动力的低压差热泵空调器。

技术背景

微分冷谷管(以下简称J管)是一种单位面积热流量大,并可使终点传热温差无限趋近于零的高效换热装置,中国专利申请号 94 1 121107.0 提出的“空气能8字循环空调机”是由空气能热泵J管、超冷凝J管、低压差能量转换热泵M构成的全新风空调机,具有较高的热力循环效率,且其空气调节中,冷(热)量的输出均需采用100%的室外新风才能获得最佳热力循环效率。但上述技术方案主要是针对8字循环理论性的探讨,在J管的热交换率和热力循环效率等方面,仍需进一步提高,在其冷重比、体积比、制造工艺产业化和降低产品成本等方面尚存在不少问题,因此在解决空调器的三大难题(高能耗、低空气品质、CFCs氟氯烃的限制使用)中,很难从根本上取得成效。

发明内容

为了解决上述问题,本发明提出了一种高效J管空调器,该空调器中设弧形 J_1 换热装置,该装置由多层弧形 J_1 片和多层波形梯波相间叠合而成,被夹合紧固于弧形肋状夹板和拉杆组成的框架内,夹板和梯波接触处有缓冲软垫,梯波形成的风道F'流向为S形并在其壁面上开有几条长条形的绝热孔,每个 J_1 片在其扁管内插入内波浪板,扁管外包贴薄铝片,工质的出入口处分别连接着进液支管和吸汽支管;高效J管空调器中还设有弧形 J_2 换热装置,该装置由多层弧形 J_2 片和多层波形膜波相间叠合而成,被夹合紧固于弧形肋状夹板和拉杆组成的框架内,夹板和膜波接触处有缓冲软垫,膜波形成的风道F流向为S形在其壁面上开有几条长条形绝热孔、膜波的支撑架是薄铝或其它金属或细金属网片制成的梯波在其两面贴合着梯膜由此构成膜波,每个 J_2 片在其扁管内插入内波浪板构成一个完整的 $t_1 \sim t_2$ 不等温工质流道,工质的出入口处分别连接着进汽支管和出液支管,扁管外包铝片或耐腐金属片,可用耐腐金属直接制成扁管,其外再包贴膜式蒸发面、平行排列的扁管和膜式蒸发面之间嵌入载水沙条;在 J_1 换热装置和 J_2 换热装置之间设一低压泵M,低压泵M在较低冷凝压力 P_2 的 J_2 和较高蒸发压力 P_1 的 J_1 之间工作,且

可液、气共输，当循环工质是单一或混合（共沸或非共沸）制冷剂时可获得最大制冷量，当循环工质是吸收剂和制冷剂组成的工质对时可获得最高循环效率的刀字循环和全新风8字循环。

本发明旨在创造一种具有较高实用价值和较高热力循环效率的系列J和空调，以求从根本上解决现行空调产业面临的高能耗、低空气品质、CFCs氟氯烃被禁止使用的三大难题。

本发明首先着力于热交换效率和热力循环效率的提高及空气能量的充分利用。高效J管是指较小体积的热交换器就能完成大的换热量和较低的传热温差。由于J管的高效特性使得本发明在冷重比、体积比（单位制冷量空调所占有的体积）、制造成本等关键的技术指标优于现行空调器。将空气能量的充分利用和高效J管的不等温、低传热温差特性有机的融合为一体的高效J管空调，在刀字循环时COP（制冷量/低压泵输出净功）值可以运行到25以上，在全新风8字循环时COP值可以运行到30以上。

附图简要说明

图1 是本发明高效J管空调器循环原理示意图。

图2 是J₂管的主视图。

图3 是图2 的俯视图。

图4 是图2 的放大左剖视图。

图5 是图2 中细圆管J₂片剖视图。

图6 是图2 中标号5 的局部放大图。

图7 是弧形J₂管的阶梯剖视图。

图8 是J₁管的主视图。

图9 是图8 的俯视图。

图10是图8 的放大左剖视图。

图11是J₁J₂刀字分机结构示意图。

图12是J₁J₂刀字窗机结构示意图。

图13是J₁J₂刀字窗机结构示意图。

图14是J₁J₂8字窗机结构示意图。

图15是J₂J₂刀字热泵式窗机结构示意图。

图16是J₂J₂8字热泵式窗机结构示意图。

本发明的最佳实施方式

图1 是本发明循环原理示意图。

J_1 是 J_1 管、 J_2 是 J_2 管、 M 是低压泵、 m 是毛细管。

由于 J 管热交换效率较高， J_1 和 J_2 采用(2~5)个温度区分割即能实现0.1~0.5℃传热温差。

J_1 管的工作压力为 P_1 ， J_2 管的工作压力为 P_2 。

室外空气 a_3 经 J_1 从 $t_n \sim t_1$ 冷却至 a_2 态输入室内， $a_2 \approx t_1$ ， $a_3 \approx t_n$ 。

室内空气 a_1 经 J_2 从 $t'_1 \sim t'_n$ 吸热，吸湿后以 a_4 态排向室外， t'_1 趋近于 a_1 的湿球温度。

由吸收剂和相应制冷剂组成的液态稀溶液 x_2 经 J_2 管冷却至 t'_1 温度后经毛细管 m 降压至 P_1 在 J_1 管内从 $t_1 \sim t_n$ 逐步被空气加热为温度趋近于 a_3 干球温度的过热制冷剂蒸气和吸收剂浓溶液的混合物 x_3 ， x_3 经低压泵 M 从 P_1 增压至 P_2 的 x_1 态进入 J_2 从 $t'_n \sim t'_1$ 逐步冷却至 x_2 的稀溶液。被冷却至 $t'_n \sim t'_1$ 的浓吸收剂溶液其表面分压较低，具有强烈吸收汽态制冷剂的能力，因此 J_2 管的平衡冷凝压力 P_2 较低。

高效 J 管空调的窗机和分体机的室外机设有底盘，底盘内存有一定液位的水溶液或其它载冷剂水溶液。 J_1 的凝结水经滴水管流向底盘由水循环系统定时、定量喷润 J_2 的通风流道 F ， F 具有载水性和吸水性，在润湿状态时可形成巨大的表面蒸发水膜，其内部的含水层又有极好的导热性；因此 J_2 是呈连续的全湿状态散热的，所以 t'_1 能无限趋近 a_1 的湿球温度，且 $t'_1 \sim t'_n$ 温升较小，上述循环为8字循环。

当通过 J_1 的被冷却空气是室内空气 a_1 、通过 J_2 的冷却空气是室外空气 a_3 时， x_3 只能加热到 a_1 的干球温度($a_1 < a_3$)、 J_2 管的最低温度 t'_1 也只能冷却到 a_3 的湿球温度， a_3 的湿球温度高于 a_1 的湿球温度。由于通过 J_1 、 J_2 管的空气状态的变化，因此8字循环就演化为刀字循环。

与现行空调相比在8字循环、刀字循环中 J_1 管相当于蒸发器、发生器， J_2 管相当于冷凝器、吸收器。区别在于 J_1 的蒸发压力 P_1 高于现行空调、而冷凝温度和压力 P_2 却远低于现行空调；因此低压泵 M 与同流量的压缩机相比，所需净功不到1/3，而制冷量则可增大1倍以上。

参见附图2、3、4、5、6，图2是 J_2 管的主视图、图3是 J_2 管俯视图、图4是 J_2 管的放大左剖视图、图5是细圆管 J_2 片剖视图、图6是标号5的局部放大图。

J_2 片1、膜式梯形波浪板(膜波)2、夹板3、拉杆4、弯道6、垫块7、进汽支管8、并联管9、进汽管10、出液支管11、并联管12、供液管13、扁管14、内波浪板15、膜式蒸发面16、绝热孔17、软垫18、绝热条19、载水纱条20、梯形波浪板(梯波)21、梯形膜式蒸发面(梯膜)22。

J_2 管的换热系统由多层 J_2 片1 和多层膜波2 相间叠合而成,被肋状夹板3 和拉杆4 紧固夹合在其组成的框架内。冷却空气 $a_1 \rightarrow a_4$ 的风道F 由膜波2 和 J_2 片1 构成,每片膜波2 的两端各有一个细方条形垫块7,在夹板3 和膜波2接触处贴有缓冲软垫18;每个 J_2 片1 在扁管14内构成一个完整的从 $t_{1n} \rightarrow t_{1i}$ 不等温工质流道,工质的入口处有进汽支管8 被连接于进汽管10的并联管9(或分配器)并联、工质的出口处有出液支管11被连接于供液管13的并联管12(或分配器)并联。

见图3、4。在 J_2 片1 中2 根平行排列的扁管14、其内插入用薄铝片制成的内波浪板15用以扩大工质流体的散热面积,工质的折流处设有弯道6,工质的出口和入口处分别接有出液支管11和进汽支管8,扁管14外包贴着膜式蒸发面16,扁管14和膜式蒸发面16之间嵌入2 根载水纱条20,载水纱条20被绝热材料制成的绝热条19分隔为2 个温区,因此每根扁管14构成一个等温换热区,扁管14可用 Φ 6mm 左右的薄金属管压制成交而薄的扁管。

图5 是细圆管 J_2 片剖视图。工质流道为细圆管14',其内插入内波浪板15,每根细圆管14'构成1 个以绝热条19为界的等温换热区,细圆管14'组成的 J_2 片的好处在于可以多分割温区和减少膜波2 和夹板3 的承压。扁管14和细圆管14' 可选用导热性强的耐腐金属制成,如用铜或铝材时应进行表面防腐处理,以提高耐久性。

见图5、6,梯波21的两面贴合着梯膜22组成膜波2,膜波2 在绝热条19的上方冲有长条形绝热孔17用以分割换热温区,冷却空气可在此形成湍流以加强热交换。梯波21作为支撑骨架可用极薄耐蚀金属(不锈钢或不锈铁)片或细金属网制成。膜式蒸发面16、梯膜22、载水纱条20用载水性、吸水性极强的耐腐不织布(无纺布)制成,在湿润状态时膜式蒸发面16、梯膜22、载水纱条20均饱含着水,梯膜22和膜式蒸发面16构成的梯形风道F 具有巨大的水蒸发表面积,含水层又具有极好的导热性能;载水纱条20储存的含水量可使F 表面处于连续的湿润状态,使喷水时间间隔尽可能延长,另一方面又可加强片 J_2 片1 和膜波2 之间的导热性。因风道F 是呈连续的全湿状态工作的,因此可将 x_2 冷却至 a_1 的湿球温度。梯形风道F 还可在其流向的横向或纵向设计成S 形以进一步增强热交换性能。

经低压泵M 压缩至 P_2 的过热制冷剂蒸气和吸收剂浓溶液的混合物 x_1 ,从进汽管10经并联管(或分配器)9 进入各根进气支管8,在 J_2 片1 的扁管14(或细圆管14')内从 $t_{1n} \rightarrow t_{1i}$ 逐步不等温冷却至 a_1 的湿球温度的稀溶液 x_2 从出液支管汇入并联管(或分配器)器12,经供液管13流向 J_1 管。

见图7,是弧形 J_2 管的阶梯剖视图,图中 J_2 片1 中有3根按同心圆弧方向平行排列的扁管14,膜波2 的风道F 呈扇形排列,其余结构和 J_2 管完全一样。 J_2 管可进

一步增大散热面积,降低通风阻力、冷重比、体积比。

J_2 和 J_2' 是一种热交换效率极高的全湿热交换器,具有广阔的应用范围,在 J 管空调中一般作为冷凝器使用,但也可以作为蒸发器使用。

参见附图8、9、10,图8是 J_1 管的主视图,图9是 J_1 管的俯视图、图10是 J_1 管的放大左剖视图。

夹板3、拉杆4、弯道6、垫块7、扁管14、内波浪板15、 J_1 片30、梯形波浪板(梯波)31、风道 F' 、进液支管23、分配器24、毛细管25、分流头34、供液管13、吸气支管27、并联管28、吸气管29、绝热腔32、渗水纱条33、绝热孔17。

J_1 管的换热系统由多层 J_1 片30和多层梯波31相间叠合而成被紧固夹合在肋状夹板3和拉杆4组成的框架内。被冷却空气 $a_2 \rightarrow a_2'$ 的风道 F' 由梯波31和 J_1 片30构成,梯波31的两端各有一个细方条形垫块7,在夹板3和梯波31接触处贴有缓冲软垫18;每个 J_1 片30在扁管14内构成一个完整的从 $t_1 \sim t_n$ 不等温工质流道,工质的入口处接有进液支管23,进液支管23被连接于毛细管25的分配器24并联,工质的出口处接有吸气支管27、吸气支管27被连接于吸气管29的并联管(或分配器)28并联。

梯波31用薄铝制成,梯形风道 F' 的间距和高度根据空气放热特性和制冷的传热温差要求而设计,其梯形坡度较小近似于矩形,风道 F' 可在其流向的横向或纵向设计成S形以进一步增加热交换性能,在绝热腔32的上方梯波31冲有长条形的绝热孔17用以分割导热温区和增强热交换。

图9、10中 J_1 片30有3根平行排列的扁管14、扁管14内插入内波浪板15用以扩大工质吸热面积,工质折流处有弯道6,扁管14外包贴着薄铝片使 F' 成为连续均匀流道,因此 J_1 片30和梯波31结合处同是薄铝片,同种金属不易在空气中发生电化腐蚀。薄铝片和扁管14之间形成的封闭空气腔是绝热腔32,用以分割导热温区,使每一根扁管14构成一个等温换热区。扁管14采用较小的宽度和较薄管壁,较小宽度可以减小梯波31和夹板3的承压,较薄管壁可以增强膨胀作用使 J_1 片30和梯波31紧密贴合以增强热交换。

由吸收剂和制冷剂组成的液态稀溶液 x_2 从供液管13进入分流34向各根毛细管25分流,从毛细管25进入各组分配器24经各根进液支管23而进入 J_1 的工质流道。 x_2 在扁管14内被室外空气 a_2 逐步加热至 a_2 干球温度的过热制冷剂蒸气和过热浓吸收剂溶液的液气混合物 x_3 、从吸汽支管27汇入并联管28(或分配器)经吸气管29被低压泵M抽吸走;同时室外空气 a_2 在 F' 流道内被降温、降温至 a_1 态输入室内, a_1 的温度趋近于制冷剂在 J_1 片30中的蒸发温度。 J_1 片30左侧的条状渗水纱条33使 J_1 管 F' 流道的出风面上形成一个相互贯通的水流面,可迅速排除梯波31表面的凝结水。制作梯波31

和包覆 J_1 片30的薄铝片应选用亲水铝片。

与 J_2 管一样 J_1 同样可以制成弧形 J_1' 管, J_1 管在 J 管空调中一般作为蒸发器使用, 但也可以作为冷凝器而制成 J_1J_1 式 J 管空调。 J_1 管是一种热交换效率较高的热交换器, 显然具有广泛的适用范围。

附图11上 J_1J_2 刀字分机结构示意图。 J_1 是指蒸发器用 J_1 管、 J_2 是指冷凝器用 J_2 管、分机是指分体式空调、刀字是指刀字循环。

室内机由 J_1 (或 J_1') 管、风扇37等组成。室内空气 a_1 在安装 J_1 前面的风扇37的抽吸作用下从 J_1 管后面经滤网36在 J_1 管内冷却至 a_2 后经可调风门35导向而输入室内, a_2 的温度可由 P_1 的压力状态来设定。凝结水由连接于接口38的滴水管41引向室外机底盘, 工质的供液管13连接于接口39, 工质的吸气管29连接于接口40。由于 J_1 (或 J_1') 通风阻力较低因而可以使用轴流风扇。

室外机由 J_2 (或 J_2') 管、风扇26、低压泵M、底盘、水位控制器、水循环系统等组成。室外空气 a_3 在 J_2 右侧风扇26的抽吸下从左侧经挡水板50在 J_2 的风道F内吸热、吸湿至 a_4 态排向室外大气。底盘内的水位由水位控制器的供水管控制。水循环系统由水泵47、过滤器48、喷头49及连接管组成, 由自动控制系统间隔性、定时、定量喷润 J_2 的迎风面。M 安装在底盘内、挡水板50安装于进风口, 用以防止水雾溅出。

J_1J_2 刀字分机的工质连接管与市售分体式空调器一样, 供液管13连接于室外机连接阀45, 吸气管29连接于室外机的连接阀44。滴水管41连接于室外机的接口46将凝结水引向底盘。

J_1J_2 刀字分机具有较高的热力循环效率, 其 J_2 管制成的室外机组亦可配用现行空调的室内机使用, 但效率有所下降。

图12是 J_1J_2 刀字窗机结构示意图。 J_1 指蒸发器用 J_1 管、 J_2 指冷凝器用 J_2 管、刀字窗机指刀字循环的窗式空调, 其通风结构与市售窗机一样, 离心风扇55在 J_1 后侧抽吸、室内空气 a_1 在面板的一侧经滤网36在 J_1 的风道F'内冷却至 a_2 后, 经涡道在面板的另一侧通过导向风门35导向而输入室内。室外空气 a_3 在墙外两侧经挡水板, 在 J_2 的风道F内吸热、吸湿至 a_4 态被风扇26抽向室外大气。底盘内的水位由浮球54、离合口53、支架52组成的水位控制器和供水细管51控制。水循环系统由水泵47、过滤器48等组成, 间隔性、定时、定量(一般是每隔20分钟喷15秒左右)喷润 J_2 的迎风面。低压泵安装于底盘内, 挡水板安装于墙外两侧的进风口。

图13是 J_1J_2 刀字窗机结构示意图, 室内侧前面的风扇37安装在 J_1 的凹弧内, 在其抽吸下, 室内空气 a_1 从室内两侧进风口58经滤网36自 J_1 的凸弧面进入风道 F'

冷却至 a_2 后通过可调风门35导向而输入室内。室外侧后端的风扇26安装在 J_2 的凹弧内,在其抽吸下,室外空气 a_3 从墙56外两侧的挡水板50自 J_2 的凸弧面进入风道F吸热、吸湿至 a_4 排向室外大气。

室外后端面的护网59用以保护风扇26,中间的弧形隔板57用以隔热和分隔风道,底盘内的水循环、水位控制系统及低压泵M的安装不再重述。

图14是 J_1J_2 8字窗机结构示意图。

室内前面风扇37、室外后面风扇26分别安装于 J_1 和 J_2 的凹弧内在其抽吸作用下:

室外空气 a_3 从墙56外顶部的斜窗60经滤网36自 J_1 凸弧面进入风道F'冷却至 a_2 后通过可调风门35导向而输入室内, a_2 的温度可由 P_1 状态来设定。

室内空气 a_1 自室内两侧的进风口58经 J_2 的凸弧面进入风道F吸热、吸湿至 a_4 排向室外大气。

底盘内有水位控制、水循环系统和低压泵。

上述 J_1 、(J_1)、 J_2 、(J_2)刀字及8字窗机或室外机的底盘内均有水循环和水位控制系统,在一般湿度的空气状态下耗水很少,如在缺水的状态下可在底盘内加入适量不易挥发于空气的载冷剂丙三醇或乙二醇水溶液,使之构成自给自足的水平衡循环系统。

图15是 J_2J_2 刀字热泵式窗机结构示意图。冷凝器、蒸发器均用 J_2 管便以制热时转换。制冷时风扇、J管、通风结构与图13的 J_1 、 J_2 刀字窗机完全一样,室内两侧进风口58改制成可调风窗58'在制冷时作挡水板使用,制热时作可调风窗使用,底盘内的水溶液被隔板57分隔为室内底盘和室外底盘,每个 J_2 管各配一套由水泵、过滤器、喷头和连接管组成的水循系统。底盘内可加入不易挥发于空气的载冷剂丙三醇、乙二醇、氯化锂、溴化锂中的任何一种水溶液,以构成 J_2 管的外循环工质及水平衡。

制冷时水泵47将室内底盘内的稀水溶液间隔、定时、定量喷向室外 J_2 管,同时水泵47'将室外底盘内的浓水溶液间隔、定时、定量喷向室内 J_2 管,使之构成供水或不供水的水平衡系统。

制热时,换向阀使室内 J_2 管转换为冷凝器,室外 J_2 转换为蒸发器,室内外风扇37、26反转。室内空气 a_1 从可调风门35自室内 J_2 的凹弧面进入风道增热、增湿至 a_4 从可调风窗58'导向输入室内;室外空气 a_3 从护网59自室外 J_2 的凹弧面经风道降温、降湿至 a_2 从墙外两侧的挡水板50排向大气。同理水泵47将室内底盘的浓水溶液间隔、定量、定时喷向室外 J_2 凸弧面以防止风道结霜,同时水泵47也将

室外底盘内的稀水溶液喷向室内 J_2 的凸弧面以调节 a_4 的湿度,使之构成供水或不供水的平衡系统及调节所需湿度。

当底盘的载冷剂水溶液是盐类氯化锂或溴化锂时,制作 J_2 片的扁管14或细圆管14'或细圆管14'应是耐腐蚀不锈钢制成。制冷时底盘亦可单独用水作为外循环工质。

上述图15的 J_2J_2 刀字热泵式窗机沿隔板57可以分解为室内侧和室外侧两个部份,因此其原理、结构同样可制成 J_2J_2 刀字热泵式分机。

图16是 J_2J_2 8字热泵式窗机结构示意图。冷凝器和蒸发器均用 J_2 管以便于制冷、制热转换,制冷时通风机构与图14的 J_1J_2 8字窗机一样。底盘被隔板61分隔为室内底盘和室外底盘两个部份,室内、外 J_2 各有一套水循环系统,底盘内加入不易挥发于空气的载冷剂水溶液构成供水或不供水的外循环工质。

制冷时水泵47将室内侧底盘内的稀水溶液间隔、定时、定量喷向室外 J_2 管,水泵47'将室外侧底盘内的浓水溶液间隔、定时、定量喷向室内 J_2 构成外工质循环。喷雾时室内外风扇37、26应停转。

制热时换向阀使室内 J_2 转换为冷凝器、室外 J_2 转换为蒸发器。室内空气 a_1 从室内两侧可调风窗58'经室外 J_2 冷却至 a_2 排向室外大气,室外空气 a_3 自墙56外顶部斜窗经室内 J_2 吸热、吸湿至 a_4 经可调风门35导向后输入室内。其外循环工质及水循环系统与 J_2J_2 刀字热泵式窗机完全一样。

上述刀字循环和全新风8字循环J管空调器中采用吸收剂和其相适应的制冷剂组成的循环工质对,其目的在于将被制冷空气在冷却过程中所释放的热能最大限度地储存于吸收剂溶液中(转化为化学吸收能),或者这样说吸收剂溶液最大限度地从 $t_1 \sim t_n$ 被制冷空气加热、浓缩,以尽可能地降低冷凝压力 P_2 ,使低压泵M获得最低 $P_2 - P_1 = \Delta P$ 压力差运行。在同一台J管空调器中也可以使用单一或混合(共沸或非共沸)制冷剂(不是工质对)作为循环工质,此时J管机组可获得最大制冷量,但此时J管空调运行的是卡诺或劳伦茨循环。

$J_1(J_1)J_2(J_2)$ 8字或刀字J管空调器的最佳外循环工质是水,其作用是可以最大限度地降低 J_2 管的冷凝压力 P_2 和温度,在其窗机或室外机底盘内加入载冷剂(丙三醇、乙二醇)水溶液的目的在于弥补缺水状态(供水细管不能连续供水)时 J_2 管的冷凝之不足。

同时用两个 J_2 管组成的 $J_2(J_2)J_2(J_2)$ 8字或刀字J管空调器,每个 J_2 管各配一套水循环系统,当其底盘内的外循环工质是氯化锂、溴化锂、氯化钙一类吸水性盐水溶液时:浓盐水溶液喷向作为蒸发器的 J_2 管(蒸发 J_2 管)的出风面,使之均布于风道F的膜式蒸发面16和膜波2表面,被冷却空气在风道F内具有强烈放湿、放热

作用，极大地加强了 J_2 管的热交换作用， J_2 片内的循环工质也可从被冷却空气中最大限度地获得热量，另一方面也可以提高设定蒸发温度和压力 P_1 ，在制热运行时可防止风道F 表面结霜和便于从被冷却空气中抽取热量和水份。浓盐水溶液在风道F 表面吸水、放热而逐步转化为稀盐水溶液，从迎风面流入底盘，被配备于冷凝器 J_2 管(冷凝 J_2 管)的水循环系统定时抽走喷向冷凝 J_2 管的冷却空气(制热时是被制热空气)的迎风面，在其F 表面放湿、吸热而逐步转化为浓盐水溶液从出风面流出而汇入其底盘，被配备于蒸发 J_2 管的水循环系统抽走而喷向蒸发 J_2 管的出风面……。制冷、制热时两个 J_2 管的作用互换。上述循环称之为外8字循环，从提高 P_1 的蒸发压力来提高热力循环效率，制热时可提高被制热空气的温度、湿度，阻止蒸发 J_2 管的风道F 表面结霜。

