



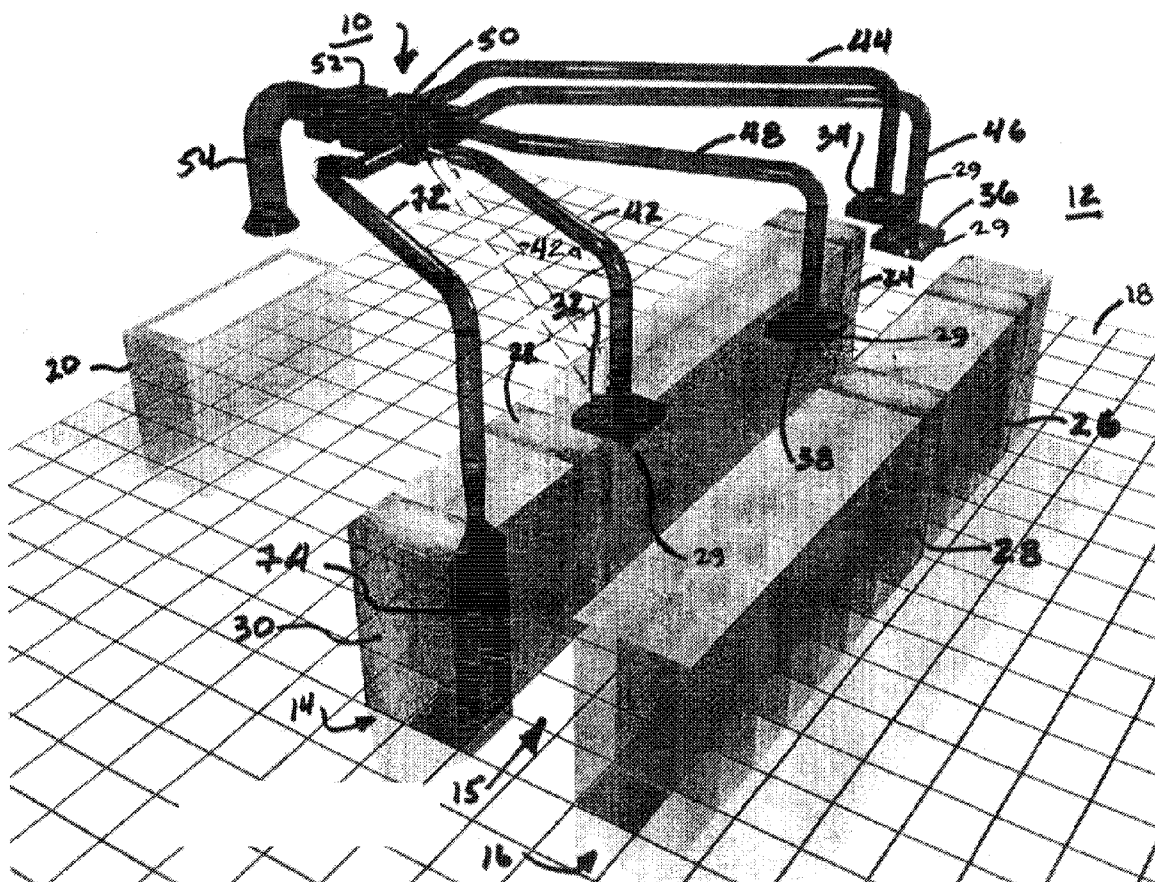
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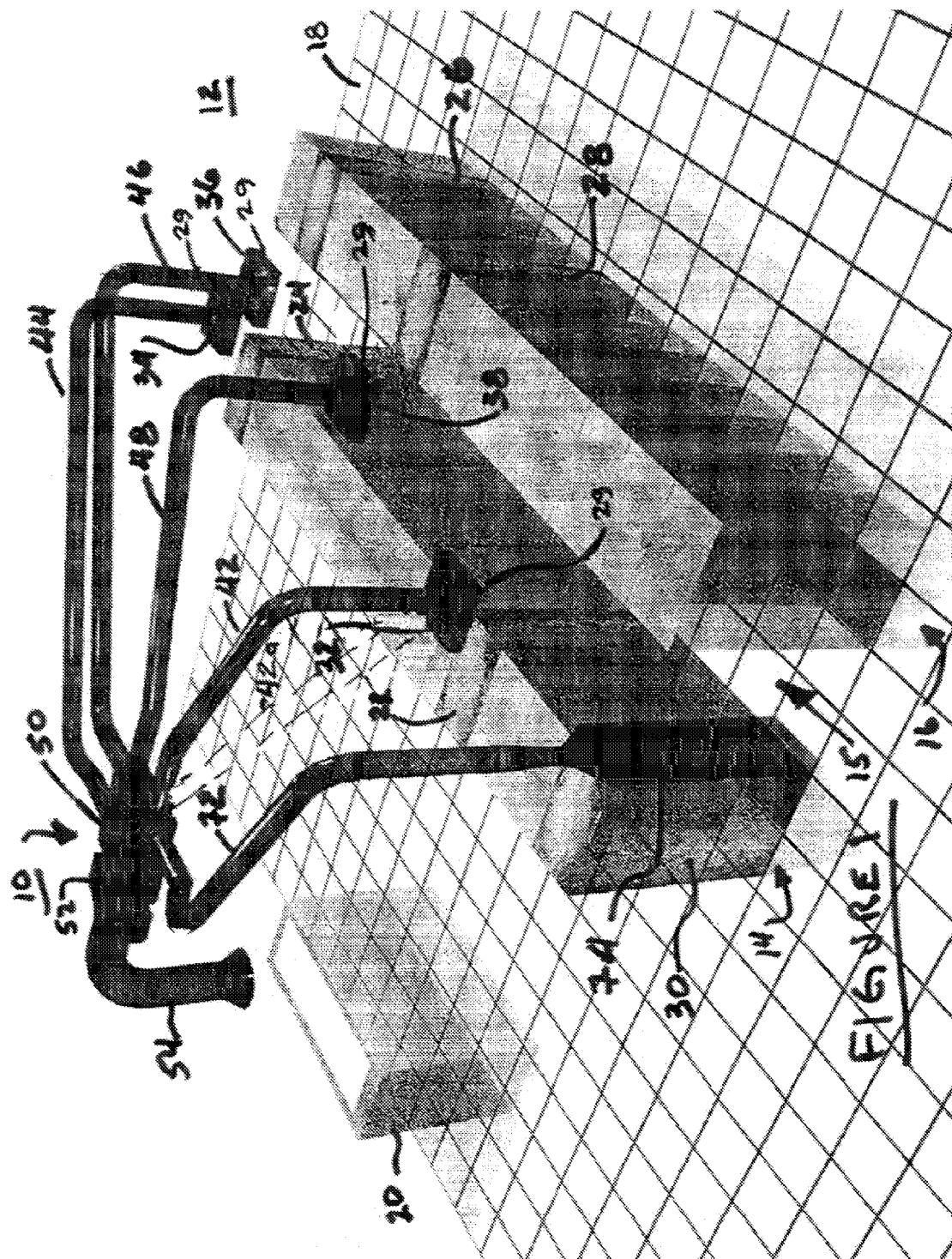
(19) **United States**(12) **Patent Application Publication**
Densham(10) **Pub. No.: US 2009/0029640 A1**(43) **Pub. Date: Jan. 29, 2009**(54) **AIR SCAVENGING SYSTEM FOR
REMOVING HEATED CONDITIONED AIR
FROM A COMPUTER ROOM****Publication Classification**(51) **Int. Cl.**
F24F 7/06

