Sept. 13, 1966 W. M. VALENTINE 3,272,427

AIR HANDLING APPARATUS

Filed May 17, 1965 2 Sheets-Sheet 1

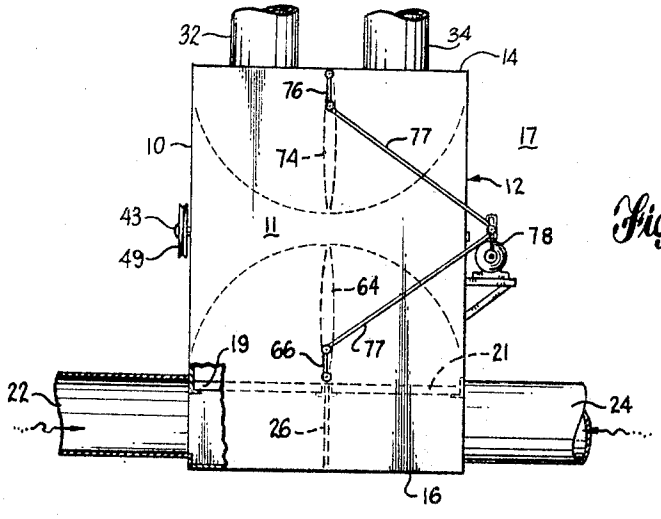


Fig. 1.

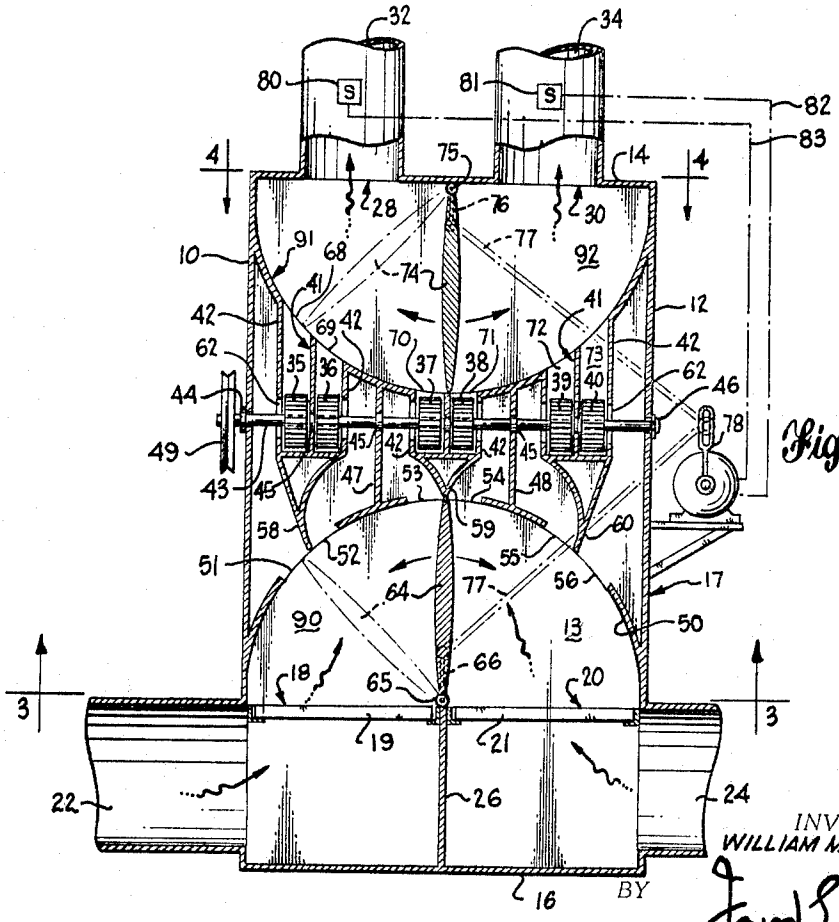


Fig. 2.