当采用丙三醇、乙二醇这类水溶液作为外循环工质时，主要目的在于防止蒸发 J_2 管风道F 表面结霜和提高冷凝 J_2 管的输出热风的温度和湿度以提高制热时空气调节的舒适度。制冷时防止供水细管供水不足。

权利要求

1. 一种高效微分冷谷管空调器, 由微分冷谷管 J_1 和 J_2 以及低压泵M构成, 其特征在于:

A. 在高效微分冷谷管空调器中设弧形 J_1 换热装置, 该换热装置由多层弧形 J_1 片(30)和多层波形梯波31相间叠合而成, 被夹合紧固于弧形肋状夹板(3)和拉杆(4)组成的框架内, 夹板(3)和梯波(31)接触处有缓冲软垫(18), 梯波(31)形成的风道 F' 流向为S形并在其壁面上开有几条长形的绝热孔(17), 每个 J_1 片(30)在其扁管(14)内插入内波浪板(15), 扁管外包贴薄铝片, 工质的出入口处分别连接着进液支管(23)和吸汽支管(27);

B. 在高效微分冷谷管空调器中还设有弧形 J_2 换热装置, 该装置由多层弧形 J_2 片(1)和多层波形膜波(2)相间叠合而成, 被夹合紧固于弧形肋状夹板(3)和拉杆(4)组成的框架内, 夹板(3)和膜波(2)接触处有缓冲软垫(18), 膜波(2)形成的风道 F 流向为S形在其壁面上开有几条长条形绝热孔(17), 膜波(2)的支撑架是薄铝或其它金属或细金属网片制成的梯波(21)在其两面贴合着梯膜(22)由此构成膜波(2), 每个 J_2 片(1)在其扁管(14)内插入内波浪板(15)构成一个完整的 $t_1 \sim t_2$ 不等温工质流道, 工质的出入口处分别连接着进汽支管(8)和出液支管(11), 扁管(14)外包贴铝片或耐腐金属片, 亦可用耐腐金属直接制成扁管, 其外再包贴膜式蒸发面(16), 平行排列的扁管(14)和膜式蒸发面(16)之间嵌入载水纱条(20);

C. 低压泵M 以管路连接在J₁ 换热装置和J₂ 换热装置之间, 低压泵M 在较低冷凝压力P₂的J₂ 和较高蒸发压力P₁的J₁ 之间工作, 且可液、气共输, 当循环工质是单一或混合(共沸或非共沸)制冷剂时可获得最大制冷量, 当循环工质是吸收剂和制冷剂组成的工质对时可形成最高循环效率的刀字循环和全新风8字循环。

2. 根据权利要求 1 所述的高效微分冷谷管空调器, 其特征在于: 弧形 J_1 片 30 和弧形 J_2 片 (1) 中的复数根扁管 (14) 是按圆弧方向平行排列, 梯波 (31) 和膜波 (2) 呈扇形分布, 在使用轴流风扇时可将其安装于 J_1 、 J_2 的凹弧内, 当扁管 (14) 按平直方向平行排列时就分别成为平直的 J_1 和 J_2 , 因此梯波 (31) 和膜波 (2) 呈平直分布, 夹板 (3) 亦为平直夹板, 上述 J_1 片 (30) 和 J_2 片 (1) 中的扁管 (14) 在各自的工质折流处有弯道 (6) 使平行排列的扁管 (14) 串联。

3. 根据权利要求1所述的高效微分冷谷管空调器, 其特征在于: 数根连接于J₁片(30)的进液支管(23)被连接于毛细管(25)的分配器(24)并联, 毛细管(25)亦被连接于进液管(13)之上的分配器(34)并联, 所有连接于J₁片(30)的吸汽支管(27)被连接于吸气管(29)的并联管(或分配器)(28)并联, 所述梯波(31)和内波浪板(15)用



薄铝片或亲水铝片制成, 梯波(31)同样也适用于其它层叠式热交换器。

4. 根据权利要求1所述的高效微分冷谷管空调器, 其特征在于: 梯模(22)、膜式蒸发面(16)、载水沙条(20)用载水性和吸水性较好的耐腐不织布(无纺布)制成, J_2 片(1)中的扁管(14)用薄金属管、或用细圆管(14')制成。

5. 根据权利要求1中所述的高效微分冷谷管空调器, 其特征在于: J_1 、 J_1' 作为蒸发J管也可以作为冷凝J管, J_2 、 J_2' 作为冷凝J管也可以作为蒸发J管, 制冷时: 当被蒸发J管冷却的是室外空气 a_3 、冷却冷凝J管的是室内空气 a_1 时J管空调运行全新风8字循环, 当被蒸发J管冷却的是室内空气 a_1 、冷却冷凝J管的是室外空气 a_3 时, J管空调器运行刀字循环, 制热时: 当被冷凝J管加热的是室外空气 a_3 、被蒸发J管冷却的是室内空气 a_1 , J管空调器运行全新风8字循环, 当被冷凝J管加热的是室内空气 a_1 、被蒸发J管冷却的是室外空气 a_3 , J管空调器运行刀字循环。

6. 根据权利要求1中所述的高效微分冷谷管空调器, 其特征在于: 当 J_1 、 J_1' 作为蒸发J管、 J_2 、 J_2' 作为冷凝J管时组成的8字或刀字循环的窗机或室外机, 在其窗机或室外机的底盘内装有水泵(47)、过滤器(48)、喷头(49)及连接管组成的水循环系统由自动控制系统按需间隔、定时、定量, 一般是每隔20分钟喷15秒, 底盘内的水溶液喷向 J_2 、 J_2' 的迎风面, 底盘内的水位由浮球(54)、离合口(53)、支架(52)、供水细管(51)组成的水位控制系统控制, J_1 、 J_1' 的凝结水引向底盘, 在供水细管不能连续供水时, 可在底盘内加入丙三醇或乙二醇等不易挥发于空气的载冷剂水溶液以构成自给自足的水平衡系统, 上述分体机的室外机组亦可配用现行空调的室内机。

7. 根据权利要求1中所述的高效微分冷谷管空调器, 其特征在于: 当冷凝J管、蒸发J管都用 J_2 、 J_2' 时组成的热泵型8字或刀字循环窗机或分体机时, 每个 J_2 、 J_2' 管各有存水底盘和水循环系统, 其中一只底盘设水位控制系统, 当底盘内加入氯化锂、氯化钙、溴化锂吸水性盐水溶液时: 蒸发J管的水泵定时、间隔、定量将冷凝J管底盘内的浓盐水溶液喷向蒸发J管的出风面, 喷雾时其风扇应停转, 浓盐水溶液在其风道F表面逐步吸湿、放热而转化为稀盐水溶液从迎风面流向底盘, 同时冷凝J管的水泵也将蒸发J管底盘内的稀盐水溶液喷向冷凝J管的迎内面, 喷雾时其风扇应停转, 稀盐水溶液在其风道F表面逐步放湿、吸热而转化为浓盐水溶液从出风面流出汇入底盘, 制热时冷凝J管和蒸发J管的作用互换, 上述外循环工质盐水溶液构成的循环是外8字循环, 外循环工质也可以是丙三醇、乙二醇等不易挥发于空气的载冷剂水溶液, 制冷时外循环工质可以单独用水。



8. 根据权利要求 1 所述的高效微分冷谷管空调器, 其特征在于: 其 J_1 、 J_1 、 J_2 、 J_2 刀字分机的室外机的室外空气 a_s 的进风口设有挡水板(50); 其 J_1 、 J_2 刀字窗机前后两个端面处的室内风扇(37)和室外风扇(26)分别安装于 J_1 和 J_2 的凹弧内, 室内空气 a_1 的进风口(58)设置在墙(56)内两侧, 室外空气 a_s 的进风口设置在墙(56)外两侧, 进风口处有挡水板(50), 其 J_1 、 J_2 8 字窗机前后两个端面处的室内风扇 37 和室外风扇 26 分别在 J_1 和 J_2 的凹弧内, 室内空气 a_1 的出风口 58 设置在墙 56 内两侧、室外空气 a_s 从墙外顶部的斜窗(60)进入 J_1 的凸弧面在风道 F' 内冷却至 a_2 而输入室内。

9. 根据权利要求 1 所述的高效微分冷谷管空调器, 其特征在于: 其前后两个端面处的室内风扇(37)和室外风扇(26)分别在室内 J_2 和室外 J_2 的凹弧内, 其刀字机室内空气的通风口设在墙(56)内两侧、通风口设有可调风窗(58'), 室外空气 a_s 的通风口设在墙(56)外两侧, 通风口处有挡水板(50), 其 8 字机的室内空气 a_1 的出风口设置在墙(56)内的两侧, 出风口处有可调风窗(58'), 室外空气 a_s 从墙(56)外顶部斜窗(60)进入 J_2 凸弧面在风道 F 内被冷却或制热后输入室内。





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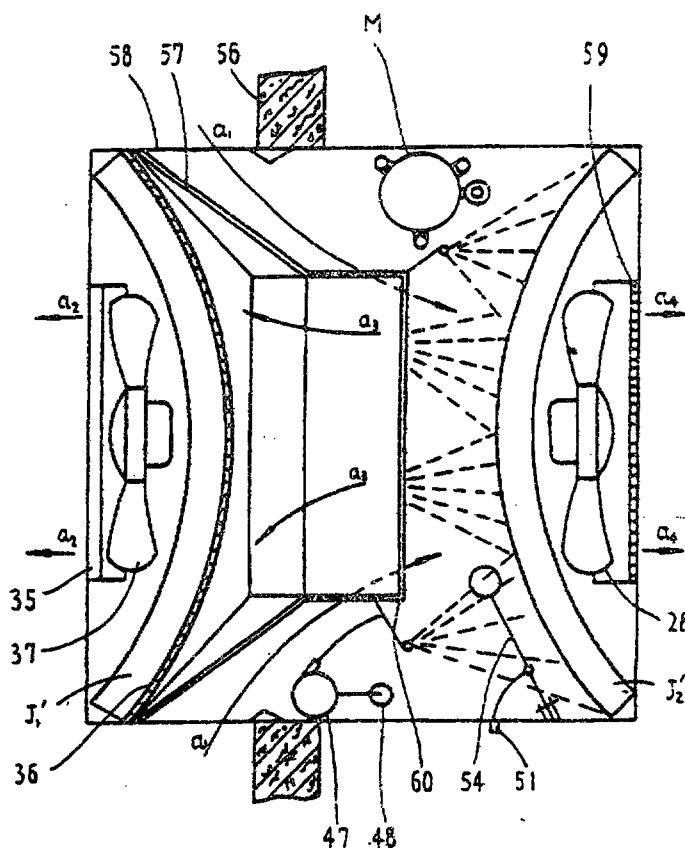
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(54) Title: AN AIR-CONDITIONER WITH HIGH-EFFICIENCY DIFFERENTIAL COOL-
VALLEY PIPES

(54) 发明名称: 高效微分冷谷管空调器

(57) Abstract

An air-conditioner with high-efficiency differential cool-valley pipes, which include J-type pipes and a low-pressure circulating pump, has a first arc heat-exchanger which is formed by multiple-layer ladder-shaped corrugated plates and multiple-layer arc J-type pipes stacked alternatively, and a second arc heat-exchanger which is formed by multiple-layer arc J-type pipes and multiple-layer wave-shaped film-type evaporation face stracked alternatively. A low pressure pump is connected between the first arc heat-exchanger and the second arc heat-exchanger through pipelines. The air-conditioner solves the problems that the conventional air-conditioner consumes high energy, quality of the air in the room is low and the use of CFCS is confined.



(57) 摘要

一种高效微分冷谷管空调器, 由微分冷谷管(J管)及低压循环泵构成, 在该空调器中还设有第一弧形换热装置, 它由多层弧形J管和多层波形梯波相间叠合而成, 还设有第二弧形换热装置, 它由多层弧形J管和多层波形膜波相间叠合而成。低压泵M通过管路连接在第一和第二换热器装置之间。该空调器解决了传统空调器能耗高、空气品质低和氟利昂被限制使用的难题。

以下内容仅供参考

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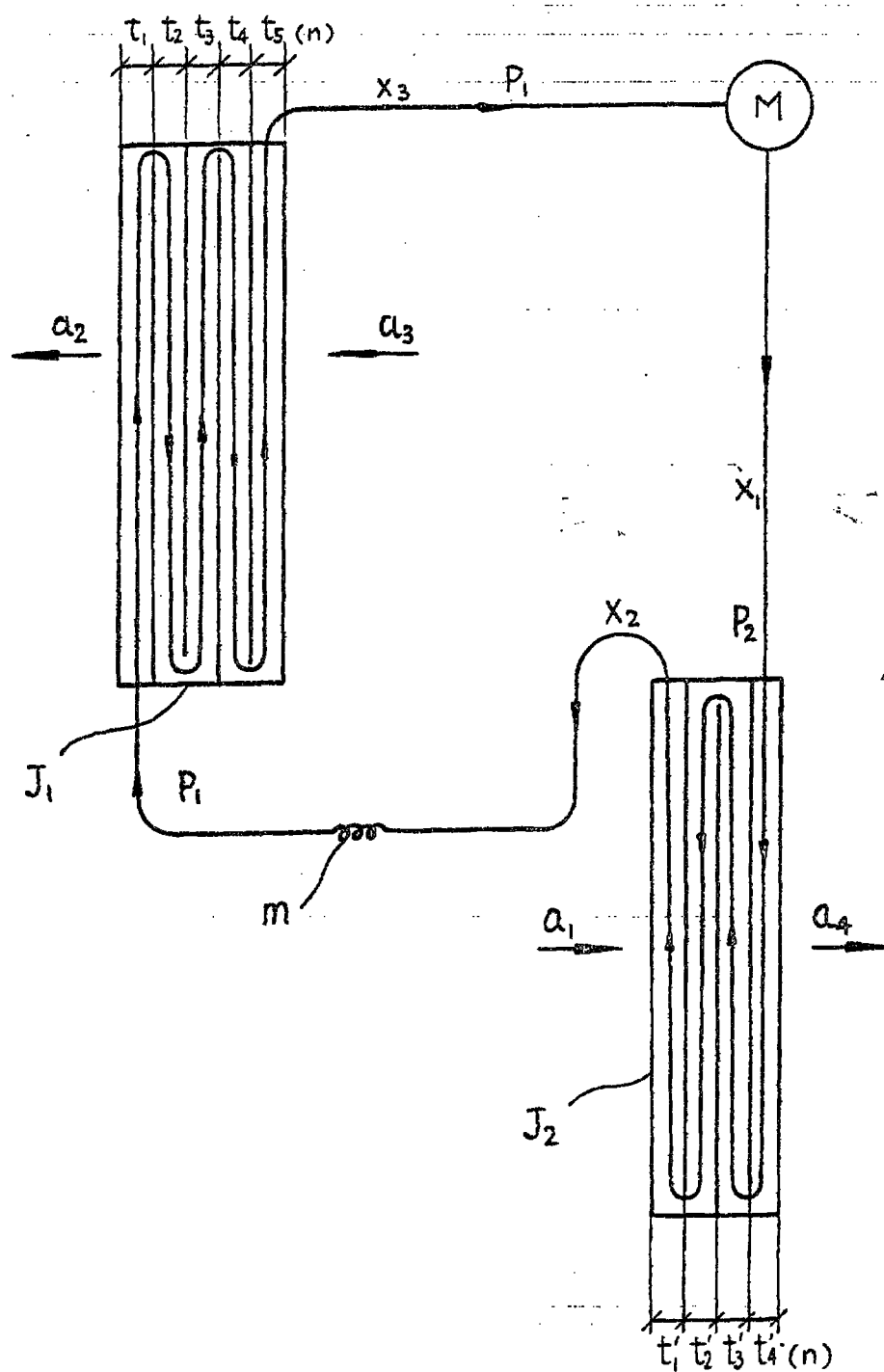


图 1

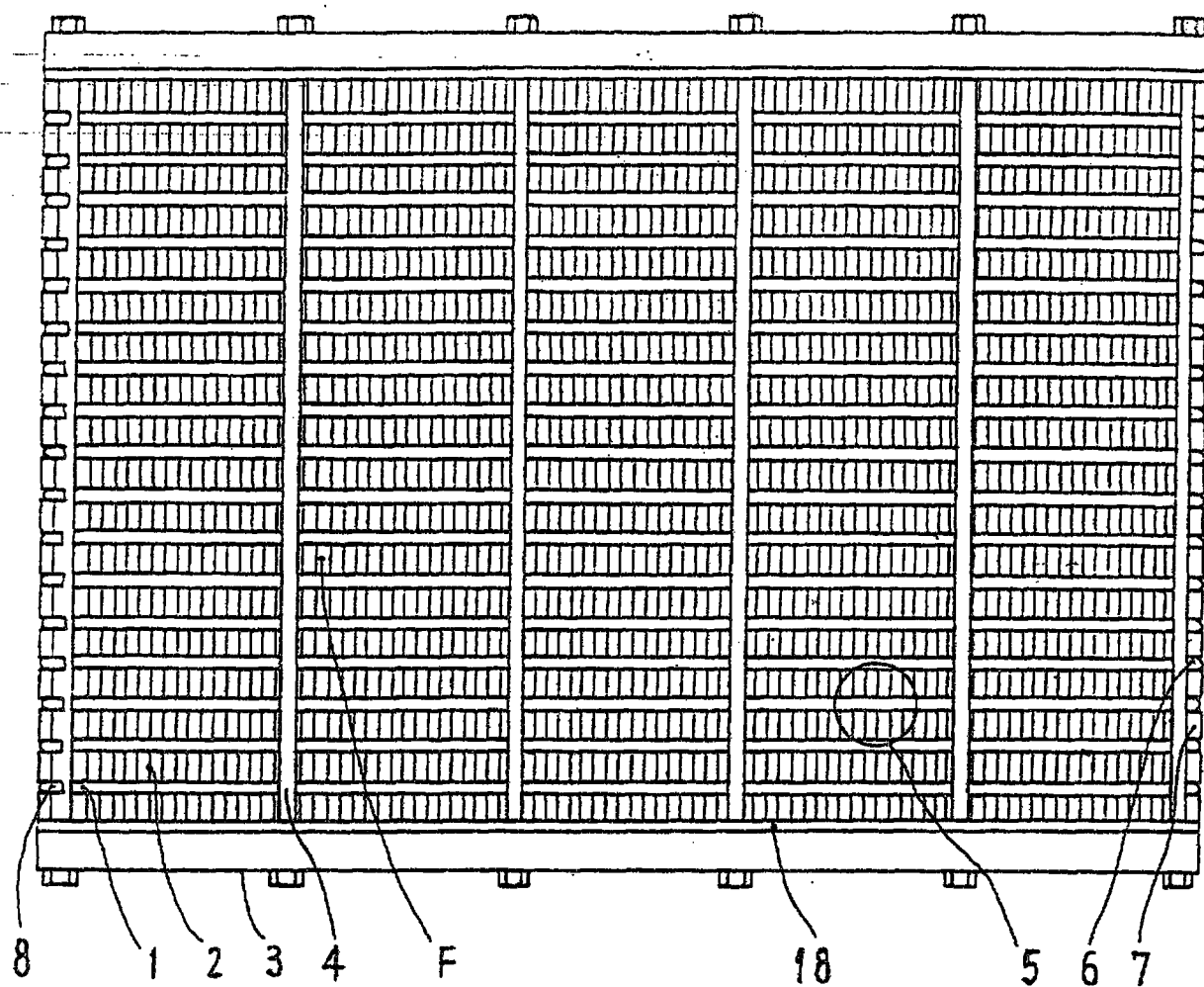


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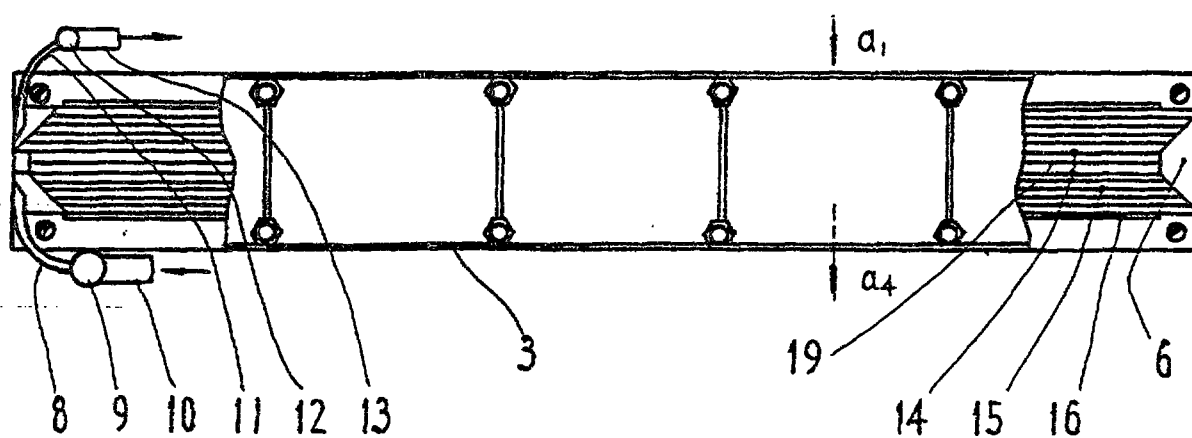


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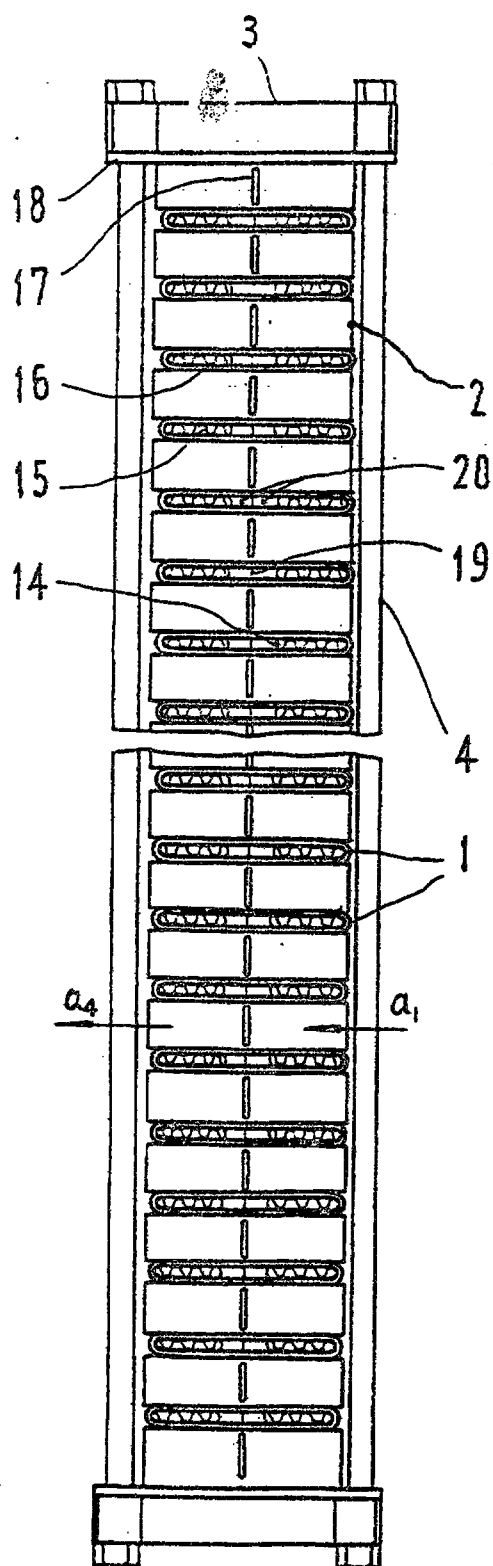