(2006.01)

(52) **U.S. Cl.** **454/232**(57) **ABSTRACT**

An air scavenging system for removing heated air from a computer room, comprises at least one air intake port in communication with a first duct, a plenum chamber having at least one air input to which the first duct is connected, and an air output from the plenum chamber to a return duct for an air conditioner unit which supplies conditioned air to the computer room. The air flow is induced by an electrically driven fan at the output side of the plenum chamber. At least one air intake port is horizontally oriented, and is positioned at any position in the computer room. There are at least as many inputs to the plenum as there are ducts connected to it. At least one air intake port may be vertically oriented and is mounted to a rack which is hotter than the other racks.

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OAKVILLE, ON L6M-2G2 (CA)**(21) **Appl. No.: 11/829,071**(22) **Filed: Jul. 26, 2007**



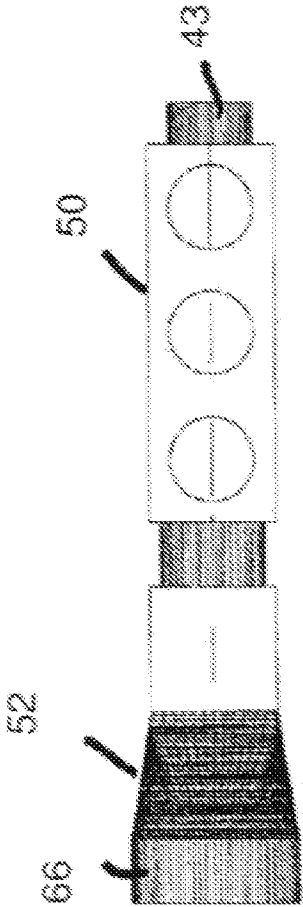


FIG. 3

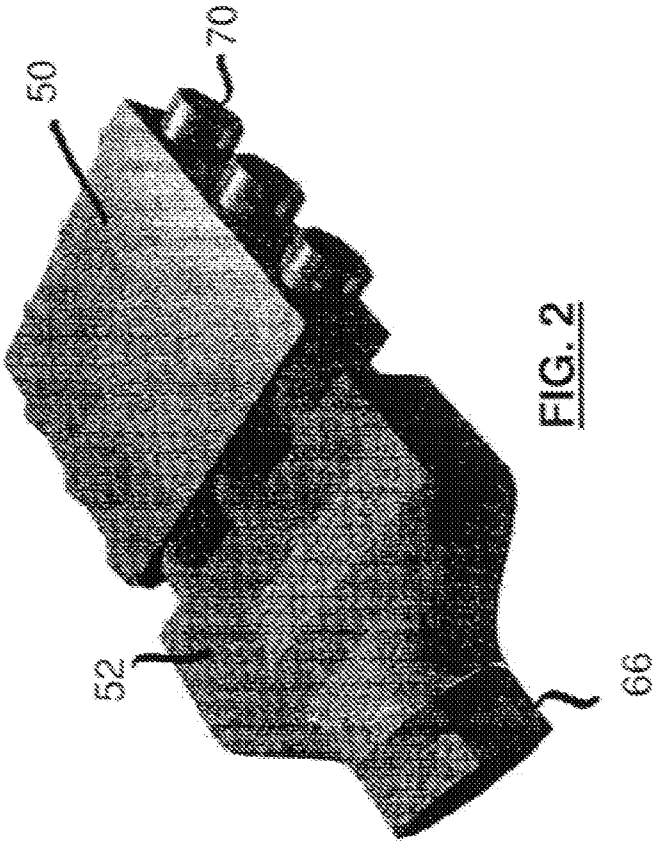


FIG. 2

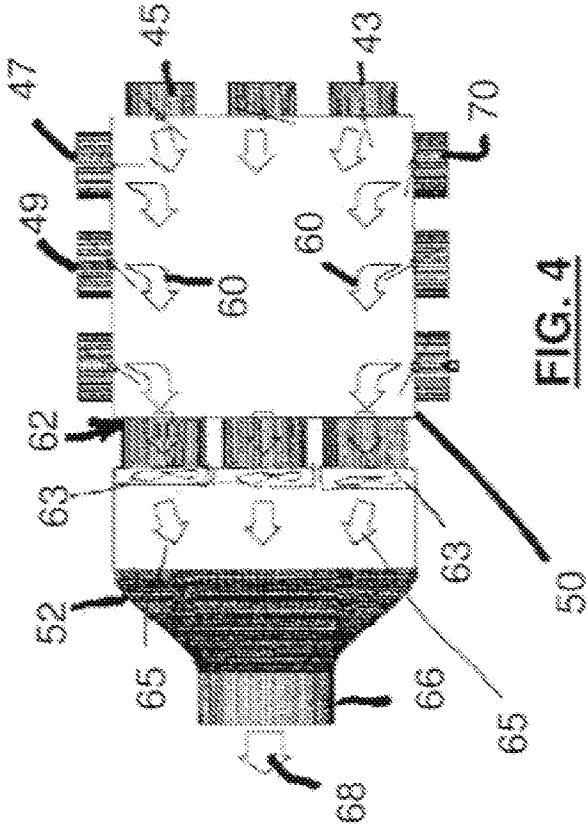


FIG. 4

AIR SCAVENGING SYSTEM FOR REMOVING HEATED CONDITIONED AIR FROM A COMPUTER ROOM

FIELD OF THE INVENTION

[0001] This invention relates to computer room installations, and particularly to systems by which conditioned air which has been introduced into a computer room and which has become heated by flowing over or past power distribution units and rack mounted computer devices, and the like, may be scavenged and returned to the air conditioning unit for that computer room. Thus, a closed air flow loop is formed, and the purpose of the air-conditioning unit is to recool and rehumidify the returned air, as necessary.

BACKGROUND OF THE INVENTION

[0002] Computer rooms that are provided for large enterprises of many sorts, including governments, banks, manufacturing companies, universities, insurance companies, and so on, are generally quite large and have very many rack mounted computing devices and power distribution units installed therein. There is typically also an uninterruptible power supply installed in the computer room. Details of any of those electrical devices are beyond the scope of the present invention. However, in keeping with the provisions of co-pending application Ser. No. _____, filed Jul. 26, 2007, the teachings of which are incorporated herein by reference, there may also be a plurality of power distribution units distributed throughout the computer room and rack mounted together with the rack mounted computing devices.

