

13th GOLDEN SILICON AWARDS

A13-071

Rapid-ventilation high-performance energy-saving hot/cold air conditioner

可快速換氣高效能節電冷暖氣機

隊伍名稱

空調魔法師 / Air conditioning magician

隊長

張裕峰 崑山科技大學機械與能源工程研究所

隊員

王星海 崑山科技大學機械與能源工程研究所
 陳宏恩 崑山科技大學機械與能源工程研究所
 李永長 崑山科技大學機械與能源工程研究所



作品摘要

傳統冷暖氣機以四通閥來改變冷媒流向來產生冷氣或暖氣，其室內外熱交換器兼作蒸發器或冷凝器，因冷凝器的散熱面積需要等於蒸發器的約1.3倍才能能量匹配。故此，以冷氣功能為主的冷暖氣機，室外熱交換器必須大於室內熱交換器，故熱天會有高效能冷氣，但冷天使用暖氣時由於無法匹配而效能不佳。以暖氣功能為主冷暖氣機，室外熱交換器必須小於室內熱交換器，故冷天會有高效能暖氣，但熱天使用冷氣時由於無法匹配而效能不佳。且在運轉中切換冷暖功能時必須停機的不便。況且，市售空調機的換氣功能效果不佳，長久使用空調機必導致室內空氣品質不佳，有害人體健康。

如圖1所示之本「可快速換氣高效能節電冷暖氣機」3D示意圖，圖2則為本機之實機示意圖，以調控的上下風門不同位置產生高效能的冷/暖氣和快速換氣之諸多功能，其冷氣永遠由較小的蒸發器產生，而暖氣永遠由較大的冷凝器產生，故冷/暖氣均有高的效能。當外氣溫度在26°C以上時，可使用冷氣功能；當外氣溫度在宜人的21~25°C時，壓縮機可被控制停機，只使用風扇引入適溫外氣作節能90%以上空調，尤其是在夜間睡眠或需要安靜時，可調控只使用其中一個風扇吸入宜人外氣作安靜高氧和節能95%以上的空調；當外氣溫度在6~20°C時，可使用節電的熱泵暖氣功能，相較使用電暖器節能約70%；若蒸發器溫度設定為-3°C，低於5°C的外氣便無法使蒸發器內冷媒液體完全蒸發，冷凍循環因而會失效，可於冷凝器後方加裝的電熱器，於低於5°C可控制壓縮機和蒸發器風扇停止運轉，只令冷凝器風扇運轉和啟動電熱器產生電暖氣，使本機適用全球大多數地區的任何季節。由於本機具有超越目前市售空調機諸多優異的功能，而成本只較同級冷氣機稍高，故具有取代所有窗型空調機之市場潛力。

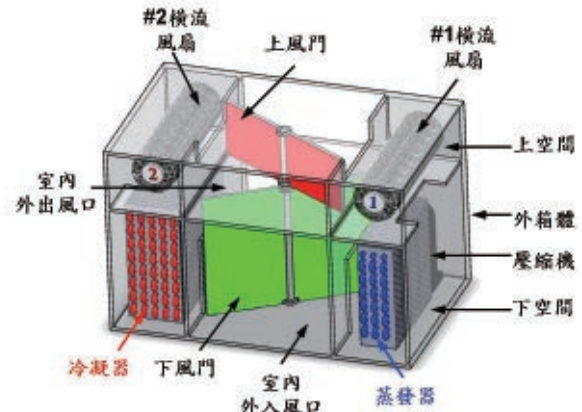


圖1 > 本機3D示意圖



圖2 > 本機之實機示意圖

指導教授**黃景良 / 崑山科技大學機械工程系**

1973 年取得陸軍官校理學士、1977 年及 1979 年獲成功大學機械學士和碩士、1983 年獲美國密西根大學機械碩士、1987 年獲成功大學機械博士。1977-1993 年任教於陸軍官校機械系，1988 年升任教授，1991-1993 年兼任系主任，1993 年轉任崑山科技大學機械系教授迄今，其中 2006-2010 年擔任潔淨能源中心主任。

任教職期參加國家考試分別取得機械工程和冷凍空調工程技師。

研究領域

熱流分析、能源工程技術與應用、冷凍空調相關之多功能節能家電之研發。

Abstract

Conventional cold/hot-function air conditioners using four-way valve to generate cooling or heating effect by changing the refrigerant flow-directions. The heat exchanger of indoor or outdoor is used as a condenser or an evaporator. The surface-area of the condenser must equal to about 1.3 times to that of evaporator to match energy balance. Thus, while the air conditioner is designed mainly in cold function, the outdoor heat exchanger must be greater than the indoor heat exchanger; the machine will be with good cold-function efficient in hot days, but with the poor hot-function efficiency in cold days. On the contrary, while the air conditioner is designed mainly in hot function, the outdoor heat exchanger must be less than the indoor heat exchanger; the machine will be with good hot-function efficient in cold days, but with the poor cold-function efficiency in hot days. Moreover, if one wants to change the cold/hot function into hot/cold function during the machine in operation, the pressure difference on both sides of the four-way valve is about more than 10 times atmospheric pressure, it is very inconvenient to stop the machine before switching cold/hot function. Furthermore, the ventilation-function of window-type air conditioner is very poor. For energy saving, all the windows and doors are always closed when air conditioner is in use. It will lead to poor indoor air quality, especially while there are many people in a classroom or office.

In order to improve the above shortcomings, we invented this "Rapid-ventilation high-performance energy-saving hot/cold air conditioner. The multiple-functions of high-performance cold/hot air and rapid-ventilation with high-oxygen and energy-saving effect, is switched by controlling the variable dampers-positions. From this, the cold air is ever generated by the smaller evaporator and hot air

is ever generated by the larger condenser. Thus, both hot and cold functions are with high performances. The cooling function is used while the outdoor air temperature is above 26°C; In situations of outdoor air temperature is between the 21~25°C, the compressor is controlled to stop, the indoor air is replaced by comfortable outdoor air by using the fans, the energy can be saved over 90% and higher indoor air quality thus can be obtained, especially in situations of sleeping time or quiet requirement, only one fan is used to introduce comfortable outside fresh air into the room, 95% energy-saving and quiet high-oxygen air conditioning can be obtained; The energy-saving heat pump warm air is used while outdoor temperature is between 5~20°C. If the evaporator temperature is set as -3°C, in situations of outdoor temperature is below 5°C, the temperature difference between the outdoor air and evaporator is too small to evaporate the liquid coolant into vapor, the refrigeration cycle will be break down. Thus the compressor and evaporator fan are then controlled to switch off and the electric heater, set after condenser, is controlled to operated, the condenser fan is operated to circulate the room air and heated up by the hot electric heater. There is no any more energy-saving effect in above situation, but let machine become an all-weather one, thus it can be suitable for most region of the world. Therefore, it should be widely welcomed by users around the world. Thus, with these outstanding features beyond the current cold/hot-function heat-pump air conditioners, and with about the same cost as present air conditioner, this product has the market potential to replace all the present window-type air conditioners after its commercialization by technology transfer domestic well-known appliance maker.