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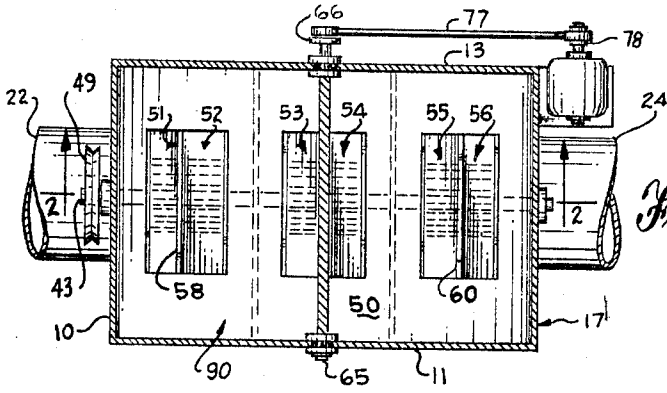


Fig. 3.

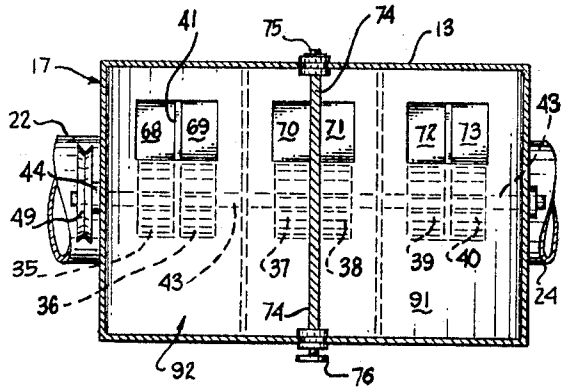


Fig. 4.

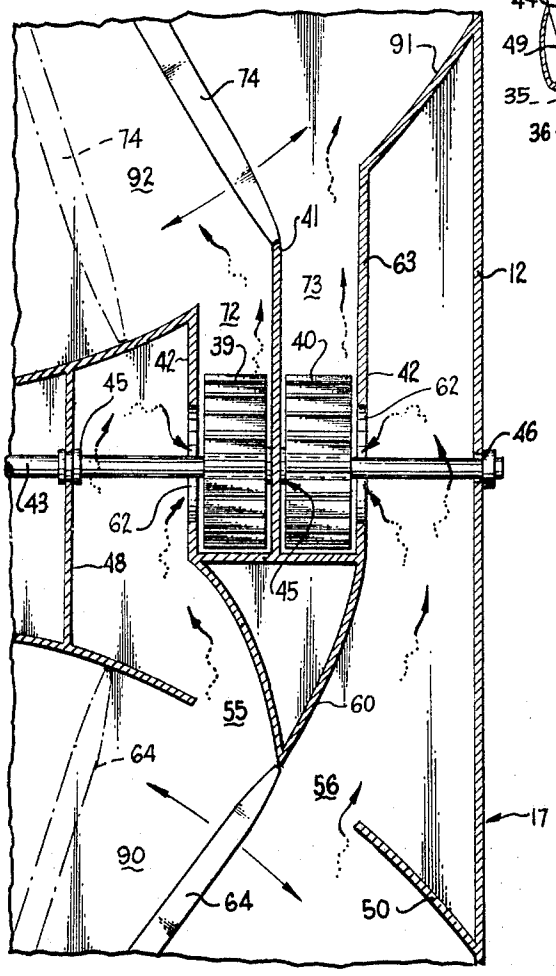


Fig. 5.

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AIR HANDLING APPARATUS

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3 Claims. (Cl. 230—47)

This invention relates to air handling apparatus and, more particularly, to cabineted fans adapted to collaterally move different or stratified air streams.

The main purpose of the invention is to provide an air handling apparatus which will deliberately and simply stratify air through a fan cabinet and, by astute positioning of opposed dampers, increase or decrease the volumes of air received from and directed into respective collateral ducts of a double duct ventilating system while maintaining uniform pressures in each duct.

In accomplishing this purpose, a double duct system is rendered more versatile, and economical to operate. Air taken in by the cabinet fan means is either recirculated hot air or cold supply air. The latter supply air may be fresh air as from the outside or pre-cooled air. The pressure and relative quantities of supply air and recirculating air can be economically adjusted as necessary from pressure sensing instruments in both the hot outlet duct and the cold outlet duct. In this way a double duct system can utilize heat given off to ventilating air from a lighting system. This heated air enters the cabinet fan unit and serves as the source of heat.