[0003] Moreover, it must be known that computer rooms typically have very rigorous requirements to establish the ambient within which the computing devices operate. In particular, there are typically very large air conditioning and humidifying units which are provided to maintain the air in the computer room within a very narrow temperature range and within a very narrow humidity range. The air-conditioning systems for computer rooms are closed circuit systems, whereby the same air is continually circulated through the computer room and is filtered, cooled, and re-humidified each time it arrives back at the air conditioning unit. Indeed, great lengths may be gone to in order to assure the purity of the air in the computer room, including the provision of so-called "man traps" which function in a manner similar to air locks.

[0004] In most computer rooms, the air return of heated air after it has flowed over or past the various computer devices in the computer room is returned to the air-conditioning unit by being sucked into vents which are connected to an air duct which is installed at or near the ceiling of the room and around the periphery of the room. In other computer rooms, particularly those having high ceilings, an air collection duct is arranged across one side or end of the room and is connected to a powerful suction blower so as to create laminar flow of heated air across the ceiling and just below it.

[0005] However, it is well-known that in computer rooms some of the rack mounted computer devices may run much hotter than other devices. Power distribution units or certain servers, and the like, may run at temperatures which are considerably warmer than the computing devices which are rack mounted in the other racks distributed throughout the computer room. That means that there may be certain regions in the computer room where the air is much warmer than in other regions or positions in the computer room. It has unex-

pectedly occurred to the inventor herein that positionable air intake ports may be placed in various positions throughout the computer room where they will be most effective in scavenging the warmest air in the computer room before that air mixes with cooler air in the computer room. This helps to maintain the average air temperature within the computer room lower than it would otherwise be, even though the same number of joules of energy is to be removed from the computer room by whatever air scavenging or air recirculation system is installed therein.