图 4

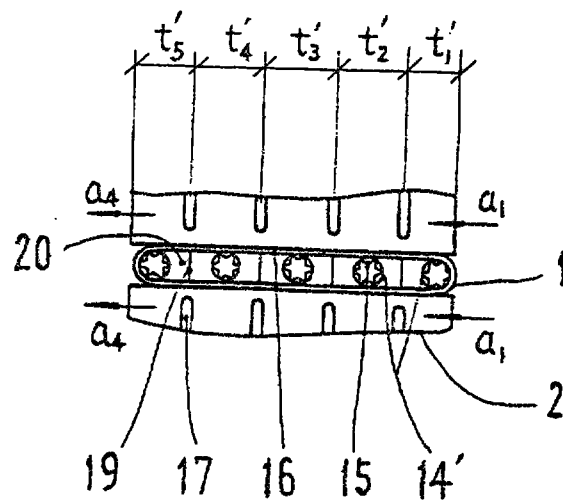


图 5

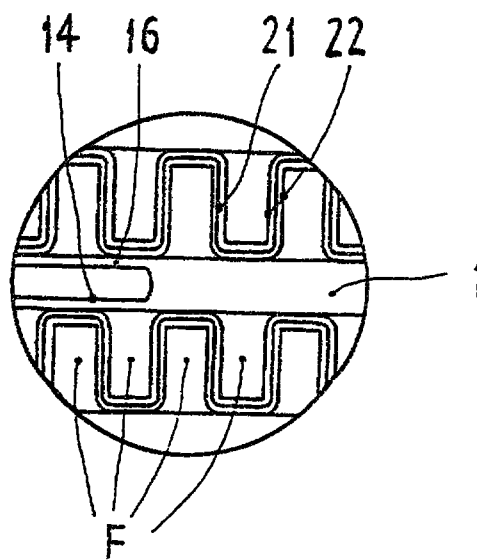


图 6

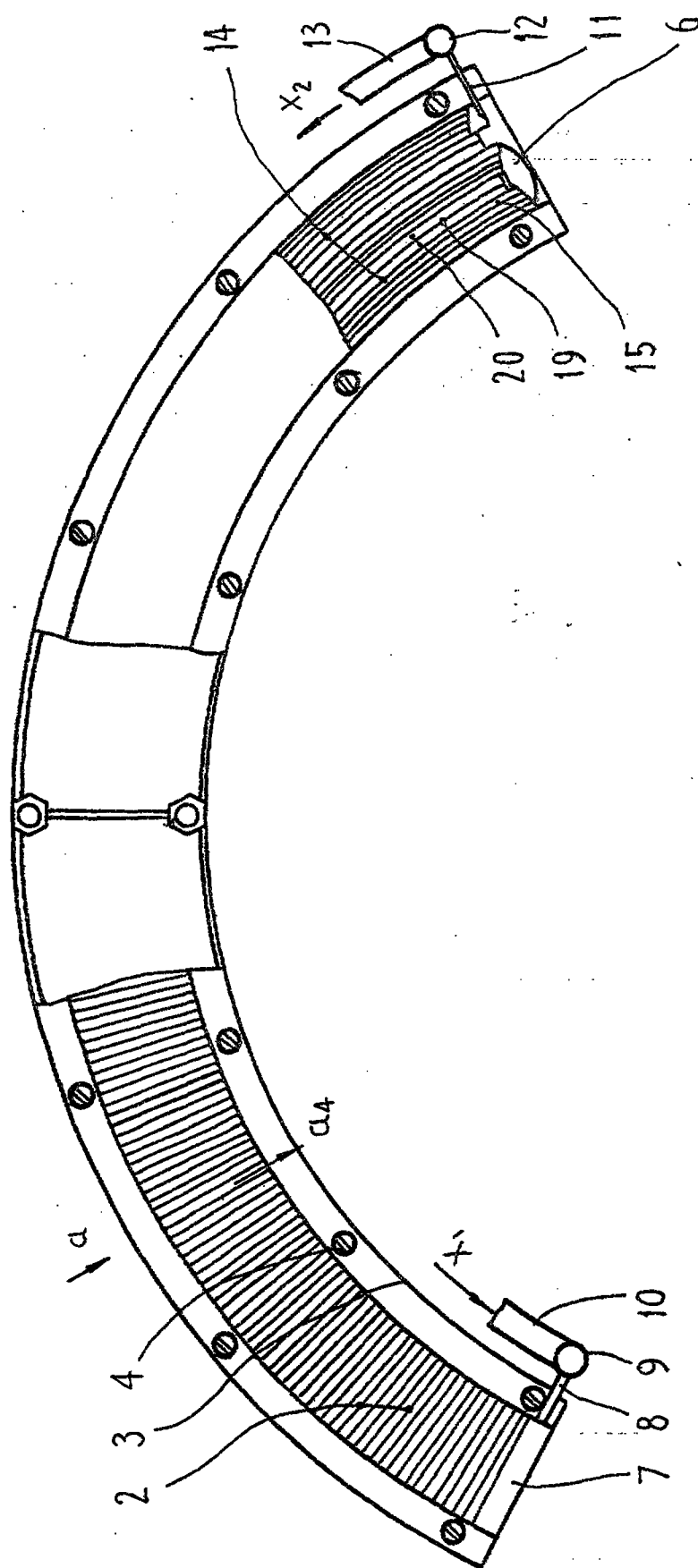


图 7

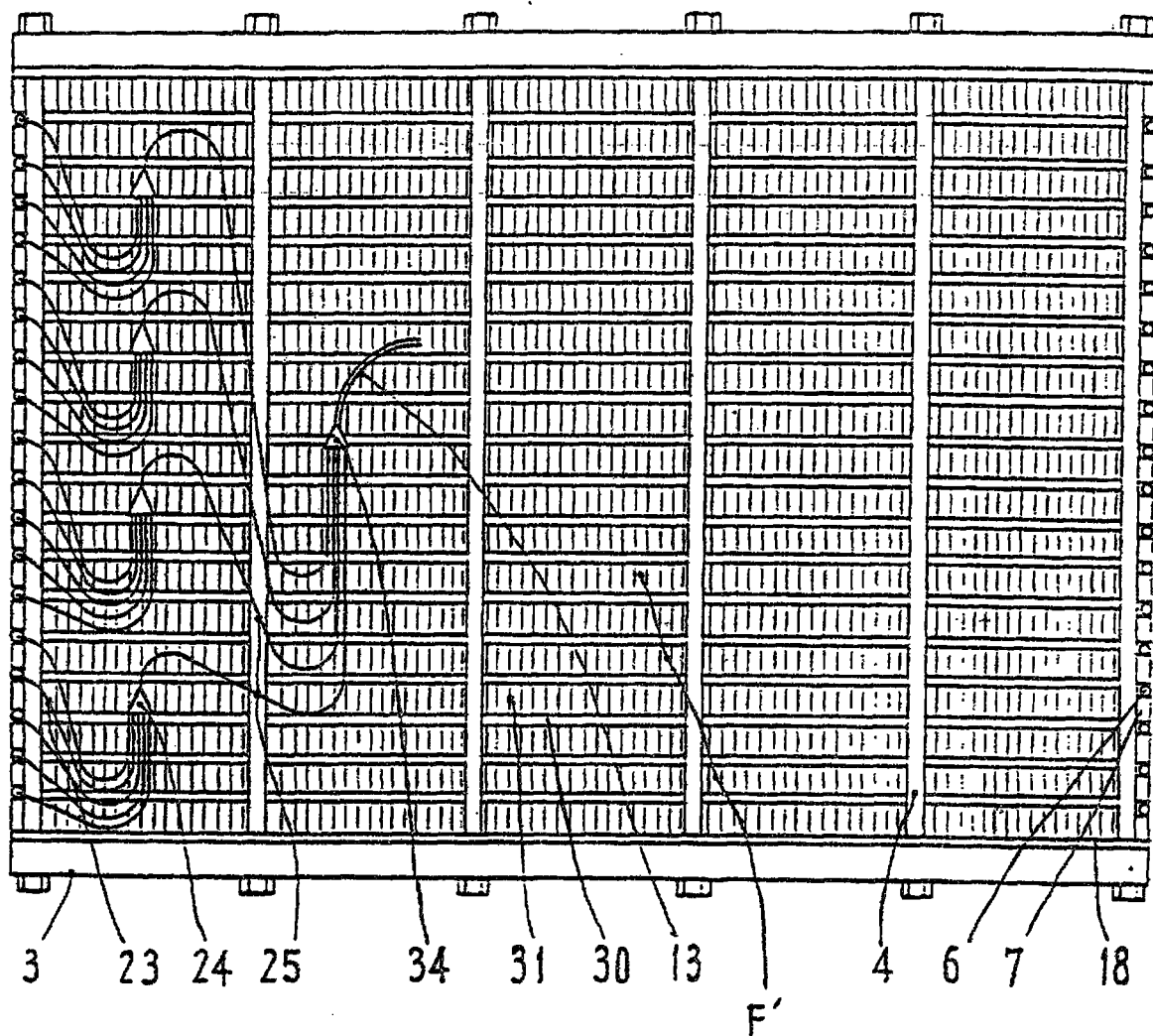


图 8

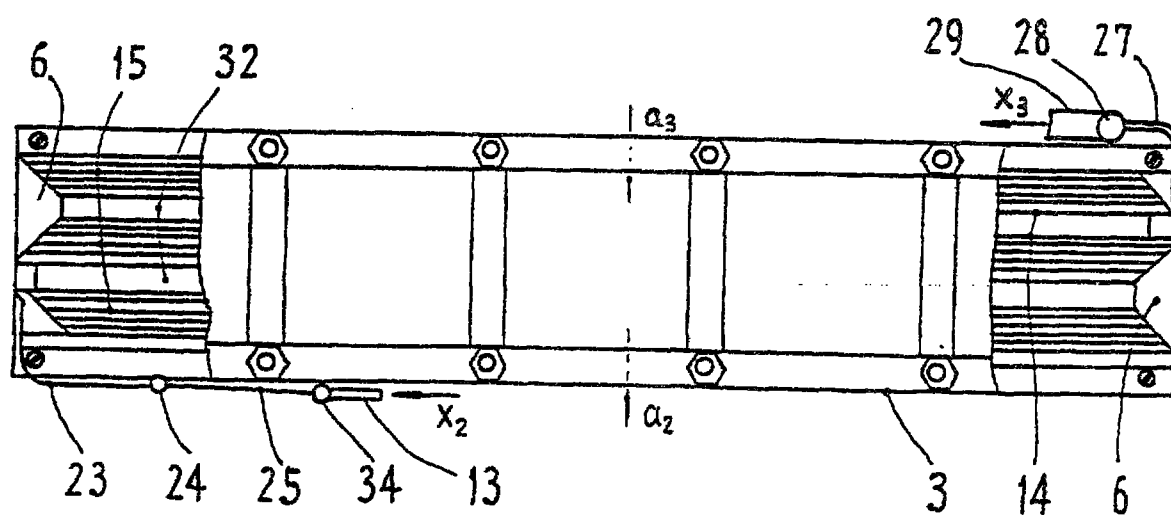


图 9

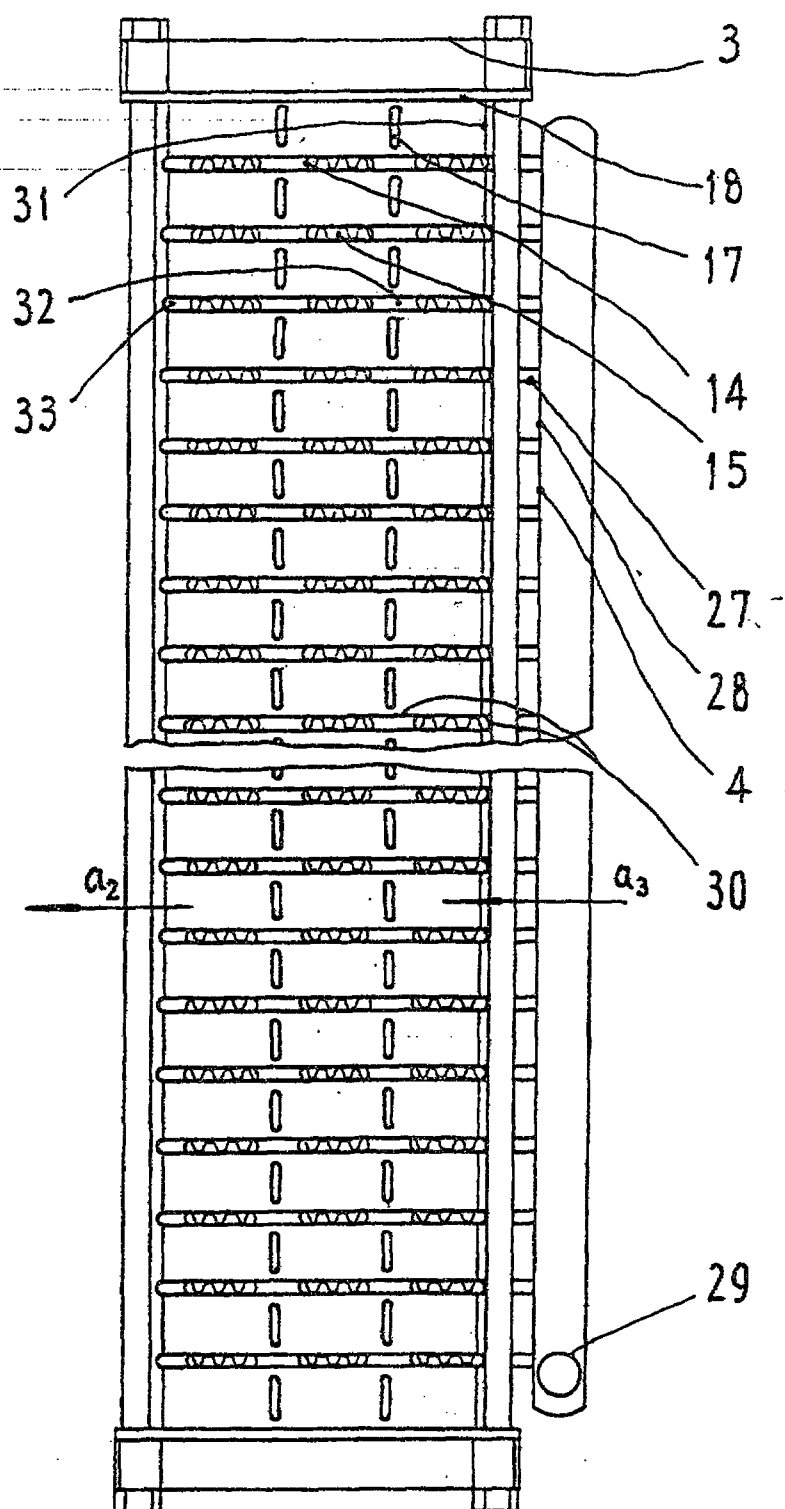


图 10

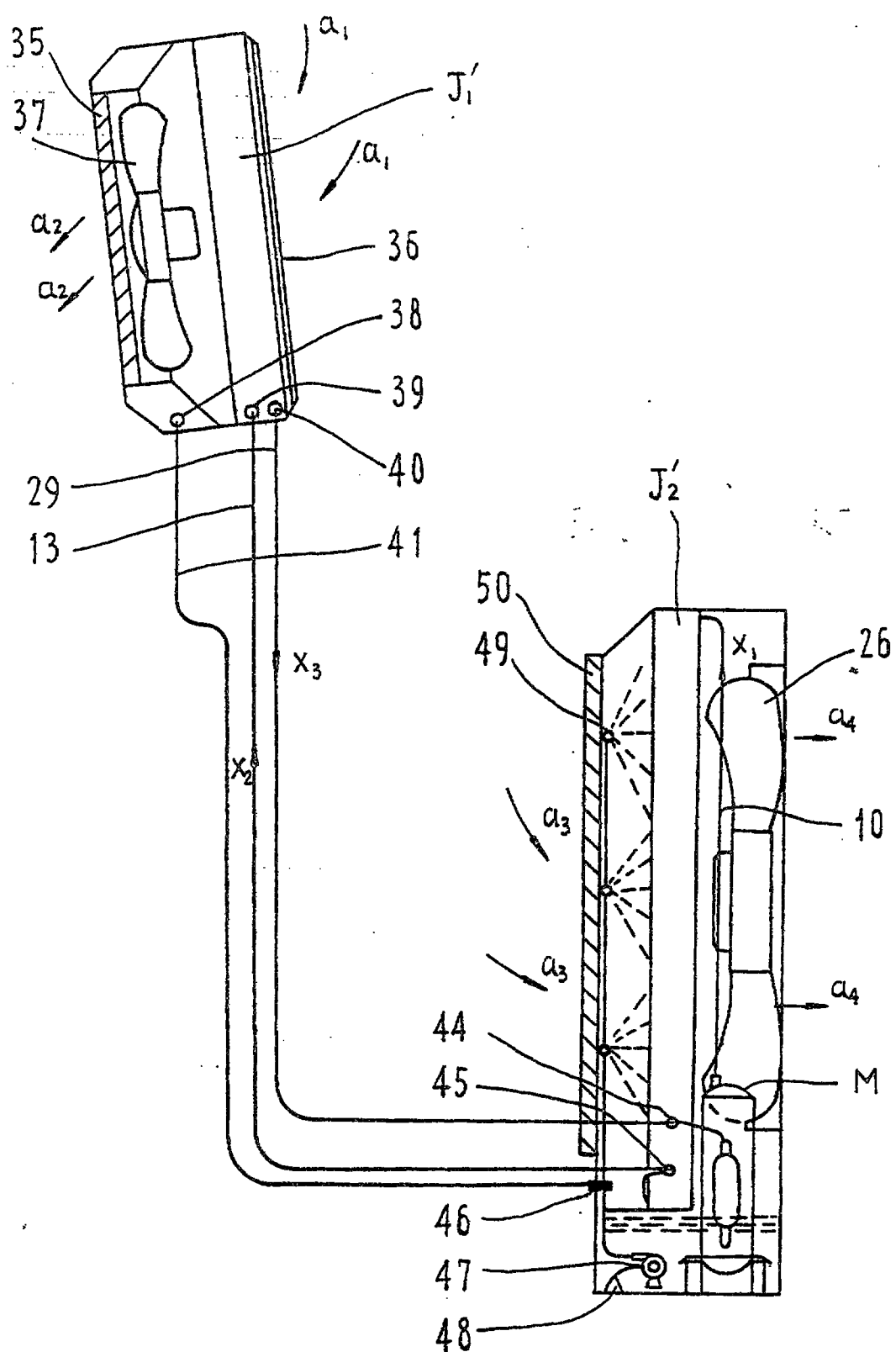


图 11

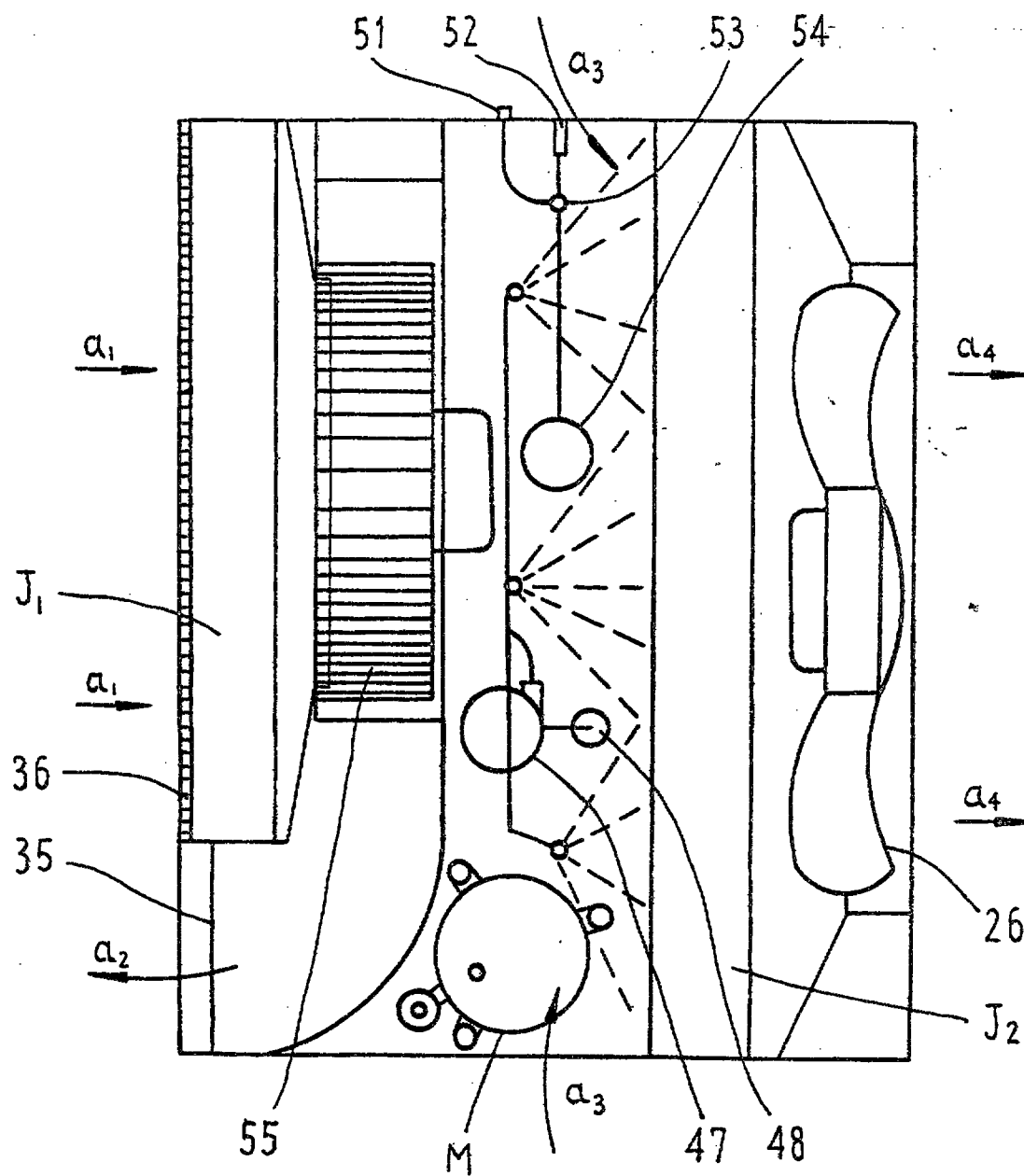


图 12

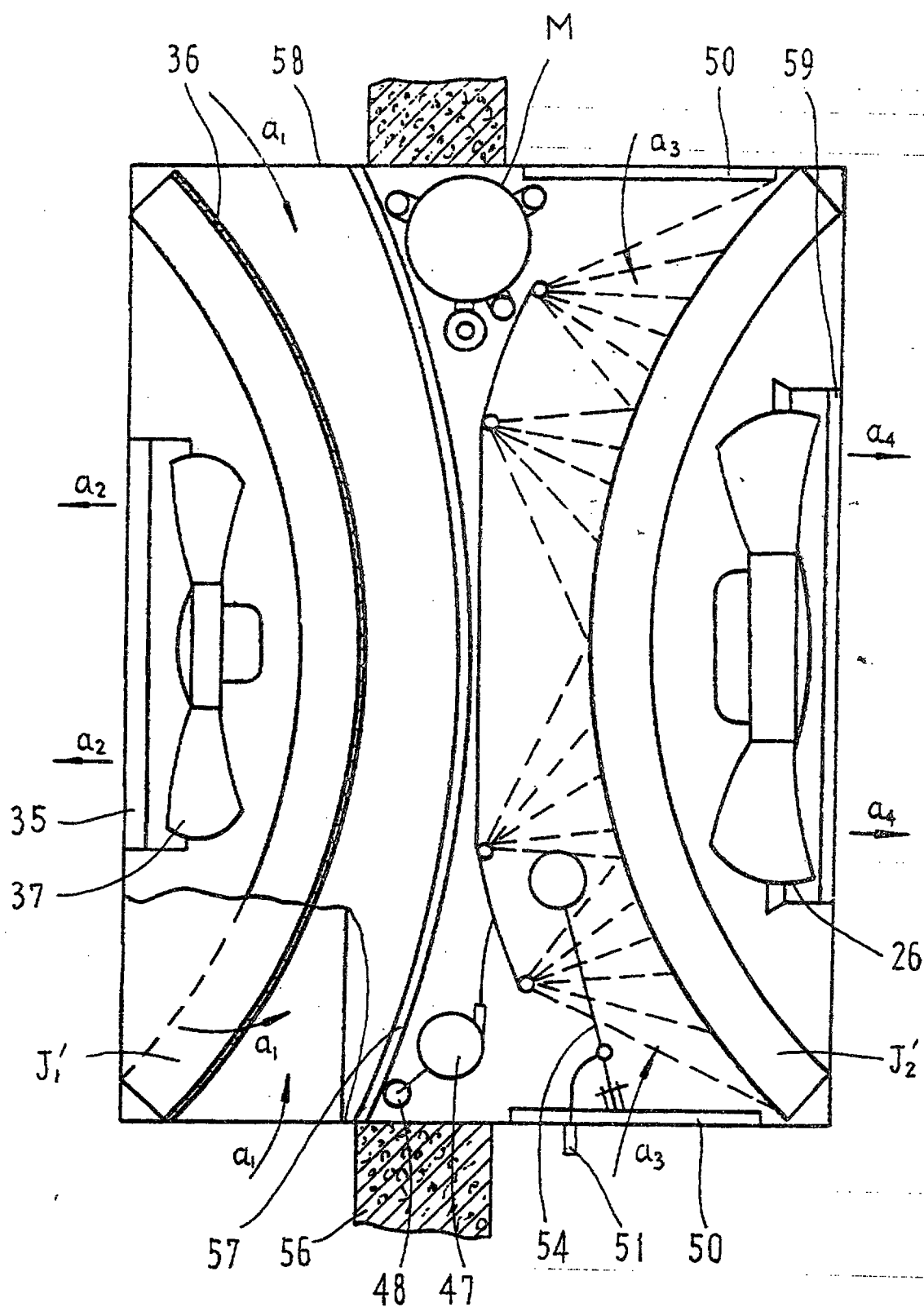


图 13

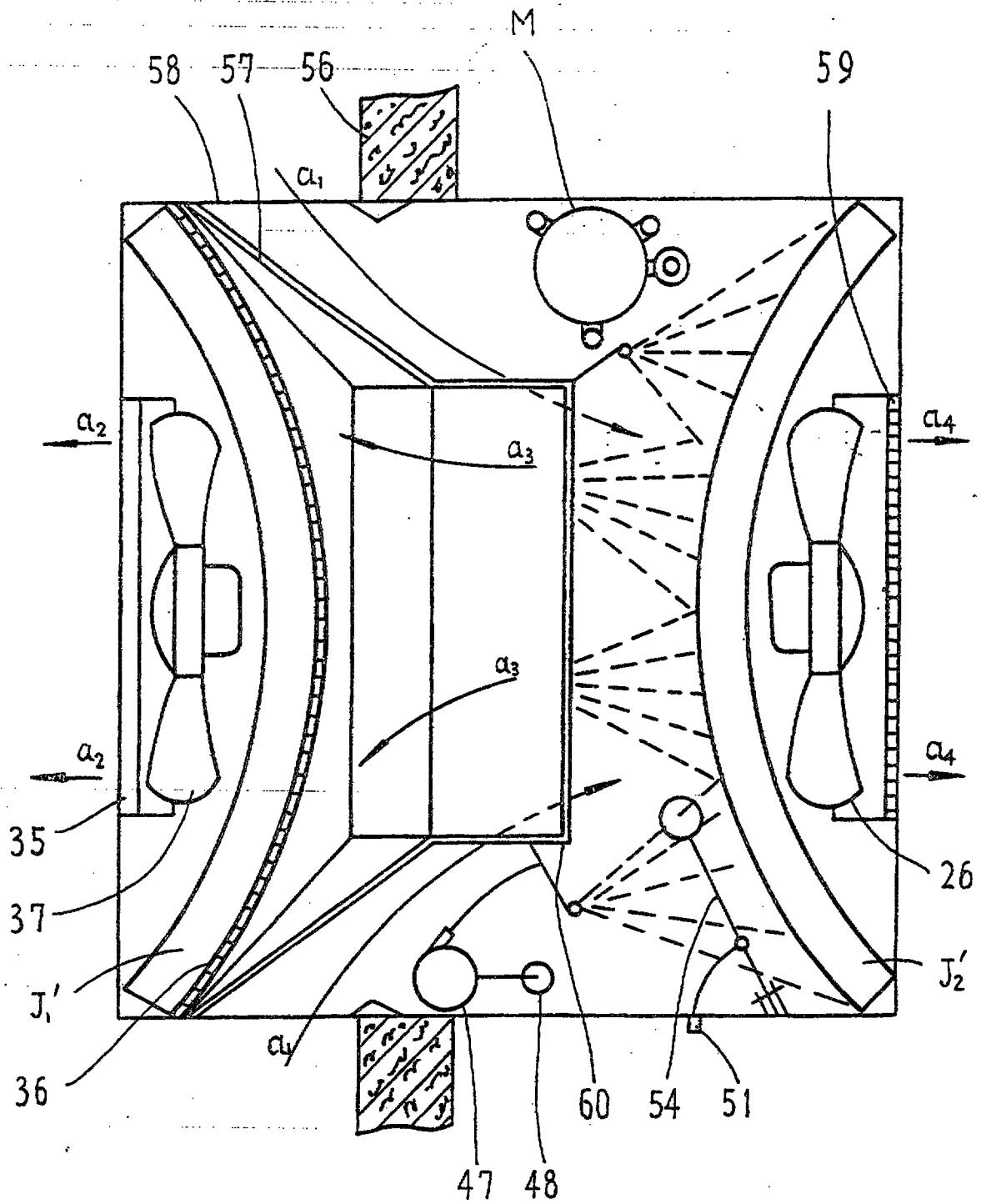


图 14

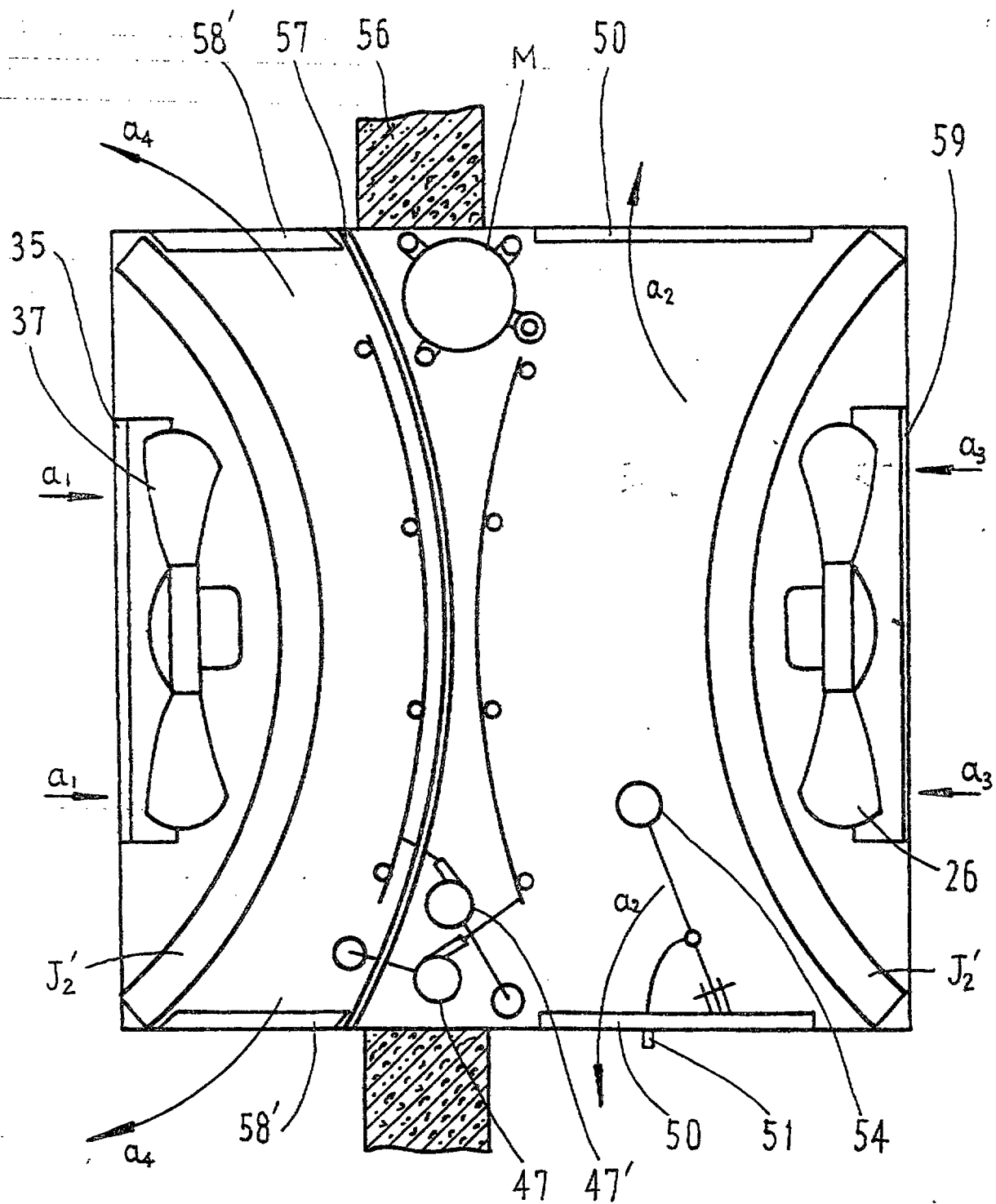


图 15

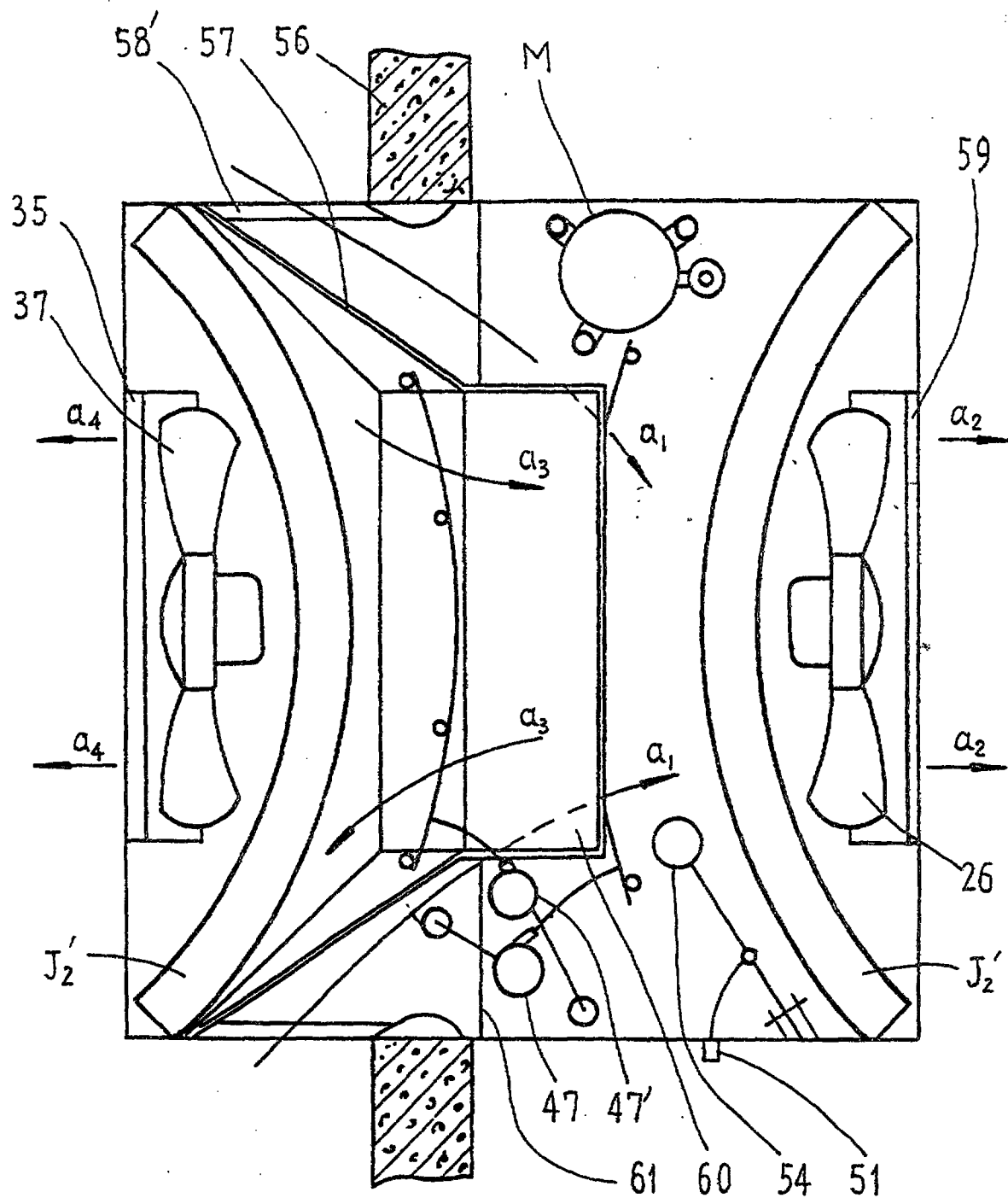


图 16

An Air-conditioner with High-Efficiency Differential Cold-valley Pipes

Technology field

The present invention relates to a kind of air conditioning apparatus, particularly to a kind of low pressure difference heat pump air conditioner with air energy as refrigerating heating circulating power.

Technology Background

The differential cold-valley pipe (herein after called J-pipe for short) is a kind of high efficiency heat exchange device featuring a large heat flow rate per unit area and enabling the end temperature difference for heat transmission to approach zero indefinitely. The Chinese patent application No. 941,121, 107.0 has put forward an " air energy 8-form circulation air conditioner" which is an all fresh air conditioner composed of an air energy heat pump J-pipe, a super condensation J-pipe, a low pressure difference energy transformation heat pump M, has rather high thermodynamic cycle efficiency and requires 100% outdoor fresh air for both cool (heat) output in its air conditioning just for achieving the optimal thermodynamic cycle efficiency. However, the above-mentioned technical scheme is mainly pointing to the theoretical research of 8-form circulation and in need of further improvement with respect to heat exchange and thermodynamic cycle efficiency of J- pipe . There still exist quite a few problems in its cooling-weight ratio, volumetric ratio, industrialization of manufacturing process and reducing product cost, hence it is difficult to achieve a fundamental result in solving the three major difficult problems (high energy consumption , low air quality, limited use of CFCs (chloroflurocarbons).

Summary of the present invention

In order to solve the above-mentioned problems, the present invention puts forward a kind of high efficiency J-pipe air conditioner , in said air conditioner is provided an arc J1' heat exchange device which is formed by stacking alternately multiple-layer arc J1 strips and multiple-layer corrugated step corrugations and being tightly clamped up into frames composed of arc rib-shaped clamping plates and tie rods, at the contact places of clamping plates and step corrugations there are buffer cushions, ducts F' formed by step corrugations have a flow direction of S shape, and on their wall surface are cut out several long and strip-shaped heat insulating ports, each J1 strip has inner corrugated plates inserted into its flat tubes, outside the flat tubes is wrapped thin aluminum sheet, at the outlet and inlet of the working substance are



connected respectively the incoming liquid branch tube and suction vapor branch tube; in the high efficiency J pipe air conditioner is also provided an arc J2' heat exchange device which is formed by stacking alternately multiple-layer arc J2 strips and multiple-layer corrugated membrane corrugations and being tightly clamped up in frames composed of arc rib-shaped clamping plates and tie rods, at the contact places of said clamping plates and membrane corrugations there are buffer cushions, ducts F formed by membrane corrugations have a flow direction of S shape and on their wall surface are cut out several long and strip-shaped heat insulating ports, supporting frames of membrane corrugations are constituted from step corrugations made of thin aluminum or other metallic sheet or fine metallic wire mesh by adhering step membranes on their both surfaces thus to form the membrane corrugations, each J2 strip constitutes by inserting inner corrugated plates into its flat tubes has a complete $t_1' \sim t_2'$ non-isothermal working substance flow passage, at the outlet and inlet of the working substance are connected respectively incoming vapor branch tube and outgoing liquid branch tube, outside the flat tubes is wrapped aluminum sheet or corrosion resistant metallic sheet, the flat tubes can be made directly form corrosion resistant metal with membrane type evaporating surface adhered further on the outside, between the parallel arranged flat tubes and membrane type evaporating surfaces are inserted water-carrying yarns; a low pressure pump M is provided between the J1' heat exchanger device and J2' heat exchanger device, the low pressure pump M will work at a rather low condensing pressure P_2 of J2' and a rather high evaporating pressure P_1 of J1' and can jointly convey liquid and vapor; the maximum refrigerating capacity can be obtained when the circulating working substance is a single or mixed (azeotropy or non-azeotropy) refrigerant, the J-J-form circulation and all fresh air 8-form circulation of the highest circulation efficiency can be obtained when the circulating working substance is a working substance pair composed of absorbent and refrigerant.

The present invention aims at creating a kind of series J pipe air conditioners with rather high practical value and rather high thermodynamic cycle efficiency, and striving to solve the three major difficult problems confronting the current air conditioning industry as high energy consumption, low air quality, limited use of Chlorofluorocarbons (CFCs)



The present invention, first of all, is striving for the raise of heat exchange efficiency and thermodynamic cycle efficiency and full utilization of air energy. The high efficiency J pipe means that heat exchanger of rather small volume can achieve large heat exchange capacity and rather low heat transmission temperature difference. Due to high efficiency characteristics of J pipe, the key technical indices of the present invention on cooling-weight ratio, volumetric ratio (volume occupied by unit refrigerating capacity air conditioning), manufacturing cost, etc. are superior to current air conditioners by merging the full utilization of air energy and non-isothermal, low temperature difference heat transfer characteristics of high efficiency J pipe organically into one integral can run at a COP (refrigerating capacity / net output power of low pressure pump) value above 25 during 刀-form circulation, and run at a COP value above 30 during all fresh air 8-form circulation.

Brief explanation of accompanying drawings

Fig 1 is a schematic diagram of the cycle principle of the high efficiency J pipe air conditioner of the present invention.