This invention will be fully understood from the following description when read with reference to the drawings, in which:

FIGURE 1 is a face view of a fan cabinet housing this air handling apparatus;

FIGURE 2 is a vertical section of the cabinet of FIGURE 1, taken in the plane of line 2—2 of FIGURE 3, illustrating the interior arrangement of elements with alternate positions of opposed air deflectors and the deflector actuating means suggested in phantom;

FIGURE 3 is a cross-sectional view taken on line 3—3 of FIGURE 2;

FIGURE 4 is a cross-sectional view taken on line 4—4 of FIGURE 2, and

FIGURE 5 is an enlarged fragmentary sectional view detailing a typical fan arrangement with related air passages to and from the fans and showing various positions of the opposed deflectors relative the air passages to and from the fans.

Referring to the drawings, side walls **10** and **12**, top wall **14** and bottom wall **16**, together with near and far side walls **11** and **13** respectively form a cabinet **17** enclosing a plenum chamber. On the inlet or adit side of the chamber are adit apertures **18** and **20** with which are respectively associated the collateral air inlet ducts **22** and **24**. Filters **19** and **21** may be disposed adjacent openings **18** and **20** as shown. Parting wall **26** divides the ducts **22**, **24** and separates apertures **18**, **20**.

At the exhaust or exit side of the cabinet plenum chamber are outlet apertures **28** and **30** with which are respectively associated the separate exhaust ducts **32** and **34**.

Ducts **22** and **24** conduct inflowing air derived from separate sources. For example, duct **22** may convey return heated air as from a lighting fixture and duct **24** may convey fresh or outside air. At the opposite apertures **28** and **30**, outlet duct **32** may accommodate the reused or return air and duct **34** the cool or outside air. It will be noted that ducts **22** and **24** are collateral as also are ducts **32** and **34**.

Buried in the plenum chamber **17** between these adit and exit apertures are the fans on each inlet and exhaust side of which are air stratifying wall means. Preferably the fan means comprises plural, single inlet, centrifugal

fans **35**, **36**, **37**, **38**, **39**, and **40** arranged in pairs all coaxially disposed on a common fan drive shaft **43**. Each pair of fans is separated by a central wall **41**. The drive shaft **43** is mounted in bearings **44** and **46** opposite walls **10** and **12** and also in bearings **45** in the intermediate fan walls **41** and divider walls **47** and **48**. A drive sheave **49** is secured to shaft **43** and power, from a source not shown, is supplied thereto to revolve these fans.

Each fan has a sidewall **42** provided with an axial air inlet **62** to the fan center and a generally tangential air exhaust outlet. The exhausts of adjacent fans are separated by walls **41**. Thus, each fan is in a separate chamber or passageway as, for example, **72** and **73** in FIGURE 5. Stratification of air is further provided by walls **47** and **48** which are respectively disposed between fans **36** and **37** and between fans **38** and **39**.

An arcuate wall **50** is located in the inlet portion of the plenum chamber **17** in concave relation to the inlet apertures **18** and **20** to define an inlet chamber **90**. Preferably wall **50** is radially symmetrical relative to such apertures and includes a plurality of orifices **51**, **52**, **53**, **54**, **55**, and **56**. Between orifices **51** and **52** is a pointed air divider **58** which parts the air and leads it to the intake openings of fans **35** and **36**. Similarly pointed divider **59** is associated with fans **37** and **38** and is disposed between orifices **53**, **54**. And, in like manner, pointed divider **60** is related to fans **39** and **40** and orifices **55**, **56**.

A damper or deflector blade **64** is secured to shaft **65** and is pivotally mounted between the adit apertures **18**, **20**. Blade **64** extends into close proximity with wall **50** and its several orifices **51** et seq. Crank arm **66** outstands from blade shaft **65** and is actuated to swing the blade to its various positions.

A second arcuate wall **73** is located in the outlet or exhaust portion of the plenum chamber **17** in concave relation to exit apertures **28**, **30**. The discharge or exhaust passages **68**, **69**, **70**, **71**, **72**, and **73** from fans **35**, **36**, **37**, **38**, **39**, and **40** extend to wall **91** and air streams moving therein discharge into the arcuate discharge chamber **92** defined by wall **91**. A second damper blade or deflector **74** is mounted on pivoted shaft **75** which has crank arm **76** outstanding to a side of the said pivot axis oppositely to that of arm **66**.