[0006] By capturing or scavenging the heated air more directly as it exits from any rack mounted devices in the computer room, and routing the heated air directly back to the air conditioning unit, greater efficiencies of the air conditioner unit may be achieved; along with the concomitant economic savings in operation of the unit. Indeed, it may be possible to reduce the designed BTU ratings for an air conditioning unit to be installed in a new (or renovated) computer room. It is apparent that the heated air from hot running rack mounted devices will have less opportunity to become mixed with cooler air coming off other rack mounted computer devices; thereby keeping the overall temperature in the computer room somewhat cooler than it would otherwise be.

[0007] Thus, the present invention provides for the placement of one or a plurality of air intake ports either slightly above the height of the computer racks, and over the aisles which extend between rows of computer racks; or in some instances, an air intake port may be associated with an ingress structure that is installed adjacent to a computer rack which has computer or other electrical equipment installed therein, and which tends to run very hot. By the latter alternative, the very hot air from any specific computer rack is scavenged before it has any opportunity to enter into the ambient air within the computer room.

SUMMARY OF THE INVENTION

[0008] In accordance with one aspect of the present invention, there is provided an air scavenging system for removing conditioned air from the computer room, wherein the air has been heated by flowing over or past power distribution units and rack mounted computer devices installed in the computer room. The air scavenging system comprises at least one air intake port in communication with a first duct, a plenum chamber having at least one air input to which the first duct is connected, and an air output from the plenum chamber which is in communication to a return duct for the air conditioning unit which supplies the conditioned air to the computer room.

[0009] There is at least one electrically driven fan or blower located at the output side of the plenum chamber, and it is adapted to create a negative air pressure at the at least one air input relative to the air pressure at the output side of the plenum chamber.

[0010] The at least one air intake port may be positioned in any position in the computer room, and the respective duct associated with that at least one air intake port has a length which is sufficient to reach the plenum chamber.

[0011] It is possible, in keeping with a provision of the present invention, that at least one of the air intake ports and its respective duct may be moved from its first position to another position as may be necessary to scavenge air having a higher temperature than the air at the former position of the intake port.

[0012] Typically, each of the power distribution units which are installed in the computer room is a rack mounted unit.

[0013] In general, there is a plurality of air intake ports installed in a computer room, and each of the air intake ports is in communication with its respective duct. Each of the ducts is, in turn, connected to a respective input of the plenum chamber.

[0014] The air scavenging system of the present invention will usually comprise a reducer chamber which is located between the at least one fan in the plenum chamber and the return duct, whereby the rate of air flow into the return duct is higher than the rate of air flow through the plenum chamber.

[0015] Typically, the at least one air intake port comprises an ingress structure mounted at the end of the first duct.

[0016] Indeed there are usually a plurality of air intake ports, and each comprises an ingress structure mounted at the end of each respective duct.

[0017] In an alternative option of the present invention, when there is a plurality of air intake ports installed, is that at least one of the air intake ports may be vertically oriented and mounted at the side of a computer rack in the computer room, being the side from which heated air exits from the rack.

[0018] In some instances, the at least one air intake port is horizontally oriented, at least at first portion of the first duct is vertically oriented, and a second portion of the first duct as well as the plenum chamber are horizontally oriented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The novel features which are believed to be characteristic of the present invention, as to its structure, organization, use and method of operation, together with further objectives and advantages thereof, will be better understood from the following drawings in which a presently preferred embodiment of the invention will now be illustrated by way of example. It is expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention. Embodiments of this invention will now be described by way of example in association with the accompanying drawings in which:

[0020] FIG. 1 is a perspective view from above showing a typical installation of the air scavenging system for a computer room, in keeping with the present invention;

[0021] FIG. 2 is a perspective view of a plenum chamber and its associated components;

[0022] FIG. 3 is a side view of the plenum chamber and its associated components of FIG. 2; and

[0023] FIG. 4 is a plan view of the plenum chamber and its associated components of FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] The novel features which are believed to be characteristic of the present invention, as to its structure, organization, use and method of operation, together with further objectives and advantages thereof, will be better understood from the following discussion.