Fig.2 is a front view of the J2 pipe.

Fig.3 is a top view of Fig.2

Fig.4 is an enlarged left sectional view of Fig. 2.

Fig.5 is a sectional view of the slender round tube J2 strips in Fig.2.

Fig.6 is a partial enlarged view of designation 5 in Fig.2.

Fig.7 is a sectional view of steps of the arc J2' pipe.

Fig.8 is a front view of J1 pipe.

Fig.9 is a top view of Fig.8.

Fig.10 is an enlarged left sectional view of Fig.8.

Fig.11 is a structural schematic diagram of J1 J2 刀-form extension machine.

Fig.12 is a structural schematic diagram of J1 J2 刀-form window machine.

Fig.13 is a structural schematic diagram of J1' J2' 刀-form window machine.

Fig.14 is a structural schematic diagram of J1' J2' 8-form window machine.

Fig.15 is a structural schematic diagram of J2' J2 刀-form heat pump type window machine.

Fig.16 is a structural schematic diagram of J2' J2'8-form heat pump type window machine.

The preferred embodiment mode of the present invention

Fig.1 is a schematic diagram of circulation principle of the present invention.

J1 is J1 pipe, J2 is J2 pipe, M is low pressure pump, m is capillary tube. The low pressure pump is connected between the incoming vapor tube of J2 pipe and suction vapor tube of J1 pipe, the heat pump type is connected in between a four-way conversion valve; the capillary tube m is connected between the liquid supplying tube of J2 pipe and an incoming liquid tube of J1 pipe.

Due to a rather high heat exchange efficiency of J pipe, the J1 pipe and J2 pipe by adopting (2-5) temperature zones of separation will realize 0.1~0.5 °C heat transfer temperature difference.

The working pressure of J1 pipe is P_1 , the working pressure of J2 pipe is P_2 .

Outdoor air a_3 through J1 pipe being cooled from t_n - t_1 to a_2 state is conveyed indoor, $a_2 \approx t_1$, $a_3 \approx t_n$.

Indoor air a_1 through J2 pipe from $t_1' \sim t_n'$ absorbing heat, after absorbing moisture at a_4 state is discharged outdoor, t_1' approaches wet bulb temperature of a_1 .

The liquid state dilute solution x_2 composed of absorbent and corresponding refrigerant through J2 pipe after being cooled to t_1' temperature through capillary tube m being decompressed to P_1 , in J1 pipe is heated by air gradually from $t_1 \sim t_n$ to a temperature approaching a_3 dry bulb temperature of a mixture x_3 of superheated refrigerant vapor and absorbent concentrated solution, x_3 through the low pressure pump M is pressurized to x_1 state of P_2 to enter J2 and from $t_n' \sim t_1'$ is gradually cooled to dilute solution of x_2 . The concentrated absorbent solution being cooled to $t_n' \sim t_1'$ with its surface differential pressure being rather low has a strong ability to absorb vapor state refrigerant, hence the equilibrium condensing pressure P_2 of J2 pipe is rather low.

The window machine and outdoor machine of split-body machine of high efficiency J pipe air conditioners are provided with a bottom tray, in the bottom tray is stored water solution or other cool-carrying agent solution at a certain level. The condensed water of J1 through dripping tube flows to the bottom tray and is sprayed to moisten ventilation ducts F of J2 by water circulating system through timing and metering, F ducts have water carrying and water absorbing capacity and can form a large superficial evaporating water film when it is in wetting state and its inner hydrous layer has very good thermal conductivity. So J2 radiates heat in continuously completed wet state. Hence t_1' can indefinitely approach wet bulb temperature of a_1 , and as the $t_1' \sim t_n'$ temperature rise being is rather small, the above-mentioned circulation is an 8-form circulation.

When the cooled air passing through J1 pipe is indoor air a_1 and the

cooling air passing through J2 is outdoor air a_3 , x_3 can only be heated to dry bulb temperature of a_1 ($a_1 < a_3$), the lowest temperature t_1' of J2-pipe can also only be cooled to wet bulb temperature of a_3 , and the wet bulb temperature of a_3 is higher than wet bulb temperature of a_1 . Due to changes of air state via J1 pipe and J2 pipe, the 8-form circulation will evolve to π -form circulation.

As compared with current air conditioners, the J1 pipe in 8-form and π -form circulation corresponds to evaporator, and generator, J2 pipe corresponds to condenser and absorber. The distinction lies in that the evaporating pressure P_1 of J1 is higher than the current air conditioners, while the condensing temperature and pressure P_2 are far lower than the current air conditioners; hence the low pressure pump M as compared with compressors of equal flow volume requires a net power less than $1/3$, while with a refrigerating capacity being able to increase over 1 time.

Referring to accompanying Figures 2,3,4,5,6, Fig. 2 is a front view of J2 pipe, Fig. 3 is a top view of J2 pipe, Fig. 4 is an enlarged left sectional view of J2 pipe, Fig. 5 is sectional view of slender round tubes of J2 strips, Fig. 6 is a partial enlarged view of designation 5 in Fig. 2.

J2 strips 1, membrane-type, step-shaped corrugated plates (membrane corrugations) 2, clamping plates 3, tie rods 4, curved conduits 6, pads 7, incoming vapor branch tubes 8, parallels connecting tubes 9, incoming vapor tubes 9, incoming vapor tubes 10, outgoing liquid branch tubes 11, parallel connecting tubes 12, liquid supplying tubes 13, flat tubes 14, inner corrugated plates 15, membrane type evaporating surfaces 16, heat insulating ports 17, buffer cushions 18, heat insulating strips 19, water-carrying yarns 20, step-shaped corrugated plates (step corrugations) 21, and step-shaped membrane type evaporating surfaces (step membranes) 22.

The heat exchange system of J2 pipe is formed by stacking alternately multiple-layer J2 strips 1 and multiple-layer membrane corrugations 2 and being tightly clamed up into frames composed of rib-shaped clamping plates 3 and tie rods 4. Ducts F of cooling air $a_1 \sim a_4$ is constituted from membrane corrugation 2 and J2 strips 1, both ends of each membrane corrugation 2 have each a slender rectangled strip-shaped pad 7, at the contact places of clamping plates 3 and membrane corrugations 2 there are adhered buffer cushions 18; each J2 strip 1 constitutes in its flat tube (14) a complete from $t_n' \sim t_1'$ non-isothermal working substance passage, at the inlet of working substance there is the incoming vapor branch tube 8 connected in parallel to the parallel connecting tube 9 (or distributor) of the incoming vapor tube 10, at the outlet of working substance there is the outgoing liquid branch tube 11 connected in parallel to the parallel connecting tube 12 (or distributor) of

the liquid supplying tube.

See Figs. 3,4. Two flat tubes 14 arranged in parallel spacing in J2 strips 1 are inserted with inner corrugated plates 15 made of thin aluminum sheet for enlarging heat dissipating area of working substance fluid, at the turns of flow of working substance are provided curved conduits 16, at the outlet and inlet of working substance are connected respectively the outgoing liquid branch tube 11 and incoming vapor branch tube 8, outside flat tubes is wrapped membrane type evaporating surfaces 16, between flat tubes 14 and membrane evaporating surfaces 16 are inserted 2 water-carrying yarns 20, the water-carrying yarn 20 is divided into 2 temperature zone by a heat insulating strip 19 made of heat insulating material, hence each flat tube 14 constitutes an isothermal heat exchange zone, the flat tube can be made of thin metallic tube about $\Phi 6$ mm pressed into narrow and thin flat tube.

Fig. 5 is sectional view of slender round tubes of J2 strips. The working substance flow passages are slender round tubes 14' into which are inserted inner corrugated plates 15, each slender round tube 14' constitutes an isothermal heat exchange zone with heat insulating strip 19 as boundary, the advantages of J2 strips composed of slender round tubes 14' lies in more divided temperature zones available and reduce the pressure of membrane corrugations 2 and clamping plates 3. Flat tubes 14 and slender round tubes 14' can be made of choice corrosion resistant metal of high heat conductivity, in case of using copper or aluminum material, surface corrosion-resisting treatment ought to be conducted to raise durability.

See Figs 5,6, the membrane corrugations (2) with corrugated fins are made of thin metallic sheet or ribbon of metallic wire mesh with non-woven fabric adhered to both surfaces, after being formed the tow surfaces of the middle step corrugation 21 are adhered with step membranes 22 to compose the membrane corrugation 2, on the vertical wall face of membrane corrugations 2 at the upper side of heat insulating strip 19 are cut out long and strip-shaped heat insulating ports 17 for dividing into heat exchange temperature zones and cooling air can herein form turbulence to strengthen heat exchange. The step corrugations 21 as supporting frames can be made of extra thin corrosion resistant metallic (stainless steel or stainless iron) sheet or fine metallic wire mesh. The membrane type evaporating surfaces 16, step membrane 22, water-carrying yarns 20 are made of corrosion resistant non-woven fabric (adhesive-bonded fabric) of very strong water-carrying and water absorbing ability, during moistened state, the membrane type evaporating surfaces 16, step membranes 22, water-carrying yarns 20 are saturated with water, the step-shaped ducts F constituted from step membranes 22

and membrane evaporating surfaces 16 have large water evaporating surface area, the water containing layers also have excellent heat conducting property; the water content stored in water-carrying yarns 20 can make F surfaces under a continuously moistened state to extend the interval of water spraying time as long as possible, and on the other hand to strengthen the heat conductivity between J2 strips 1 and membrane corrugations 2. Since ducts F are working under a continuously all-wetted state, hence x2 can be cooled to wet bulb temperature of a1. The step-shaped ducts F can be designed in their lateral or longitudinal flow directions to an S shape to further enhance heat exchange performance.

The mixture x1 of superheated refrigerant vapor and absorbent concentrated solution compressed to P2 by the low pressure pump M enters from incoming vapor tubes 10 through parallel connecting tubes (or distributors) 9 into various incoming vapor branch tubes 8, the dilute solution x2 which is cooled gradually and non-isothermally from $t_n' \sim t_1'$ to wet bulb temperature of a1 in the flat tubes 14 (or slender round tubes 14') of J2 strips 1 converges from the outgoing liquid branch tubes into the parallel connecting tubes (or distributors) 12 and flows through the liquid supplying tubes 13 to the J1 pipe.

Fig. 7 is a sectional view of steps of the arc J2' pipe. In the figure there are 3 flat tubes 14 in the J2 strips 1 arranged along concentric arc direction in parallel spacing, ducts F of membrane corrugations 2 show a sector-shaped arrangement, the rest structures are identical with J2 pipe. The J2' pipe can further enlarge heat dissipating area, lower ventilation resistance, cooling-weight ratio and volumetric ratio.

J2 and J2' are a kind of all-wetted heat exchanger of very high heat exchange efficiency to have a wide application scope, and are generally used as condenser in J pipe air conditioners, however, can also be used as evaporator.

Referring to Figs. 8,9,10, Fig. 8 is a front view of J1 pipe, Fig. 9 is a top view of J1 pipe, Fig. 10 is an enlarged left sectional view of J1 pipe

Clamping plates 3, tie rods 4, curved conduits 6, pads 7, flat tubes 14, inner corrugated plates 15, J1 strips 30, step-shaped corrugated plates (step corrugations) 31, ducts F', incoming liquid branch tubes 23, distributors 24, capillary tubes 25, split-flow heads 34, liquid supplying tubes 13, vapor suction branch tubes 27, parallel connecting tubes 28, vapor suction tube 29, heat insulating chambers 32, water-leaking yarns 33, heat insulating ports 17.

The heat exchange system of J1 pipe is formed by stacking alternately multiple-layer J1 strips 30 and multiple-layer step corrugations 31 and being tightly clamped up into frames composed of rib-shaped clamping plates 3 and tie rods 4. Ducts F' of cooled air

a3→a1 are constituted from step corrugations 31 and J1 strips 30, both ends of each step corrugation 31 have a slender rectangled strip-shaped pad 7, at the contact places of clamping plates 3 and step corrugations 31 there are adhered buffer cushions 18; each J1 strips 30 in flat tubes 14 constitutes a complete from t1~tn non-isothermal working substance flow passage, at the outlet of working substance is connected an incoming liquid branch tube 23, the incoming liquid branch tube 23 is connected in parallel to a distributor 24 of the capillary tube 25, at the outlet of working substance is connected a vapor suction branch tube 27, the vapor suction branch tube 27 is connected in parallel to the parallel connecting tube (for distributor) 28 of vapor suction tube 29.

The step corrugations 31 with corrugated fins are made of thin aluminum sheet, the spacing and height of their step-shaped ducts F' are designed according to heat dissipating characteristics of air and heat transfer temperature difference requirement for refrigeration, their step-shaped slope is rather small to approximate a rectangle, ducts F' can be designed in their lateral or longitudinal flow direction to an S shape to further enhance heat exchange performance, at the upper side of heat insulating chambers 32 on the vertical wall surfaces of the step corrugations 31 are cut out long and strip-shaped heat insulating ports 17 used to divide heat conducting temperature zones and to enhance heat exchange.

In Figs. 9, 10, each J1 strip 30 has 3 flat tubes 14 arranged in parallel spacing and in the flat tubes 14 are inserted inner corrugated plates 15 for enlarging working substance heat absorbing area, at the turns of flow of working substance, there are curved conduits 6, outside the flat tubes 14 is wrapped thin aluminum sheet to make F' as continuous uniform flow passages, hence J1 strips 30 and step corrugations 31 are the same aluminum sheet at their joining places as the same metal being less easy to cause electrochemical corrosion. The enclosed air chambers formed between the thin aluminum sheets and flat tubes 14 are heat insulating chambers 32 being used to divide heat conducting temperature zones so as to make each flat tube 14 constitute an isothermal heat exchange zone. The flat tubes 14 adopt less width and rather thin tube wall, less width can decrease the loading of step corrugations 31 and clamping plates 3, rather thin tube wall can enhance expansion action to make J1 strips 30 and step corrugations 31 nestled tightly against each other to enhance heat exchange.

The liquid state dilute solution x2 composed of absorbent and refrigerant enters from the liquid supplying tube 13 into the split-flow head 34 to flow in split streams to various capillary tubes 25, from capillary tubes to enter into distributors 24 of various sets and to pass

through various incoming liquid branch tubes 23 to enter the working substance flow passage of J1. x_2 in flat tubes 14 is heated by outdoor air a_3 gradually to superheated refrigerant vapor of dry bulb temperature of a_3 and the liquid vapor mixture x_3 of superheated concentrated absorbent solution, and converges from the vapor suction branch tube 27 into parallel connecting tube 28 (or distributor) through vapor suction tube 29 to be pumped away by the low pressure pump M, simultaneously outdoor air a_3 is lowered in temperature and in moisture in ducts F' to a_1 state to be inputted indoor, the temperature of a_1 approaches the evaporating temperature of refrigerant in J1 strips 30. The strip-shaped water-leaking yarns 33 at the left side of J1 strips 30 make F' ducts of J1 pipe on air exit surface form a mutually linked up water flowing surface, so as being able to quickly eliminate the condense water on surface of the step corrugations 31. The thin aluminum sheet selected for making step corrugations 31 and wrapping J1 strips 30 ought to be hydrophilic aluminum sheet.

Same as J2 pipes, the J1 pipe can similarly be made into arc J1' pipe, the J1 pipe is generally used as evaporator in J pipe air conditioners, however, it can also be used as condenser to make into J1J1 type J pipe air conditioners. J1 pipe is a kind of heat exchanger of rather high heat exchange efficiency apparently with extensive application value.

Fig. 11 is a structural schematic diagram of J1J2 刀-form split-body machine. J1 means J1 pipe is used as evaporator, J2 means J2 pipe is used as condenser, split-body machine means split-body type air conditioner, 刀-form means 刀-form circulation.

The indoor machine is composed of a J1 (or J1') pipe, a fan 37, etc. Indoor air a_1 under suction action of the fan 37 mounted in front of J1 pipe is from the rear of J1 pipe through a filter screen 36, after being cooled to a_2 in J1 pipe through guide of an adjustable damper 35 and then is conveyed indoor, the temperature of a_2 can be defined by the pressure state of P1. The condense water is led to the bottom tray of the outdoor machine through a dripping tube 41 connected to an adapter 38, the liquid supplying tube 13 for working substance is connected to an adapter 39, the vapor suction tube 29 for working substance is connected to an adapter 40. Due to a rather low ventilating resistance of J1 pipe (or J1' pipe), hence an axial flow fan may be used.

The outdoor machine is composed of a J2 (or J2') pipe, fan 26, low pressure pump M, bottom tray, water level controller, water circulating system, etc. Outdoor air a_3 under suction of the fan 26 at the right side of J2 pipe from left side through a water baffle 50 to absorb heat and moisture in the ducts F of J2 to a_4 state is discharged to outdoor atmosphere. The water level in bottom tray is controlled by a water

supply tube of the water level controller. The water circulating system is composed of a water pump 47, filter 48, nozzles 49 and connecting tubing to a automatically control the system at intervals and in timing, metering to moisten the air facing surface of J2. The low pressure pump M is mounted in the bottom tray, water baffle 50 is mounted at air inlet to prevent water mist from splashing out.

The working substance connecting tubing of the J1J2 刀-form split-body machine is the same as split-body air conditioners for sale on market, the liquid supplying tube 13 is connected to a connector valve 45 of the outdoor machine, the vapor suction tube 29 is connected to a connector valve 44 of the outdoor machine. The dripping tube 41 is connected to an adapter 46 of the outdoor machine to lead condensed water to bottom tray.

The J1J2 刀-form split-body machine has rather high thermodynamic cycle efficiency, its outdoor unit made of J2 pipe can also be equipped with the indoor unit of the current air conditioner, however, with a somewhat lowered efficiency.

Fig. 12 is a structural schematic diagram of a J1J2 刀-form window machine. J1 means the evaporator uses J1 pipe, J2 means the condenser uses J2 pipe, 刀-form window machine means a window type air conditioner of 刀-form circulation. Its ventilation structure is the same as window machines for sale on market, a centrifugal fan 55 will suck air at the rear side of J1, indoor air a1 is from one side of the face plate through a filter screen 36 to be cooled in ducts F' of J1 to a2, then through a volute passage to pass the guide of a guiding air damper 35 at the other side of face plate and is conveyed indoor. Outdoor air a3 from both sides outside the wall through a water baffle to absorb heat and moisture in ducts F of J2 to a4 state is sucked by fan 26 to outdoor atmosphere. The water level in bottom tray is controlled by a water level controller composed of a float 54, an on-off port 53, a support 52, and a water supply slender tube 51. The water circulating system is composed of a water pump 47, a filter 48, etc. to spray and moisten the air facing surface of J2 at intervals in timing and metering (generally to spray about 15 seconds every 20 minutes). The low pressure pump is mounted in the bottom tray, the water baffle is mounted at both sides of air inlet outside the wall.

Fig. 13 is a structural schematic diagram of a J1'J2' 刀-form window machine. A fan 37 in front of indoor side is mounted in the concave arc of J1', under its suction indoor air a1 from air inlets 58 on both indoor sides through a filter screen 36 from the concave arc face of J1' pipe enters ducts F' to be cooled to a2 then through guide of an adjustable air

damper 35 and is conveyed indoor. A fan 26 at the rear end on the outdoor side is mounted in the concave arc of J2', under its suction outdoor air a3 from a water baffle 50 on both sides of outside wall 56 through the convex arc face of J2' pipe enters ducts F to absorb heat and moisture to a4 state and is discharged to outdoor atmosphere.

A protecting screen 59 at the outdoor rear end face is use to protect the fan 26, an arc partition 57 in the middle is use to insulate heat and separate ducts, the mounting of water circulating and level control systems and low pressure pump M in bottom tray is not repeated.

Fig. 14 is a structural schematic diagram of J2'J2' 8-form window machine.

An indoor front fan 37 and an outdoor rear fan 26 are mounted respectively in the concave arc of J1' pipe and J2' pipe, and under their suction actions:

outdoor air a3 from an oblique window 60 on top of outside wall 56 through a filter screen 36 from the convex arc face of J1 pipe enters ducts F' to be cooled to a2 then through the guide of an adjustable damper 35 and is conveyed indoor, the temperature of a2 can be set by P1 state.

Indoor air a1 from air inlets at both sides indoor through the convex arc face of J2' pipe enters ducts F to absorb heat and moisture to a4 and is discharged to outdoor atmosphere.

In the bottom tray there are a water level controller and a water circulating systems and a low pressure pump.

In the bottom tray of the above -mentioned J1, (J1'), J2, (J2') 刀-form and 8-form window machines or outdoor machines, there are all water circulating and water level control systems, under air state of ordinary humidity the consumption of water is very little, in case of water deficit state a proper amount of cool-carrying agent not readily volatile to air as glycerin or glycol water solution may be filled in the bottom tray to constitute a self-sufficient water equilibrium circulating system.

Fig. 15 is structural schematic diagram of a J2'J2' 刀-form heat pump type window machine. The condenser and evaporator all use J2' pipe for ready change-over during heat generating. During refrigerating, the fans, J pipes, and ventilating structure are identical with J1'J2' 刀-form window machine of Fig.13. Air inlet 58 on indoor both sides can be remade into adjustable air windows 58' to be used as water baffles during refrigerating and as adjustable air windows during heat generating, the water solution in the bottom tray is separated into indoor bottom tray and outdoor bottom tray by a partition 57, each J2' pipe is allocated a set of water circulating system compose of water pump, filter, nozzles and connecting tubing. In the bottom tray may be filled any one kind of water solutions of cool-carrying agent as glycerin, glycol, lithium chloride,

lithium bromide not readily volatile to air to constitute an outside circulating working substance of J2' pipe and water equilibrium.

During refrigerating, the water pump 47 sprays the dilute water solution in the indoor bottom tray at intervals and in timing, metering to outdoor J2' pipe, simultaneously the water pump 47' sprays the concentrate water solution in the outdoor bottom tray at intervals and in timing, metering to indoor J2' pipe, to constitute a water equilibrium system of supplying water or supplying no water.

During generating heat, the reversing valve transforms the indoor J2' pipe into a condenser, the indoor and outdoor fans 37, 26 will rotate in the reverse direction. Indoor air a1 through the adjustable damper 35 from the concave arc face of indoor J2' enters ducts for increasing heat and moisture to a4 and is led indoor from the adjustable air window 58'; outdoor air a3 through protecting screen 59 from the concave arc face of outdoor J2' passes ducts for reducing temperature and moisture to a2 and is discharged to atmosphere from water baffles 50 at both sides of outside wall. With the same reason, the water pump 47 sprays the concentrated water solution in the indoor bottom tray at intervals and in timing, metering to the convex arc face of outdoor J2' pipe to prevent ducts from frosting, simultaneously the water pump 47 also sprays the dilute water solution in the outdoor bottom tray to the convex arc face of indoor J2' to adjust the humidity of a4, so as to constitute an equilibrium system of supplying water or supplying no water and to adjust the required humidity.

When the cool-carrying agent water solution in bottom tray is a salt category of lithium chloride or lithium bromide, the material for making flats tubes 14 or slender round tubes 14' of J2 strips ought to be corrosion resistant stainless steel. During refrigerating, the bottom tray may also use water alone as an outside circulating working substance.

The J2'J2' 刀-form heat pump type window machine of the above-mentioned Fig.15 can be decompose along the partition 57 into indoor and outdoor side two portions, hence it is possible by the same reason to make up a J2'J2' 刀-form heat pump type split-body machine.

Fig.16 is a structural schematic diagram of a J2'J2' 8-form heat pump type window machine. The condenser and evaporator all use J2' pipe for ready conversion of refrigerating and heat generating, during refrigerating the ventilating structure is the same as J1'J2' 8-form window machine of Fig. 14. The bottom tray is divided by a partition 61 into indoor bottom tray and outdoor bottom tray two portions, the indoor and outdoor J2' have each a set of water circulating system, in the bottom tray is filled in a cool-carrying agent water solution not readily volatile to air to constitute an outside circulating working substance of supplying

water or supplying no water.

During refrigerating, the water pump 47 sprays the dilute water solution in the indoor side bottom tray at intervals and in timing, metering to outdoor J2' pipe, the water pump 47' sprays the concentrated water solution in the outdoor side bottom tray at intervals and in timing, metering to indoor J2' pipe to constitute an outside working substance circulation. During spraying mist, indoor and outdoor fans 37 and 26 ought to stop rotation.

During generating heat, the reversing valve transforms the indoor J2' pipe into a condenser and transform the outdoor J2' pipe into an evaporator. Indoor air a1 from adjustable air windows 58' on indoor both sides through outdoor J2' pipe to be cooled to a2 is discharged to outdoor atmosphere, outdoor air a3 from oblique windows on top of outside wall 56 through indoor J2' to absorb heat and moisture to a4 passes the guide of an adjustable damper 35 and is conveyed indoor. Its outside circulating working substance and water circulating system are identical with J2'J2' 刀-form heat pump type window machine.

The above-mentioned 刀-form circulating and all-fresh air 8-form circulating J pipe air conditioners adopt therein circulating working substance pair composed of absorbent and its corresponding refrigerant, its object is to store the heat energy released from refrigerated air during cooling procedure in the absorbent solution to the maximum degree (transformed into chemically absorbed energy), or in other words the absorbent solution will be, to the maximum degree, heated and concentrated by refrigerated air from $t_1 \sim t_n$ to lower the condensing pressure as far as possible, and to make the low pressure pump M run at the lowest obtainable $P_2 - P_1 = \Delta P$ pressure difference. In the same J pipe air conditioner, it is also possible to use a single or mixed (azeotropy or non-azeotropy) refrigerant (not working substance pair) as circulating working substance, at this moment the J pipe unit can obtain the maximum refrigerating capacity, however, right now the running of J pipe air conditioner is in Carnot or Lorentz cycle.

The preferred outside circulating working substance of J1 (J1') J2 (J2') 8-form or 刀-form J pipe air conditioners is water, its action is to the maximum degree able to lower the condensing pressure P_2 and temperature of J2 pipe, the object to add cool-carrying agent (glycerin, glycol) water solution in the bottom tray of their window machines or outdoor machines is to compensate for inadequacy of condensation of J2 pipe during water deficient state (water supplying slender tube unable to supply water continuously).

For any J2(J2')J2(J2') 8-form or 刀-form J pipe air conditioner

composed of 2 J2 pipes being used simultaneously, each J2 pipe is allocated a set of water circulating system. When the outside circulating working substance in the bottom tray is a category of lithium chloride, lithium bromide, calcium chloride aqueous absorption salts water solution, the concentrated salt water solution is sprayed to the air exit surface of J2 pipe (evaporating J2 pipe) used as evaporator to make it uniformly distributed over the surfaces of membrane type evaporating surface 16 and membrane corrugation 2 surface of ducts F, the cooled air in ducts F has strong moisture and heat dissipating action to very much strengthen the heat exchange action of J2 pipe, the circulating working substance in J2 strips can also obtain heat from cooled air to the maximum degree, on the other hand it is also possible to raise the defined evaporating temperature and pressure P1 and during heat generating running to prevent ducts F from surface frosting and facilitate to extract heat and humidity from air being cooled. The concentrated salt water solution absorbs water and releases heat from ducts surfaces and is gradually transformed into dilute salt water solution to flow into bottom tray from air facing surface, the water circulating system provided to the condenser J2 pipe (condensing J2 pipe) periodically extracts it away and sprays toward the air facing surface of cooling air (air to be generated out of heat during heat generating) of condensing J2 pipe, then the moisture is released and heat is absorbed on ducts F surfaces and gradually transforms into concentrated salt water solution to flow from air exit surface and converges to bottom tray, the water circulating system provided to the evaporating J2 pipe extracts..... and sprays toward air exit surface of evaporating J2 pipe. The action of the two J2 pipes transforms with each other during refrigerating and heat generating. The above-mentioned circulation is called the outside 8-form circulation from raising evaporating pressure P1 to raise thermodynamic cycle efficiency, and during generating heat it is possible to raise the temperature and humidity of air to be heated to prevent ducts F surfaces of evaporating of J2 pipe from frosting.

When glycerin or glycol such kind of water solution is used as outside circulating working substance, the main object lies in preventing evaporating J2 pipe ducts F surfaces from frosting and raising the temperature and humidity of output warm air of condensing J2 pipe, so as to raise the air conditioning comfort degree during generating heat and to prevent water deficiency by water supplying slender tube during refrigerating.