[0025] Referring first to FIG. 1, an air scavenging system which is in keeping with the present invention is shown generally at 10. It will be understood that the scavenging system is located within a computer room 12, within which banks of rack mounted computer devices are arranged in rows such as 14 and 16. The computer room typically has a raised floor 18 which is raised above the original floor of the building in which the computer room is located, and beneath which con-

ditioned air is blown from such as an air conditioning unit 20. It may be that there is no raised floor in a computer room, in which case other means are provided to deliver conditioned air into the computer room. However, such circumstances are rare.

[0026] The conditioned air from the air conditioning unit 20 is at a predetermined temperature and humidity level, and may have been filtered. As noted above, the air circulation system within the computer room 12 is typically a closed circuit system. Only the principal elements of the air scavenging system of the present invention are illustrated, and it will be understood that the specific design of any of those principal elements, and any peripheral elements such as control systems and the like, are all beyond the scope of the present invention.

[0027] Within the computer room 12, in rows 14 and 16, there may be several racks which run hotter than the other racks. They are shown, for example, at 22, 24, 26, and 28. Another computer rack which runs considerably hotter than any of the others is shown at 30, and the air scavenging system for that rack will be discussed hereafter.

[0028] Referring to rack 22, there is an air intake port 32 which is at the end of the duct 42, and is located generally above the rack 22 and above the aisle 15 which is situated between rack rows 14 and 16. Likewise, racks 24, 26, and 28 have associated air intake ports 34, 36, and 38, and air ingress structures 29, which are mounted above and contiguous to the respective racks. It will be understood that the aisle 15 is a so-called "hot aisle" because the air which is blown past or over the computer devices mounted in the racks in rows 14 and 16 exits from those racks into the aisle 15. Thus, in general, the air in the aisle 15 is warmer than the air in the aisles on either side of the rack rows 14 and 16.

[0029] Associated with each of the air intake ports 32, 34, 36, and 38 are ducts 42, 44, 46, and 48, respectively. The structure may be such that each duct has two portions, a first portion of which is connected to the respective air intake ports, and is oriented vertically; and a second portion of each duct which is oriented horizontally. The design and sizing of the ducts and the other related air handling plenum, reducer chamber, etc., are beyond the scope of the present invention. However, it will be obvious to those skilled in the art, particularly those who are skilled in installing HVAC systems, that the ducts and their associated air intake ports, the plenum chamber 50, a reducer chamber 52 (discussed hereafter), and the return duct 54, may be suspended from the ceiling or installed in any other convenient manner.

[0030] The purpose of the two-portioned ducts is more for visual aesthetics than any other purpose. Thus, the first portions of each duct may pass through a suspended ceiling (not shown), and second portions are above the suspended ceiling. However, it is obvious to those skilled in the art that any duct may have a shorter, more direct route, to the plenum chamber 50, as shown in outline by duct 42a.

[0031] Referring now to each of FIGS. 2, 3, 4, more detail concerning the installation of the plenum 50, and a reducer chamber 52, is given. It will be understood, for example, that each of the ducts 42, 44, 46, and 48 is connected to a respective input 43, 45, 47, and 49 of the plenum chamber 50. It will be seen from arrows 60 that the flow of air as it is drawn into the plenum chamber 50 is towards the output side 62 of the plenum chamber 50.

[0032] However, it must be noted that there is one or more electrically driven fans or blowers 63 mounted at the output

side 62 of the plenum chamber 50. The purpose of the fans or blowers 63 is to establish a section of air flow from the plenum chamber 50, by creating a lower air pressure at any of the inputs of the plenum chamber relative to the output side 62. Thus, air flow as represented by arrows 65, is assured.

[0033] Usually, but not always, an ingress structure 29 (or 74) is mounted at the air intake ports at the ends of the ducts, as described hereafter. The purpose of the ingress structures 29 is to assure more efficient scavenging of heated air from an area larger than the diameter of each respective duct.

[0034] In general, there is a reducer chamber 52 that is interposed between input side 62 of the plenum chamber and the fans or blower 63 mounted thereat, and an exit 66, and through which air flows towards the air-conditioning unit 20, as shown by arrow 68. One purpose of the reducer chamber 52 is to mechanically match the output flow 68 from the reducer chamber 52 to the diameter of the return duct 54. However, because of the progressive reduction of cross-sectional area of the reducer chamber 52, the rate of air flow into the return duct 54 is higher than the rate of air flow through the plenum chamber 50.