Claims

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1. A kind of air conditioner with high-efficiency differential cold-valley pipes comprises differential cold-valley pipes J1 and pipe J2 and a low pressure pump M, characterized in that:
 - A. In the air conditioner with high-efficiency differential cold-valley pipes is provided an arc J1' heat exchange device, said heat exchange device is formed by attacking alternately multiple-layer J1' strips (30) and multiple-layer corrugated step corrugations (31) and being clamped up into frames composed of arc rib-shaped clamping plates (3) and tie rods (4), at the contact places of clamping plates (3) and step corrugations (31) are disposed buffer cushions (18), ducts F' formed by step corrugations (31) have a flow directions of S shape and on their wall surfaces are cut out several long strip-shape heat insulating ports (17), each J1 strip (30) has in its flat tubes (14) inserted with inner corrugated plates (15), outside flat tubes is wrapped thin aluminum sheet, at the outlets and inlets of working substance are connected respectively incoming liquid branch tubes (23) and vapor suction branch tubes (27).
 - B. In the air conditioner with high -efficiency differential cold-valley pipes is also provided an arc J2' heat exchange device, said device is formed by stacking alternately multiple-layer arc J2 strips (1) and multiple layer corrugated membrane corrugations (2) and being tightly clamped up into frames composed of arc rib-shaped clamping plates (3) and tie rods (4), at the contact places of clamping plates (3) and membrane corrugations(2) are disposed buffer cushions(18), ducts F formed by membrane corrugations have a flow direction of S shape and on their wall surface are cut out several long strip-shaped heat insulating ports (17), supporting frames of membrane corrugations are step corrugations (21)made of thin aluminum or other metal sheet or metallic wire mesh and adhered with step membrane on their both surfaces thus to constitute membrane corrugations (2), each J2 strip (1) has its flat tubes (14) inserted therein with inner corrugated plates (15) to constitute a complete t1'~tn' non-isothermal working substance flow passage, at the inlet and outlet of working substance are connected respectively an incoming vapor branch tube (8) and an outgoing liquid branch tube (11), outside flat tubes (14) is wrapped aluminum sheet or corrosion resistant metallic sheet, flat tubes can be directly made of corrosion resistant metal and are further wrapped outside with membrane type evaporating surface (16),





- between parallel arranged flat tubes (14) and membrane type evaporating surfaces (16) are inserted water-carrying yarns(20);
- c. The low pressure pump M is connected by tubing between the J1' heat exchange device and J2' heat exchange device , the low pressure pump will work between a rather low condensing pressure P2 of J2' and a rather high evaporating pressure P1 of J1' and can jointly convey liquid and vapor, the maximum refrigerating capacity can be obtained when the circulating working substance is a single or mixed(common boiling point or different boiling point) refrigerant, a 刀-form circulation and an all-fresh air 8-form circulation can be formed with high efficiency when the working substance is a working substance pair composed of absorbent and refrigerant.
2. Said air conditioner with high -efficiency differential cold-valley pipes according to claim 1, characterized in that : A plurality of flat tubes (14) in arc J1 strips (30) and arc J2 strips (1) are arranged according to parallel arc direction, step corrugations (31) and membrane corrugations (2) show a sector shape distribution, when axial flow fans are used, they can be mounted in the concave arc of J1' and J2', when flat tubes are arranged in parallel plane and straight direction, J1 and J2 will be formed plane and straight, hence step corrugations (31) and membrane corrugations (2) show a plane and straight distribution, the clamping plates (3) are also plane and straight clamping plates, the flat tubes (14) in the above-mentioned J1 strips (30) and J2 strips (1) are provided with curved conduits (6) at their turns of flow of working substance to make the parallel arranged flat tubes (14) connected in series.
 3. Said air conditioner with high-efficiency differential cold-valley pipes according to claim 1, characterized in that: Several incoming branch tubes (23) connected to J1 strips (30) are connected in parallel to distributors(24) of capillary tubes (25) , capillary tubes (25) are also connected in parallel to distributors (24) above an incoming liquid tube (13) , all vapor suction branch tubes (27) connected to J1 strips (30) are connected in parallel to parallel connecting tubes (or distributors) (28) of a vapor suction tube (29), said step corrugations (31) and inner corrugated plates (15) are made of thin aluminum sheet or water affinity aluminum sheet , step corrugations are similarly suitable for use in other multiple-layer type heat exchangers.
 4. Said air conditioner with high-efficiency differential cold-valley pipes according to claim 1, characterized in that: Step membranes (22), membrane type evaporating surfaces (16), water-carrying yarns





- (20) are made of corrosion resistant non-woven fabric (adhesive-bonded fabric)of rather good water-carrying and water absorbing property, the flat tubes (14) in J2 strips (1) are made of thin metallic tubes or slender round tubes(14').
5. Said air conditioner with high-efficiency differential cold-valley pipes according to claim 1, characterized in that: J1 and J1' used as evaporating J pipe can also be used as condensing J pipe, J2 and J2' used as condensing J pipe can also be used as evaporating J pipe, during refrigerating: When the air cooled by evaporating J pipe is outdoor air a3 and the air cooling the condensing J pipe is indoor air a1, the J pipe air conditioner is running in all-fresh air 8-form circulation, when the air cooled by evaporating J pipe is indoor air a1 and the air cooling the condensing j pipe is outdoor air a3, the j pipe air conditioner is running in 刀 -form circulation, during heat generating; when the air heated by condensing J pipe is outdoor air a3 and the air cooled by evaporating J pipe is indoor air a1, the J pipe air conditioner is running all-fresh air 8-form circulation, when the air heated by condensing J pipe is indoor air a1 and the air cooled by evaporating J pipe is outdoor air a3, the J pipe air conditioner is running in 刀-form circulation.
 6. Said air conditioner with high-efficiency differential cold-valley pipes according to claim 1, characterized in that: When window machines or outdoor machines of 8-form circulation or 刀-form circulation are composed by using J1 and J1' as evaporating J pipe, using J2 and J2' as condensing J pipe, in the bottom tray of their window machines or outdoor machines is mounted a water circulating system composed of a water pump (48), nozzles (49), and connecting tubing and controlled by an automatic control system to spray according to requirement the water solution in the bottom tray at intervals and in timing, metering , generally 15 second seconds every 20minutes, to an air facing surface of J2 and J2', the water level of bottom tray is controlled by a water level control system composed of a float (54), an on-off adapter (53), support(52), water supplying slender tube (51), the condensed water of J1 and J1' is led to the bottom tray, when the water supplying slender tube can not continuously supply water, water solution of propanetriol or ethandiol or other cool-carrying agent not readily volatile to air is added into the bottom tray to constitute a self-sufficient water equilibrium system the outdoor unit of the above -mentioned split-body machine can also be matched with the indoor machine of current air conditioners.
 7. Said air conditioner with high-efficiency differential cold-valley



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pipes according to claim1, characterized in that: When the condensing J pipe and evaporating J pipe both use J2 and J2' to compose the heat pump type 8-form or 刀-form circulation window machines or split-body machines, each J2 and J2' pipe has its own water storing bottom trays and water circulating system, wherein one bottom tray is provided with a water level control system, when water solution of lithium chloride, calcium chloride, lithium bromide water absorbing salt is added into the bottom tray: A water pump of evaporating J pipe sprays the concentrated salt solution in the condensing J pipe bottom tray at intervals and in timing, metering to an air freeing surface of evaporating J pipe, during spraying mist its fans ought to stop rotating, the concentrated salt water solution on surface of its duct F gradually absorbs moisture and releases heat to transform into dilute salt water solution and to flow to bottom tray from an air facing surface, simultaneously a water pump of condensing J pipe also spray the dilute salt water solution in the evaporating J pipe bottom tray to an air facing surface of condensing J pipe, during spraying mist its fans ought to stop rotating, the dilute salt water solution on surface of its ducts F gradually releases moisture and absorbs heat to transform into concentrated salt water solution to converge into bottom from an air freeing surface, during heat generating actions condensing J pipe and evaporating J pipe change with each other, the circulation constituted by the above-mentioned outside circulating working substance salt water solution is outside 8-form circulation, the outside circulating working substance can also be water solution of propanetriol, ehtandiol, and other cool-carrying agents not readily volatile to air, during refrigerating the outside circulating working substance can use water alone.

8. Said air conditioner with high-efficiency differential cold-valley pipes according to claim 1, characterized in that: Air inlets of outdoor air a3 of outdoor unit of its J1, J1', J2, J2' 刀-form extension machine are provided with water baffles (50), the indoor fan(37) and outdoor fan (26) at the front and rear two end faces of its J1' and J2' 刀-form window machine are mounted respectively in the concave arc of J1' and J2' , air inlets (58) of indoor air a1 are provided at two sides inside the wall (56), outdoor air a3 from a top oblique window outside the wall enters the convex arc face of J1' and is cooled in ducts F to a2 and to be conveyed indoors.
9. Said air conditioner with high -efficiency differential cold-valley pipes according to claim1, characterized in that: the indoor fan (37) and outdoor fan (26) at the front and rear two end faces are



respectively in the concave arc of indoor J2' and outdoor J2', the ventilating ports of indoor air of its 刀-form machine are provided at tow sides inside the wall (56), at the ventilating ports are disposed adjustable windows (58'), the ventilating ports of outdoor air a3 are provided at two sides outside the wall (56), at the ventilating ports are disposed water baffles (50), the air outlets of indoor air a1 of its 8-form machine are provided at tow sides inside the wall (56), at the air outlets are disposed adjustable windows (58'), outdoor air a3 from a top oblique window (60) outside the wall (56) enters the convex arc face of J2' to be cooled in ducts F or generated of heat and then to be conveyed indoors.

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Abstract

An air-conditioner with high-efficiency differential cold-valley pipes , which include J pipes and a low-pressure circulating pump, has a first arc heat-exchanger which is formed by multiple-layer ladder-shaped corrugated plates and multiple-layer arc J pipe stacked alternatively, and a second arc heat-exchanger which is formed by multiple-layer arc J pipe and multiple-layer wave-shaped film-type evaporation face stacked alternatively. A low pressure pump is connected between the first arc heat-exchanger and the second arc heat-exchanger through pipelines. The air-conditioner solves the problems that the conventional air-conditioner consumes high energy, quality of the air in the room is low and the use of CFCs is confined.

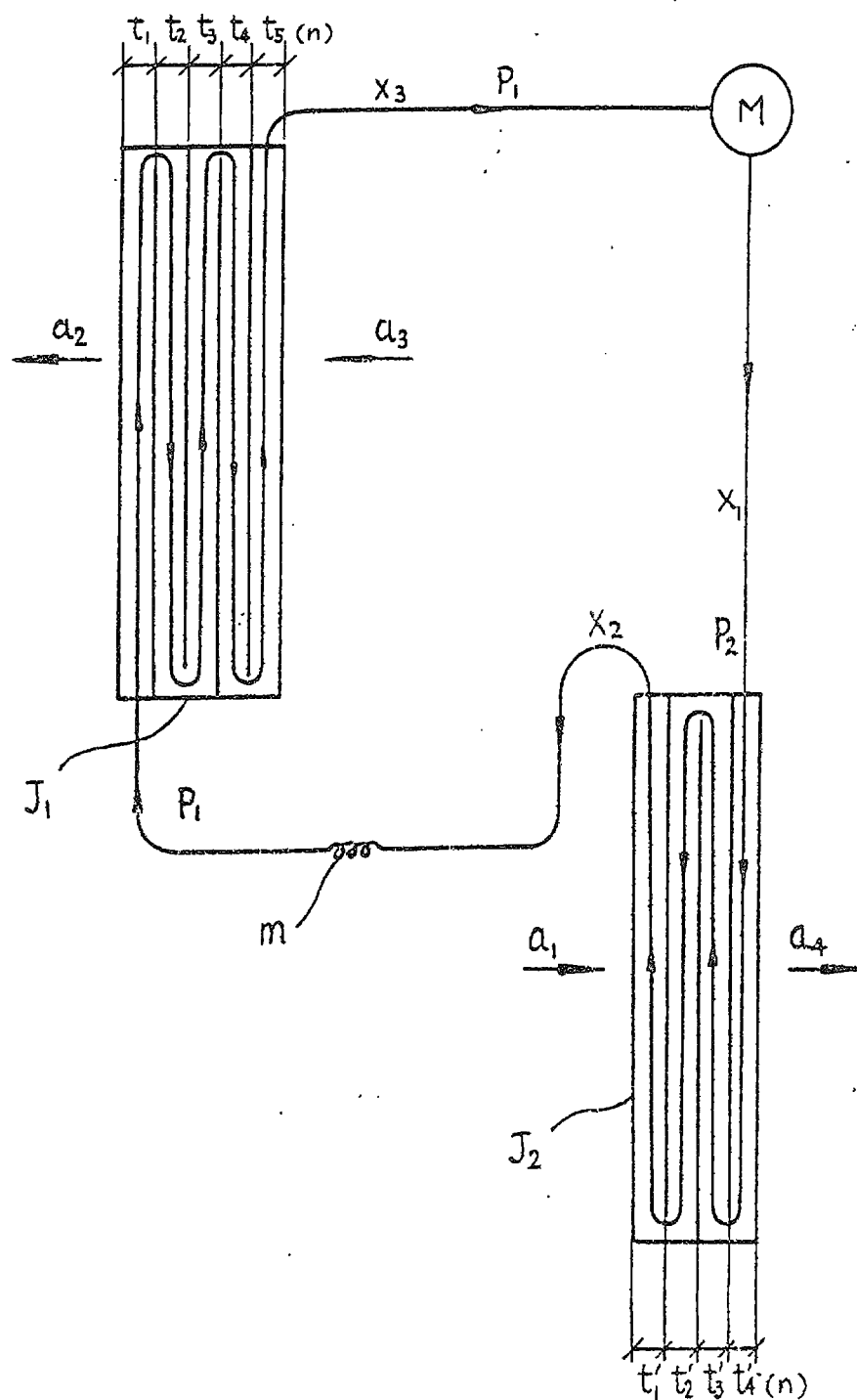


FIG.1

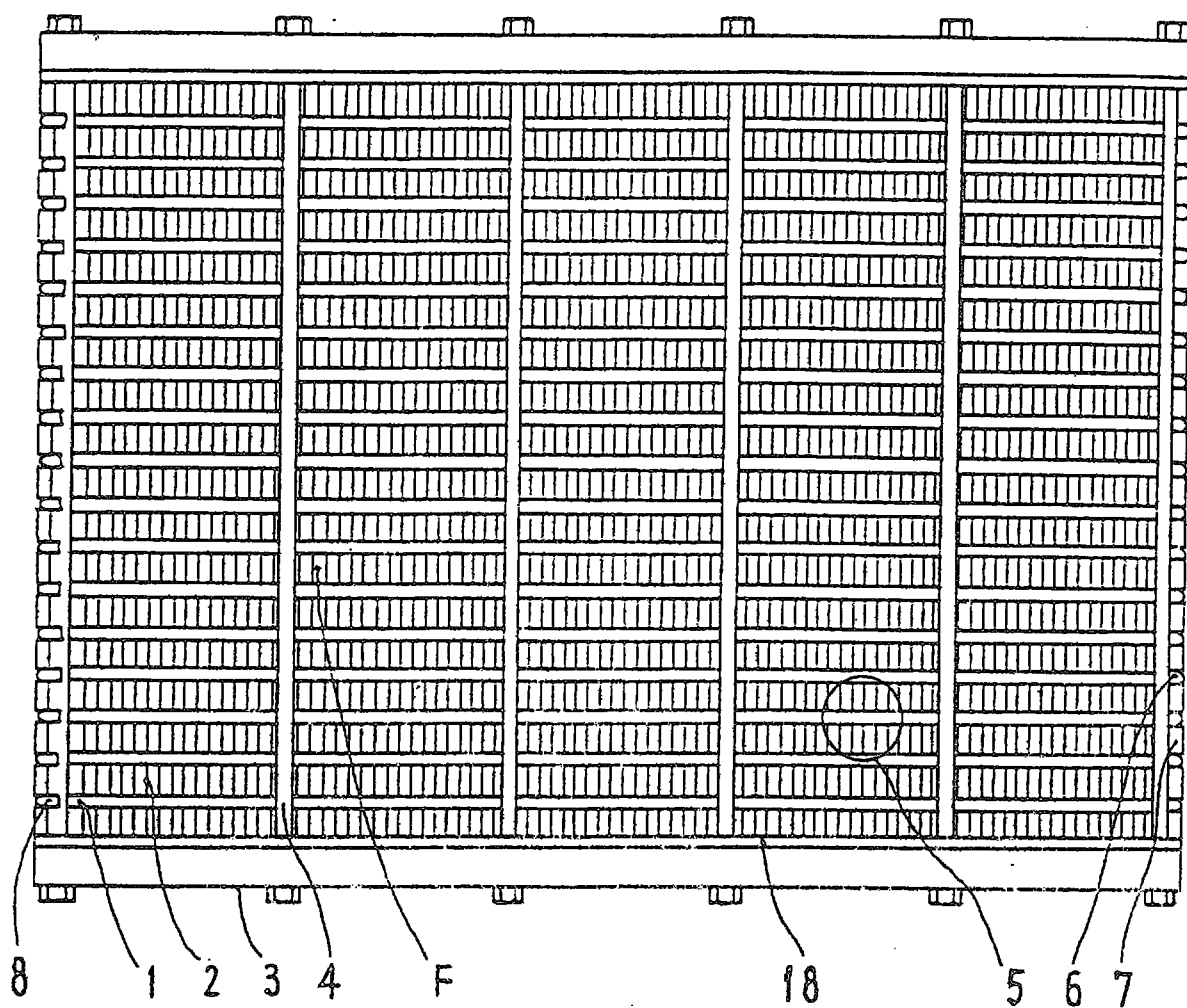


FIG. 2

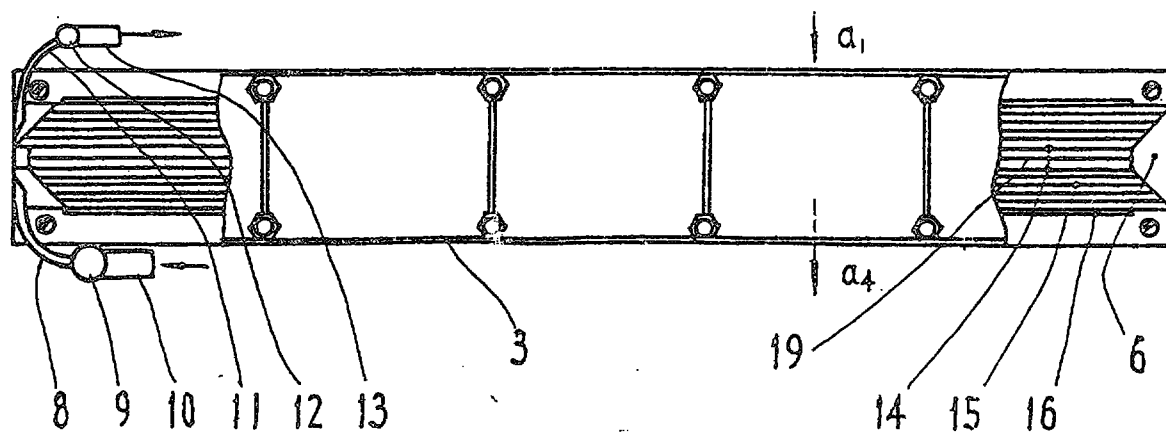


FIG. 3

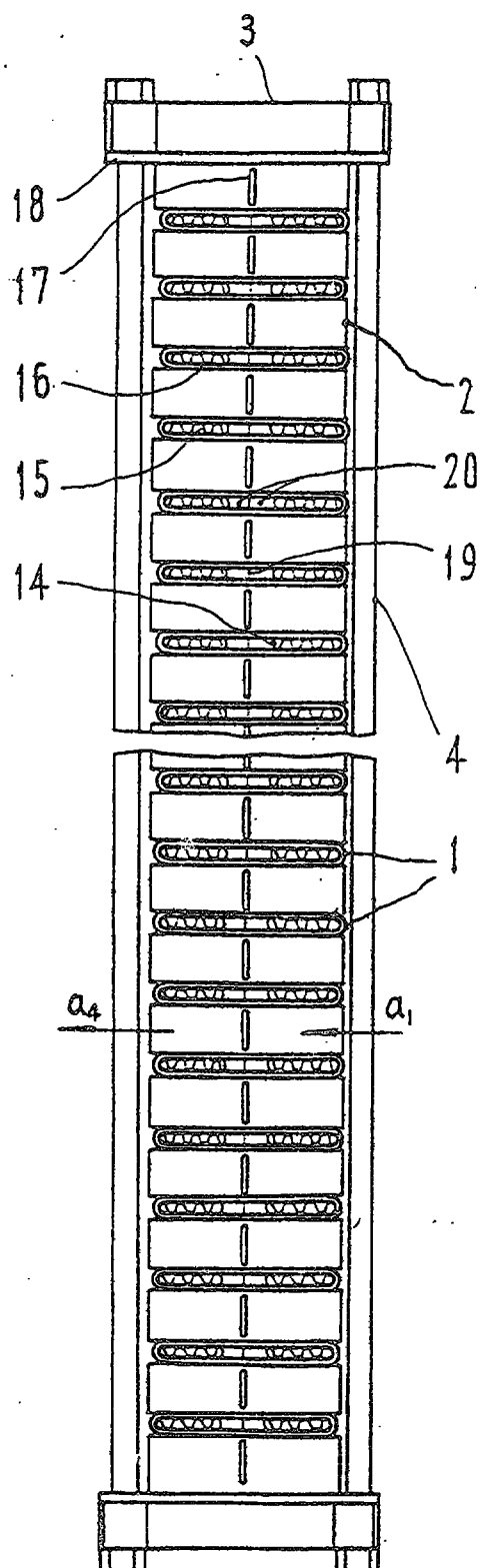


FIG. 4

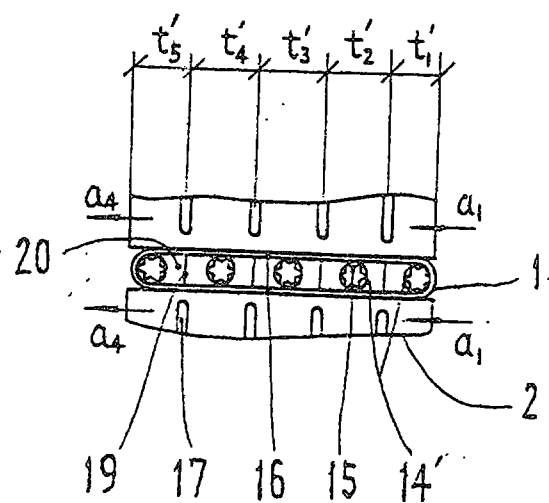


FIG. 5

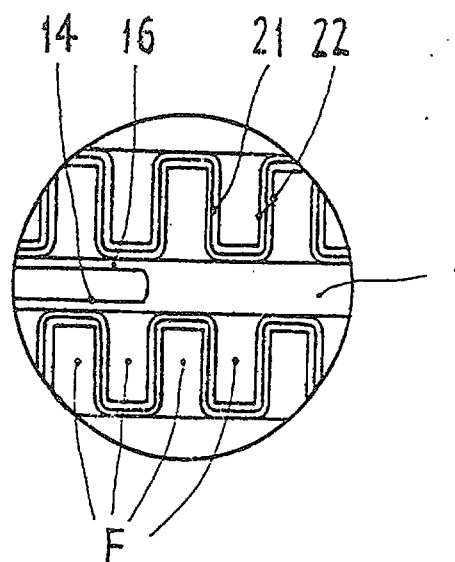


FIG. 6

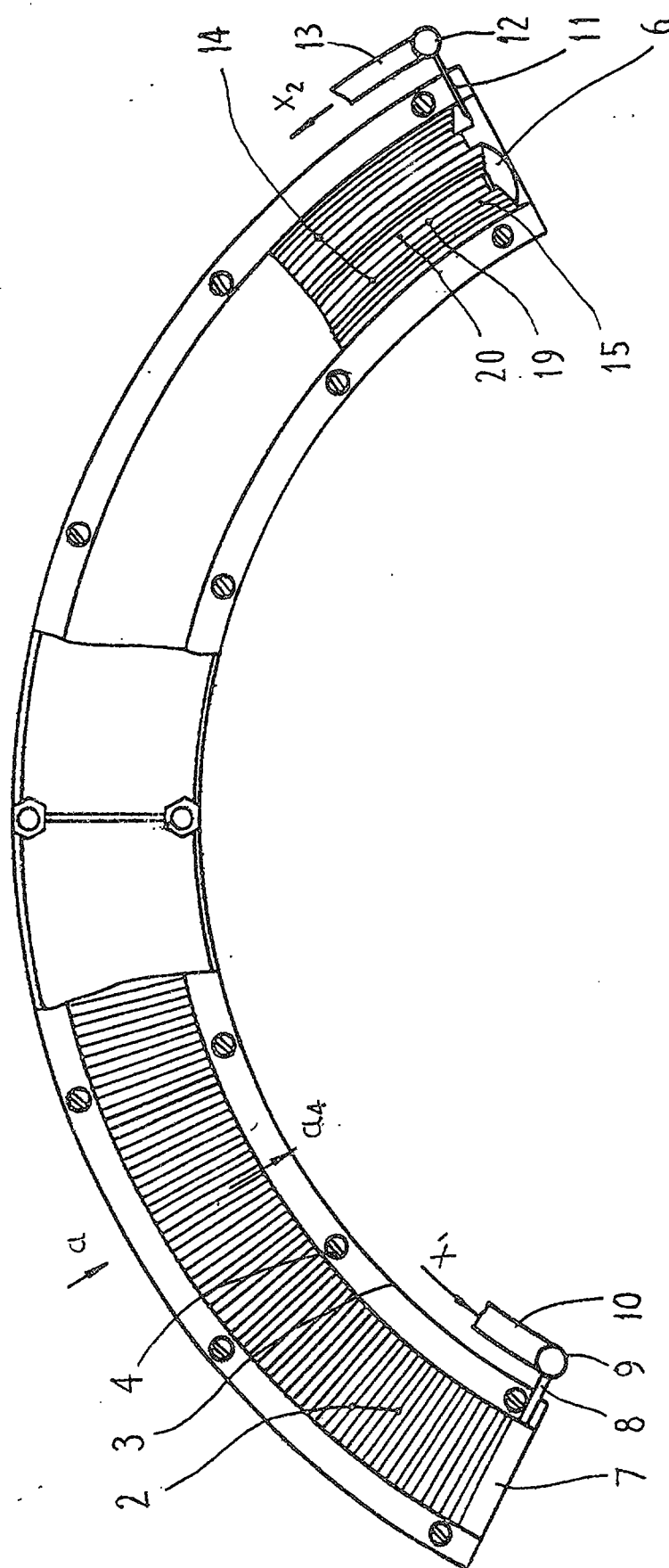


FIG. 7

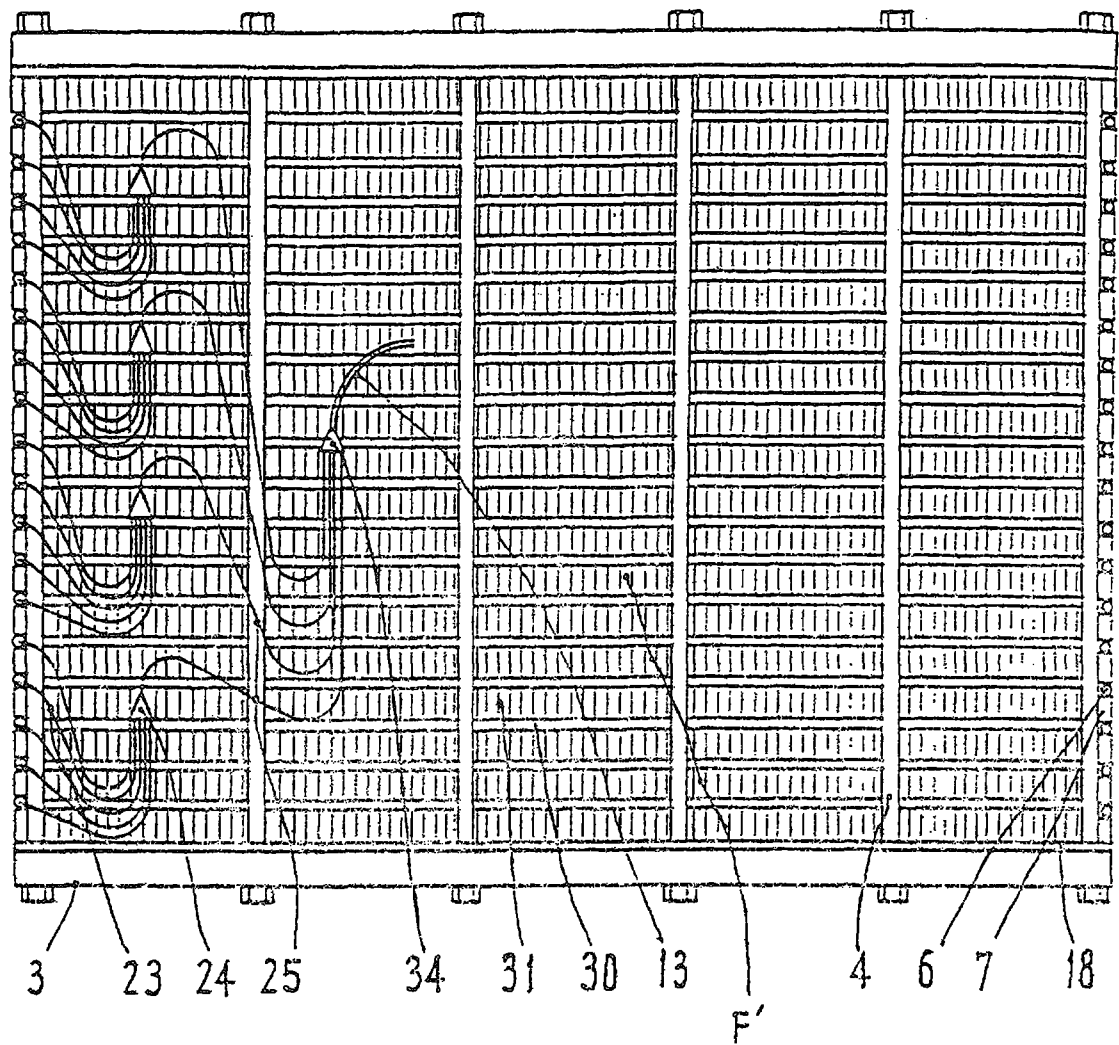


FIG. 8

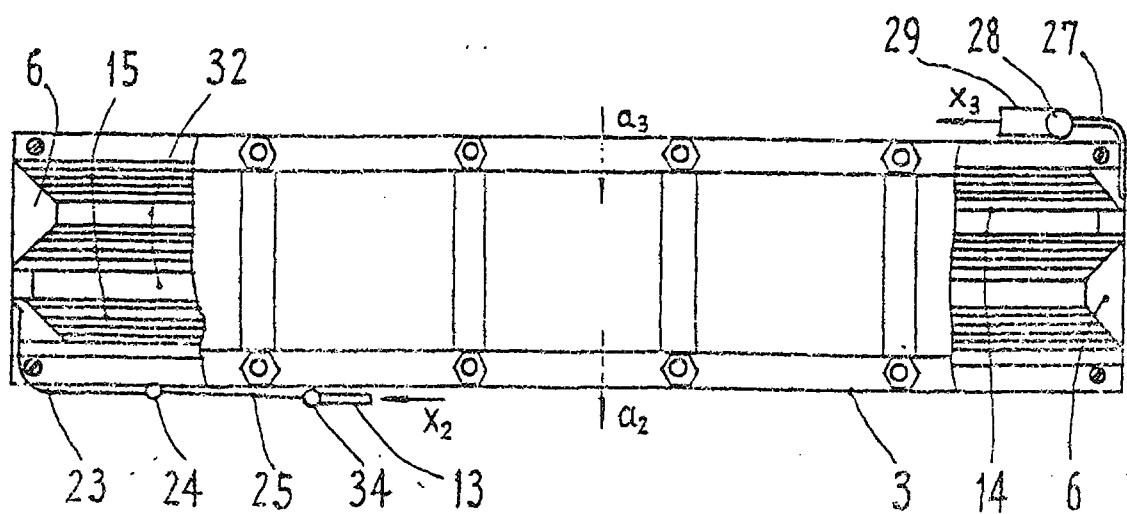


FIG. 9

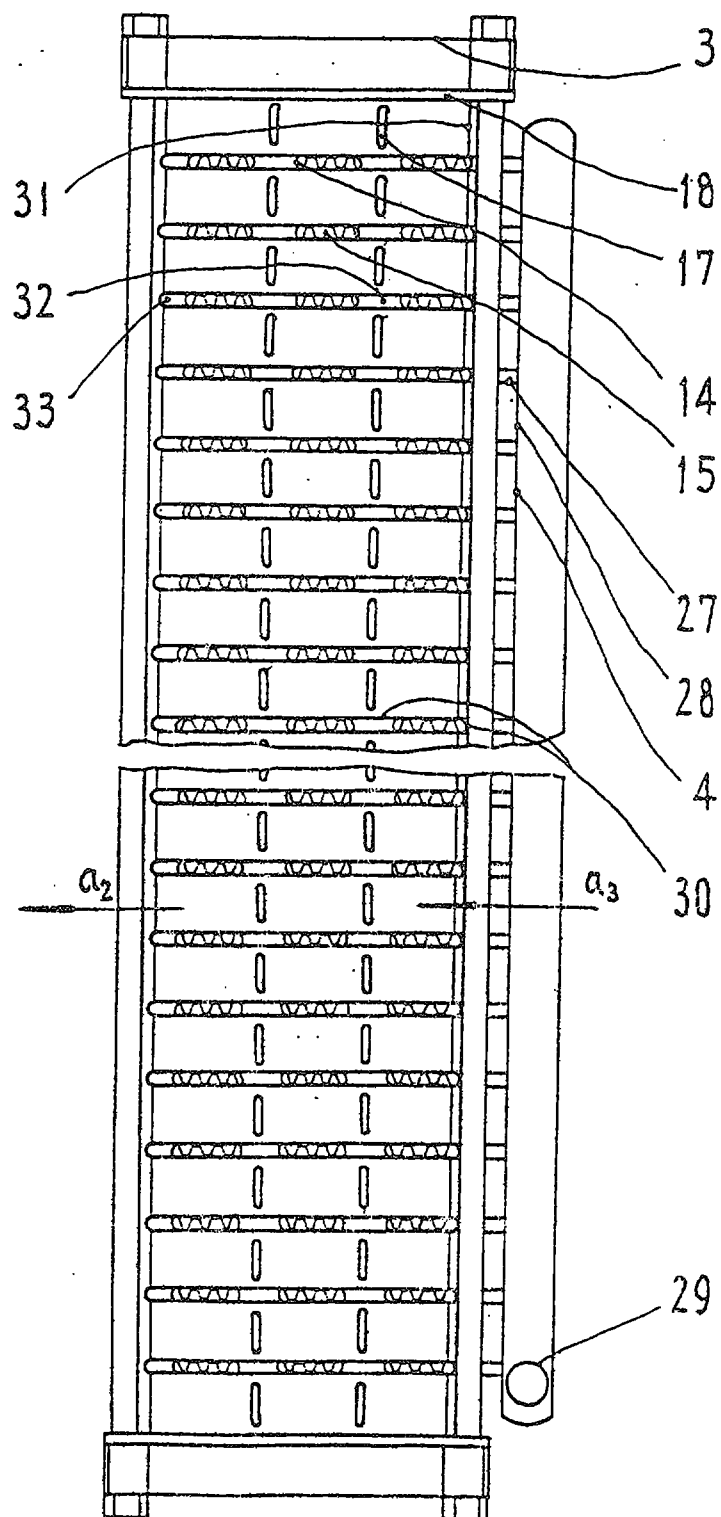


FIG. 10

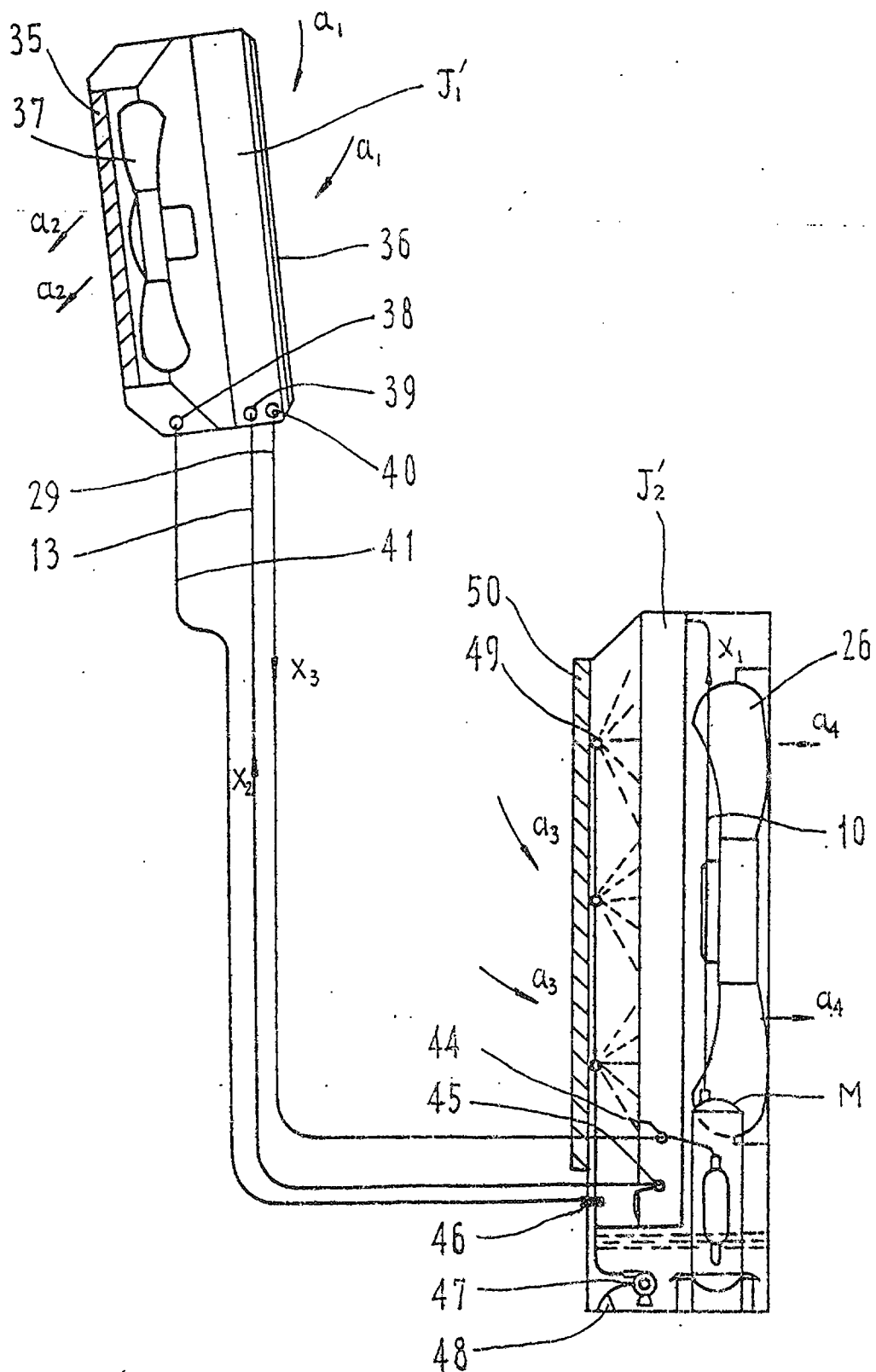


FIG. 11

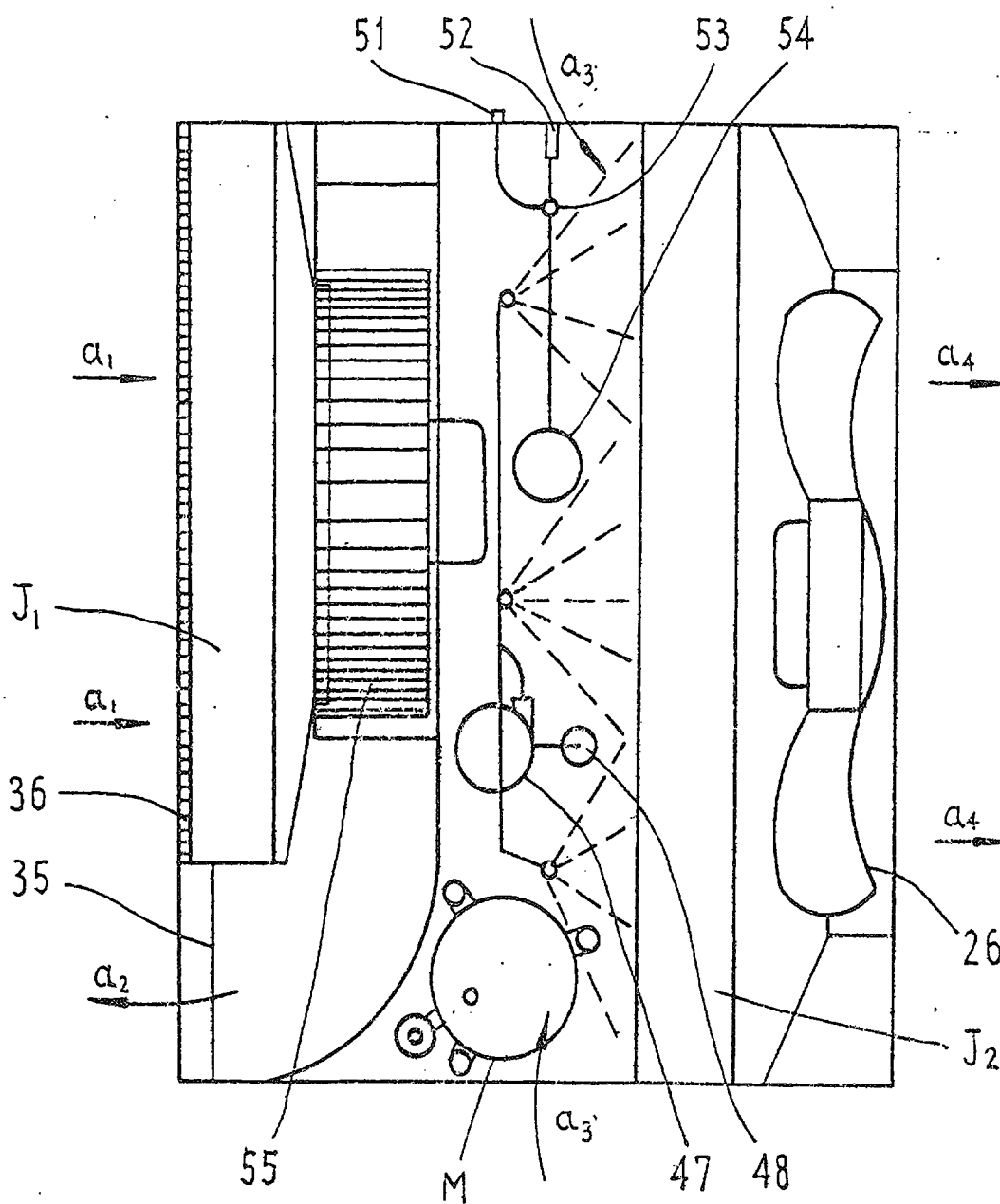


FIG. 12

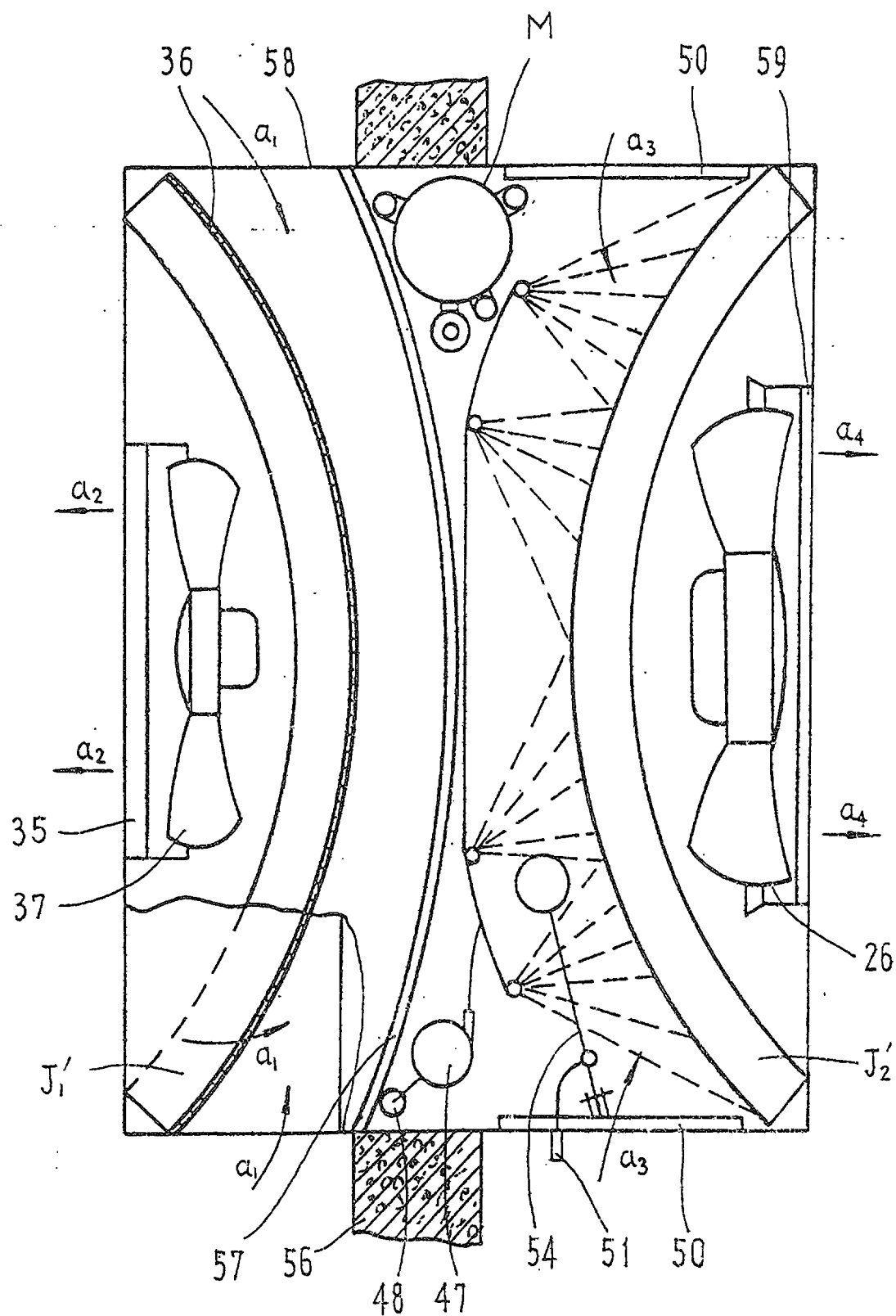
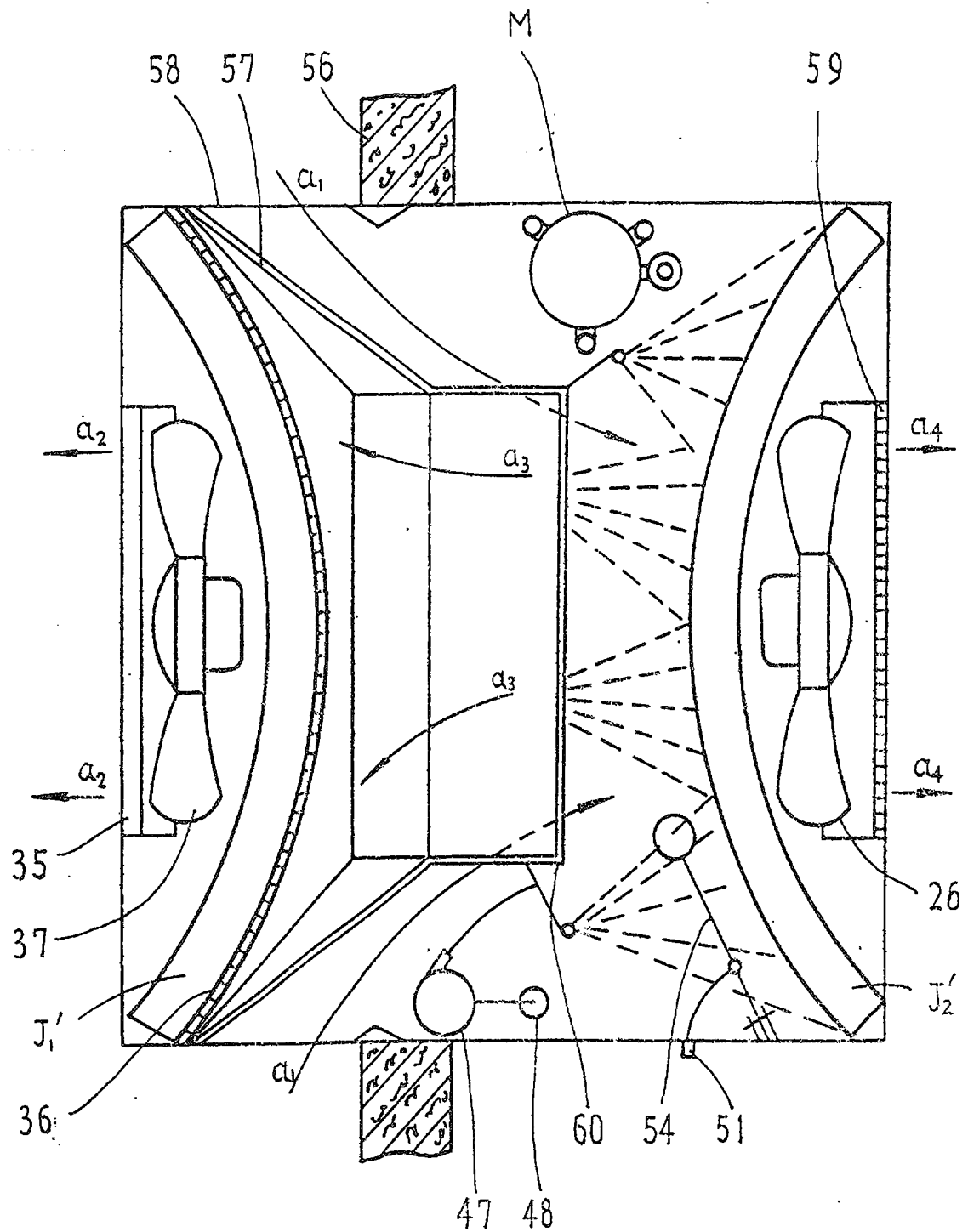
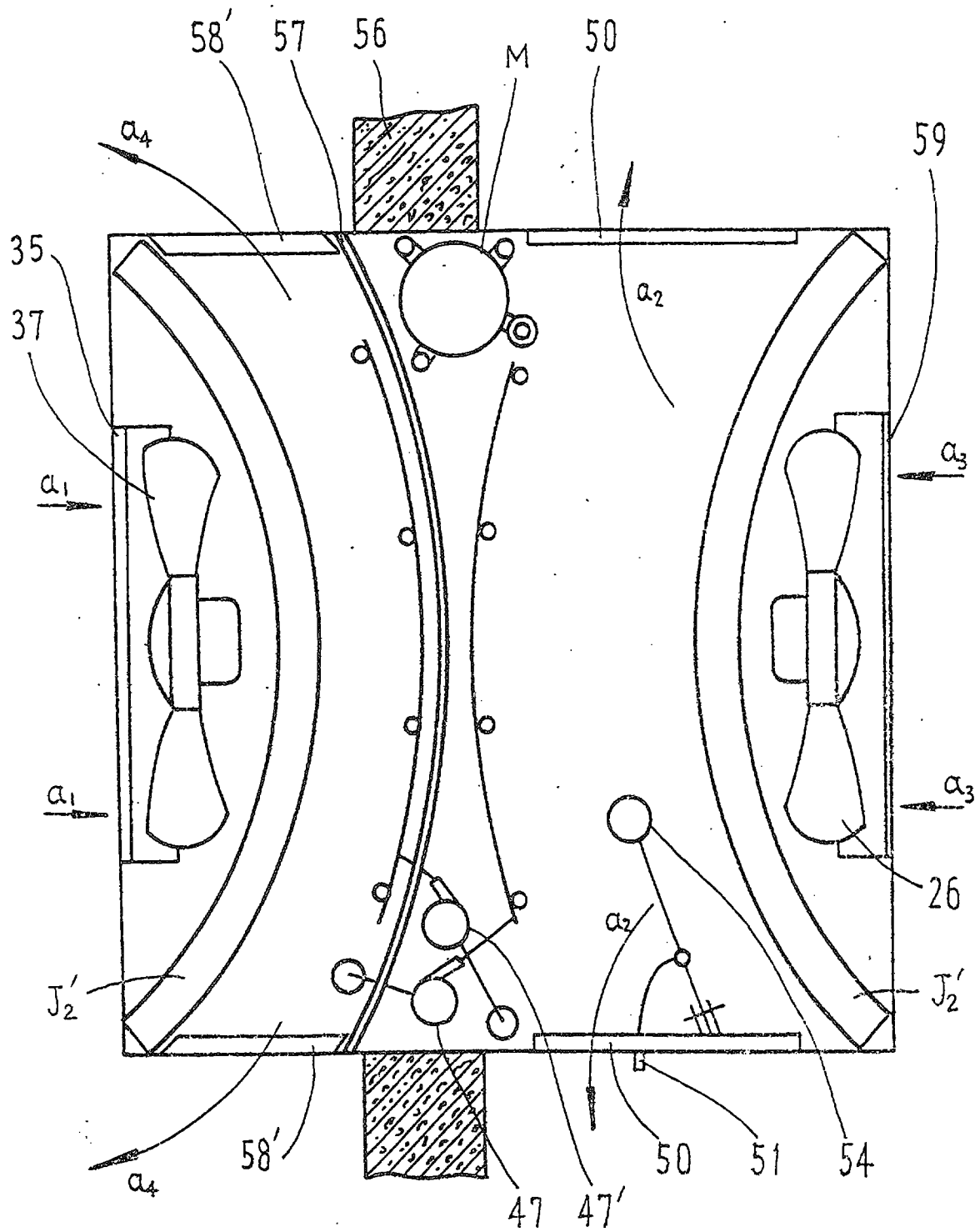