[0035] The unused inputs to the plenum chamber 50 may or may not be capped. However, in keeping with the invention as it is illustrated in FIG. 1, at least one more of the inputs 70 is used to connect duct 72 to the plenum chamber 50. In this case, however, it is seen that the air intake port at the bottom end of the duct 72 is connected to a special air ingress structure 74. This air ingress structure 74 is vertically oriented, and it is mounted at the side of the computer rack of 30 from which heated air exits that rack. This is because, in the installation which is illustrated in FIG. 1, the equipment which is in rack 30 runs considerably hotter than any of the other installed equipment in any of the other racks.

[0036] It will be obvious to one skilled in the art that the positions of any of the air intake ports 32, 34, 36, and 38, and the associated air ingress structures 39, if present, may be changed from time to time. For example, the computing equipment which is installed in any rack in the rows 14 and 16 may be replaced with other computing equipment which may run hotter than before, or cooler than before. This may necessitate the relocation of any the air intake ports; and such relocation is relatively easy to effect for those skilled in the art.

[0037] The invention as it is illustrated in the accompanying figures is representative only. Many computer rooms will have many more than two rack rows, and many more hot aisles than the one which is shown at 15. Thus, additional duct work and air intake ports will be required to be installed; the plenum chamber 50 may have to be resized with more inputs, or replicated with a further plenum chamber and associated return duct 54 so as to maintain the closed circuit air conditioning system which is required within the computer room 12.

[0038] Other modifications and alterations may be used in the design and manufacture of the apparatus of the present invention without departing from the spirit and scope of the accompanying claims.

[0039] Throughout this specification and the claims which follow, unless the context requires otherwise, the word “com-

prise”, and variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not to the exclusion of any other integer or step or group of integers or steps.

What is claimed is:

1. An air scavenging system for removing conditioned air from a computer room, wherein the air has been heated by flowing over or past power distribution units and rack mounted computer devices installed in the computer room, said air scavenging system comprising at least one air intake port in communication with a first duct, a plenum chamber having at least one air input to which said first duct is connected, and an air output from said plenum chamber in communication to a return duct for an air conditioner unit which supplies said conditioned air to said computer room;

wherein said at least one air intake port may be positioned at any position in said computer room, and the respective duct has a length sufficient to reach said plenum chamber; and

wherein there is at least one electrically driven fan or blower located the output side of the plenum and adapted to create a negative air pressure at said at least one air input relative to the air pressure at said output side of said plenum chamber.

2. The air scavenging system of claim 1, wherein said at least one air intake port and the respective duct may be moved from a first position to another position as may be necessary to scavenge air having a higher temperature than the air at the former position of said at least one air intake.

3. The air scavenging system of claim 1, wherein each power distribution unit installed in said computer room is rack mounted.

4. The air scavenging system of claim 1, comprising a plurality of air intake ports, each in communication with a respective duct, each of which is connected to a respective input of said plenum chamber.

5. The air scavenging system of claim 1, wherein a reducer chamber is located between said at least one fan in said plenum chamber and said return duct, whereby the rate of air flow into said return duct is higher than the rate of air flow through said plenum chamber.

6. The air scavenging system of claim 1, wherein said at least one air intake port comprises an ingress structure mounted at the end of said first duct.

7. The air scavenging system of claim 4, wherein said plurality of air intake ports each comprises an ingress structure mounted at the end of each respective duct.

8. The air scavenging system of claim 4, wherein at least one of said plurality of ingress structures is vertically oriented, and is mounted at the side of a computer rack in said computer room from which heated air exits from the rack.

9. The air scavenging system of claim 1, wherein said at least one air intake port is horizontally oriented, at least a first portion of said first duct is vertically oriented, and a second portion of said first duct and said plenum chamber are horizontally oriented.

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