FIG.13





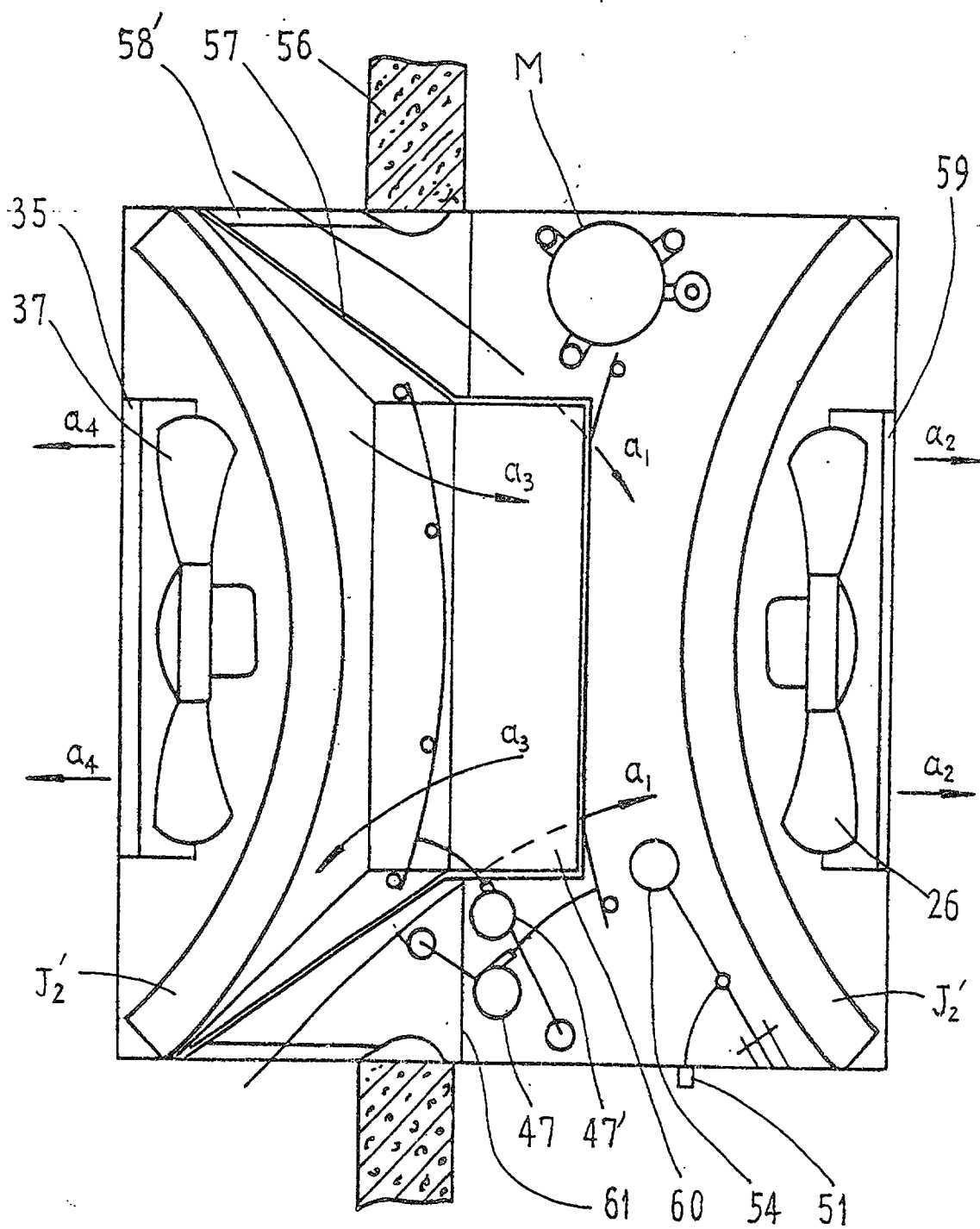


FIG.16

An Air-conditioner with
High-Efficiency Differential Cold-valley Pipes
Amended Pages (Article 41)

Technology field

The present invention relates to a kind of air conditioning apparatus, particularly to a kind of low pressure difference heat pump air conditioner with air energy as refrigerating heating circulating power.

Technology Background

The differential cold-valley pipe (herein after called J-pipe for short) is a kind of high efficiency heat exchange device featuring a large heat flow rate per unit area and enabling the end temperature difference for heat transmission to approach zero indefinitely. The Chinese patent application No. 941,121, 107.0 has put forward an " air energy 8-form circulation air conditioner" which is an all fresh air conditioner composed of an air energy heat pump J-pipe, a super condensation J-pipe, a low pressure difference energy transformation heat pump M, has rather high thermodynamic cycle efficiency and requires 100% outdoor fresh air for both cool (heat) output in its air conditioning just for achieving the optimal thermodynamic cycle efficiency. However, the above-mentioned technical scheme is mainly pointing to the theoretical research of 8-form circulation and in need of further improvement with respect to heat exchange and thermodynamic cycle efficiency of J-pipe. There still exist quite a few problems in its cooling-weight ratio, volumetric ratio, industrialization of manufacturing process and reducing product cost, hence it is difficult to achieve a fundamental result in solving the three major difficult problems (high energy consumption, low air quality, limited use of CFCs (chlorofluorocarbons).

Summary of the present invention

In order to solve the above-mentioned problems, the present invention puts forward a kind of high efficiency J-pipe air conditioner

REPLACEMENT SHEETS

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comprising differential cold-valley pipes J1-pipe and J2-pipe and a low pressure pump M, wherein:

A. In the heat exchanger J1 pipe: Multiple-layer J1 strips and multiple-layer corrugated fin step corrugations are stacked alternately and tightly clamped up into frames composed of rib-shaped clamping plates and tie rods, at the contact places of said clamping plates and step corrugations there are buffer cushions, the step ducts F' in vertical parallel arrangement to approximate a rectangled formed by step corrugations and said J1 strips are in a flow direction of S shape, on each vertical wall surface of said step corrugations are cut out several long and strip-shaped heat insulating ports, at both ends of each step corrugation is a rectangled pad, the step corrugations are made of thin aluminum sheet (or hydrophilic aluminum sheet), each J1 strip has a t_1 (working substance evaporating temperature) $\sim t_n$ (working substance return vapor temperature) continuously temperature changing working substance flow passage formed by inserting inner corrugated plates made of thin aluminum sheet into 2-5 metallic (copper or aluminum) flat tubes arranged in parallel spacing and connected in series, at each turn of flow of said working substance flow passage there is a curved conduit, the flat tube end at the inlet and outlet of working substance flow passages are respectively connected with incoming liquid branch tube and suction vapor branch tube, the suction vapor branch tube after being connected in parallel with parallel connecting tube (or distributor) is connected again with suction vapor tube, the incoming liquid branch tube after being connected in parallel with distributor is again connected with the capillary tube, the capillary tube is connected with the liquid supply tube;

B. In the heat exchanger J2 pipe: The Multiple-layer J2 strips and multiple-layer corrugated fin step membrane corrugations are stacked alternately and tightly clamped up into frames composed of rib-shaped clamping plates and tie rods, at the contact places of said clamping plates and membrane corrugations there are buffer

cushions, the step ducts F in vertical and parallels arrangement to approximate a rectangled formed by membrane corrugations and said J2 strips are in a flow direction of S shape, on each vertical wall surface of membrane corrugations are cut out several long and strip-shaped heat insulating ports, at both ends of each membrane corrugation there is a rectangled pad, each step corrugation has a t'n (working substance vapor discharging temperature of the low pressure pump)~t'l (liquid state working substance temperature after condensation) continuously temperature changing working substance flow passage formed by inserting inner corrugated plates made of thin aluminum sheet into 2-5 metallic (copper or aluminum) flat tubes arranged in parallel spacing and connected in series, at each turn of flow of said working substance flow passage there is a curved conduit, the flat tube ends at the inlet and outlet of working substance flow passages are connected respectively with an incoming vapor branch tube and outgoing liquid branch tube, the incoming vapor branch tube after being connected in parallel with parallels connecting tube (or distributor) is connected again with incoming vapor tube, the outgoing branch tube after being connected in parallel with the distributor (or parallel connecting tube) is again connected with a liquid supplying tube, outside the flat tubes arranged in parallel spacing are wrapped membrane type evaporating surfaces, between membrane evaporating surfaces and flat tubes are inserted water-carrying yarns, the membrane corrugations are corrugated fins made of thin aluminum sheet (or metallic wire mesh) adhered with non-woven fabric on both surfaces, and with thin aluminum sheet (or metallic wire mesh) inside to form supporting frame step corrugations and with its surfaces to form step membranes, the water-carrying yarns, step membranes, membrane type evaporating surfaces are made of corrosion resistant non-woven fabric (adhesive-bonded fabric) with extra high water-carrying and water absorbing capacity;

C. The low pressure pump M is connected between the vapor

suction tube leading to J1 pipe and the incoming vapor tube leading to J2-pipe, the heat pump type is connected with a four-way conversion valve in between, the low pressure pump M will work between a rather low condensing pressure P2 and a rather high evaporating pressure P1 and can jointly convey liquid and vapor; the maximum refrigerating/heat generating capacity can be obtained when the circulating working substance is a single or mixed (azeotropy) working substance, the 刀-form circulation and all fresh air 8-form circulation can be run at the highest circulation efficiency when the circulating working substance is a working substance pair composed of refrigerant and absorbent.

The flat tubes in J1 strips and J2 strips therein of the above-mentioned J1 pipe and J2 pipe of the present invention are arranged along the concentric arc direction in parallel spacing, the step corrugations between J1 strips and membrane corrugations between J2 strips are distributed in sector shape, when the plane and straight rib-shaped clamping plates are deformed to arc rib-shaped clamping plates, the plane and straight J1 pipe and J2 pipe will be deformed to arc J1' pipe and J2' pipe; the flat tubes in the J2 strips of the above-mentioned and J2 pipe can also be replaced by metallic slender round tubes.

The present invention aims at creating a kind of series J pipe air conditioners with rather high practical value and rather high thermodynamic cycle efficiency, and striving to solve the three major difficult problems confronting the current air conditioning industry as high energy consumption, low air quality, limited use of Chlorofluorocarbons (CFCs).

1. A kind of air conditioner with high-efficiency differential cold-valley pipes comprises differential cold-valley pipes J1 pipe and J2 pipe and a low pressure pump M, characterized in that:
 - A. In the heat exchanger J1 pipe: Multiple-layer J1 strips (30) and multiple-layer corrugated fin(31) step corrugations are stacked alternately and tightly clamped up into frames composed of rib-shaped clamping plates(3) and tie rods(4), at the contact places of said clamping plates (3) and step corrugations(31) there are buffer cushions(18), the step ducts F' in vertical parallel arrangement to approximate a rectangle formed by step corrugations and said J1 strips (30) are in a flow direction of S shape, on each vertical wall surface of said step corrugations are cut out several long and strip-shaped heat insulating ports(17), at both ends of each step corrugation(31) is a rectangled pad(7), the step corrugations(31) are made of thin aluminum sheet (or hydrophilic aluminum sheet), each J1 strip(3) has a t_1 (working substance evaporating temperature) $\sim$ t_n (working substance return vapor temperature) continuously temperature changing working substance flow passage formed by inserting inner corrugated plates(15) made of thin aluminum sheet into 2-5 metallic (copper or aluminum) flat tubes(14) arranged in parallel spacing and connected in series, at each turn of flow of said working substance flow passage there is a curved conduit(6), the flat tube(14) end at the inlet and outlet of working substance flow passages are respectively connected with incoming liquid branch tube(23) and suction vapor branch tube(27), the Suction vapor branch tube(27) after being connected in parallel with parallel connecting tube (or distributor)(28) is connected again with suction vapor tube (29), the incoming liquid branch tube(23) after being connected in parallel with distributor(34) is again connected with the capillary tube (25), the capillary tube(25) is connected with the liquid supply tube (13) ;
 - B. In the heat exchanger J2 pipe: The Multiple-layer J2 strips (1) and multiple-layer corrugated fin step(2) membrane corrugations are stacked alternately and tightly clamped up into frames composed of rib-shaped clamping plates(3) and tie rods(4) , at the contact places of said clamping plates(3) and membrane corrugations(2) there are buffer cushions(18), the step ducts F in vertical and parallels arrangement to approximate a rectangle formed by membrane corrugations(2) and said J2 strips(1) are in a flow



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direction of S shape, on each vertical wall surface of membrane corrugations(2) are cut out several long and strip-shaped heat insulating ports(17), at both ends of each membrane corrugation(2) there is a rectangled pad(7), each step corrugation has a t'n (working substance vapor discharging temperature of the low pressure pump)~t'1 (liquid state working substance temperature after condensation) continuously temperature changing working substance flow passage formed by inserting inner corrugated plates(15) made of thin aluminum sheet into 2-5 metallic (copper or aluminum) flat tubes(14) arranged in parallel spacing and connected in series, at each turn of flow of said working substance flow passage there is a curved conduit(6), the flat tube(4) ends at the inlet and outlet of working substance flow passages are connected respectively with an incoming vapor branch tube(8) and outgoing liquid branch tube(11), the incoming vapor branch tube(8) after being connected in parallel with parallels connecting tube (or distributor)(9) is connected again with incoming vapor tube(10), the outgoing branch tube after being connected in parallel with the distributor (or parallel connecting tube)(12) is again connected with a liquid supplying tube(13), outside the flat tubes(14) arranged in parallel spacing are wrapped membrane type evaporating surfaces(16), between membrane evaporating surfaces(16) and flat tubes(14) are inserted water-carrying yarns(20), the membrane corrugations(2) are corrugated fins made of thin aluminum sheet (or metallic wire mesh) adhered with non-woven fabric on both surfaces, and with thin aluminum sheet (or metallic wire mesh) inside to form supporting frame step corrugations(21) and with its surfaces to form step membranes(22), the water-carrying yarns(20), step membranes(22), membrane type evaporating surfaces(16) are made of corrosion resistant non-woven fabric (adhesive-bonded fabric) with extra high water-carrying and water absorbing capacity;

- C. The low pressure pump M is connected between the vapor suction tube(29) leading to J1 pipe and the incoming vapor tube(10) leading to J2-pipe, the heat pump type is connected with a four-way conversion valve in between, the low pressure pump M will work between a rather low condensing pressure P2 and a rather high evaporating pressure P1 and can jointly convey liquid and vapor; the maximum refrigerating/heat generating capacity can be obtained when the circulating working substance is a single or mixed (azeotropy) working substance, the 刀-form circulation and all fresh air 8-form circulation can be run at the highest



circulation efficiency when the circulating working substance is a working substance pair composed of refrigerant and absorbent.

2. Said air conditioner with high-efficiency differential cold-valley pipes according to claim 1, characterized in that: When the flat tubes (14) in J1 strips (30) and J2 strips (1) therein are arranged in concentric arc direction with parallel spacing, the step corrugations (31) among J1 strips (30) and membrane corrugations (2) among J2 strip(1) show a sector-shaped distribution, when the plane and straight rib-shaped clamping plates are deformed to arc rib-shaped clamping plates, the plane and straight J1 pipe and J2 pipe will be deformed then to arc J1' pipe and J2' pipe; the flat tubes (14) in J2 strips (1) in the above-mentioned J2 pipe and J2' pipe can also be replaced by metallic slender round tubes (14').
3. Said air conditioner with high-efficiency differential cold-valley pipes according to claim 1 or 2, characterized in that: J1 pipe and J1' pipe used as evaporating J pipe can also be used as condensing J pipe, J2 pipe and J2' pipe used as condensing J pipe can also be used as evaporating J pipe, during refrigerating: When the air being cooled by evaporating J pipes is outdoor air a3 and the air to cool the condensing J pipe is indoor air a1, the J pipe air conditioner is running in all-fresh air 8-form circulation, when the air being cooled by evaporating J pipe is indoor air a1 and the air to cool condensing J pipe is outdoor air a3, the J pipe air conditioner is running in 刀-form circulation, during heat generating: When the air being heated by condensing J pipe is outdoor air a3 and the air being cooled by evaporating J pipe is indoor air a1, the J pipe air conditioner is running in all-fresh air 8-form circulation, when the air being heated by evaporating pipe is indoor air a1 and the air being cooled by condensing J pipe is outdoor air a3, the J pipe air conditioner is running in 刀-form circulation.
4. Said air conditioner with high-efficiency differential cold-valley pipes according to claim 1 or 2, characterized in that: When window machines or split-body machines of 8-form or 刀-form circulation are composed of using J1 pipe or J1' pipe as evaporating J pipe and using J2 pipe or J2' pipe as condensing J pipe, in the bottom tray of their window machines or outdoor units of split-body machines is mounted a water circulating system composed of a water pump (47), filter (48), nozzles (49) and connecting tubing, which sprays by automatic control system according to requirement at intervals, and in timing, metering the water solution in the bottom tray to an air facing surface of J2 pipe or J2' pipe, the water level in bottom tray is



controlled by a water level control system composed of a float (54), an on-off adapter(53), a supporter (52), water supplying slender tube (51), etc., the condensed water of J1 pipe or J1' pipe can be led to the bottom tray, when the water supplying slender tube can not continuously supply water, glycerin or glycol or other cool-carrying agents not readily volatile to air can be added into the bottom tray to constitute a self-sufficient water equilibrium system, the outdoor unit of the above-mentioned split-body machines can also be matched with the indoor machine of current air conditioners.

5. Said air conditioner with high-efficiency differential cold-valley pipes according to claim 1 or 2, characterized in that: When the condensing J pipe and evaporating J pipe all use J2 pipe or J2' pipe to compose window machines or split-body machines of 8-form or 刀-form circulation, each J2 pipe or J2' pipe has water storing bottom trays and water circulating system, wherein one bottom tray is provided with a water level control system, when lithium chloride, calcium chloride, lithium bromide water absorbing salt solution is added into the bottom tray: The water pump of evaporating J pipe sprays at intervals and in timing, metering concentrated salt solution in the bottom tray of condensing J pipe to an air exist surface of evaporating J pipe, during spraying mist their fans ought to stop rotating, the concentrated salt water solution on surface of ducts F gradually absorbs moisture and releases heat to transform into dilute salt water and to flow to bottom tray from an air facing surface, simultaneously the water pump of condensing J pipe also sprays the dilute salt solution in the bottom of evaporating J pipe at intervals and in timing, metering to the air facing surface of condensing J pipe, during spraying mist, their fans ought to stop rotating, the dilute salt water solution on its surface of ducts F gradually releases moisture and absorbs heat to transform into concentrated salt water solution and to converge into bottom tray from the air exist surface, during heat generating, actions of condensing J pipe and evaporating J pipe change with each other, the circulation constituted by the above-mentioned outside circulating working substance salt water solution is an outside 8-form circulation, the outside circulating working substance can also be water solution of glycerin, glycol and other cool-carrying agents not readily volatile to air during refrigerating the outside circulating working substance can use water alone.
6. Said air conditioner with high-efficiency differential cold-valley pipes according to claim 1 or 2, characterized in that: Air inlets of outdoor air a3 of outdoor machine of 刀-form split-body machines using J1 pipe or J1' pipe as evaporating J pipe and J2 pipe or J2' pipe



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as condensing J pipe are provided with water baffles (50); an indoor fan (37) and an outdoor fan (26) at the front and rear two end faces of a 刀-form window machine using J1' pipe as evaporating J pipe and J2' pipe as condensing J pipe are mounted respectively in the concave arc of J1' pipe and J2' pipe, air inlets (58) of indoor air a1 is provided at two sides inside the wall (56), air inlets of outdoor air a3 is provided at two sides outside the wall (56), at the air inlets there are water baffles (50), an indoor fan (31) and an outdoor fan (26) at the front and rear two end faces of an 8-form window machine using J1' pipe as evaporating J pipe and J2' pipe as condensing J pipe are mounted respectively in the concave arc of J1' pipe and J2' pipe air outlet (58) of indoor air a1 is provided at two sides inside the wall (56), outdoor air a3 from a top oblique window (60) outside the wall enters the convex arc face of J1' pipe to be cooled to a2 and is conveyed indoors.

7. Said air conditioner with high efficiency differential cold-valley pipes according to claim1, characterized in that: the indoor fan (37) and outdoor fan (26) at the front and rear two end faces are mounted respectively in the concave arc of indoor J2' pipe and outdoor J2' pipe, the ventilating ports of indoor air of its 刀-form machine are provided at two sides inside the wall (56), at the ventilating ports are provided adjustable air windows (58'), ventilating ports of outdoor air a3 are provided at two sides outside the wall (56), at the ventilating ports are provided water baffles (50), the air outlets of indoor air a1 of its 8-form machine are provided at two sides inside the wall (56), at the air outlets are provided adjustable air windows (58'), outdoor air a3 from a top oblique window (60) outside the wall (56) enters J2' convex arc face to be cooled or generated of heat in ducts F and then is conveyed indoors.



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