Links **77** extend from crank arms **66** and **76** and are operatively connected to motor-operated crank means **78** which imparts a pushing or pulling force on the links **77**. Deflectors **64** and **74** swing in arcuate paths to either side of center, the limit to one side being suggested by their showing in dotted lines in FIGURE 2.

In conduits **32**, **34** at suitable locations downstream are static pressure sensing devices **80** and **81** which are suitably connected by conductors **82** and **83** respectively, to the motive means which operates crank arm **78**. This sensing apparatus is conventional. Its function is to direct the motor means of arm **78** to move links **77** in one or the other direction. When a push is imparted to links **77**, blades **64** and **74** swing to the left in FIGURE 2. A pull results in a similar movement of the blades to the right. Such blade movement results in more or fewer of the inlet orifices **51** et seq. being exposed or valved to incoming air from one or the other of conduits **22**, **24**. Correlatively, more or fewer of the exhaust orifices **68** et seq. are likewise valved to direct varying volumes of exhaust air to one or the other conduits **32**, **34**.

This air handling apparatus is generally incorporated into double duct systems of conventional arrangement. In such systems, air is supplied to various rooms in a building through side-by-side or collateral ducts. One duct is for hot or warm air and one is for cold or fresh air. At or near a point of discharge into a room, the two

air streams may be commingled, by means of a mixing box, and warm or cool the room to a selected temperature.

The mode of operation of this handling apparatus, assembled generally as a cabinet fan, is therefore very useful in establishing initially what pressures and temperatures of air are to be obtained in respective hot and cold ducts of such a double duct system. In usual mild weather heating situations, the source of warmer or hot air coming into this cabinet fan through duct **22** is return air taken from space where lighting fixtures generate heat. The source of cool or cold air entering the cabinet fan through duct **24** is incoming on fresh air taken from outside or it may be referigerated air. As a general rule this air, both returning and incoming, will be filtered as by elements **19, 21.**

Within the plenum chamber these respective sources of air entering through orifices **18** and **20** are handled in quantities or volumes dependent on the relative positioning of deflectors **64** and **74.** When they are in edge-facing or aligned relation the fans handle, through their respective passages approximately equal volumes of air originating in ducts **22** and **24.**

Where changes in duct pressures or air flow in either duct **32** or **34** for distribution purposes are desired deflectors **64** and **74** are pivotally moved. Motor operated crank **78** acting in response to the pressure sensing devices **80, 81** through leads **82, 83** operates to pivot the deflectors through movements of links **77** and cranks arms **66, 76.**

The direction undertaken is dependent on pressure changes desired. In FIGURE 2, the dotted lines indicate how deflectors **64** and **74** would be moved if more outside air or higher pressure in cold duct **34,** is required and less recirculated air is to be moved. The mixing box (not shown) at the end of duct runs being controlled by thermostats locally will determine whether more or less cold air or hot air is required.

Through this assembly of fans, apertures, ducts, and parting walls, the correct proportion of hot and cold air is forcibly delivered to the double duct air conditioning system making it possible to easily control room temperatures. Primary consideration has been given in this cabinet fan to the provision of means to create and handle stratified air flows originating from two air sources which can then be taken in respective quantities to change pressures in respective distribution ducts.

The disclosure herein is exemplary. It will be apparent to those skilled in the art that modifications, alterations

and changes in proportions may be desired to accommodate specific installations. All such as fall within the scope and equivalents of this invention as defined by the subjoined claims is intended to be embraced hereby.

What is claimed is:

1. Air handling apparatus, comprising:

means forming a plenum chamber having oppositely located dual adit and dual exit apertures;

collateral inlet and collateral exhaust conduits associated respectively with said dual adit and dual exit apertures external of said chamber;

a pair of the deflector blades pivotally mounted within said plenum chamber in opposition to each other, the pivotal mount of one said deflector blade being located between the dual adit apertures and the other said deflector blade having its pivotal mount located between said dual exit apertures;

means for synchronously moving said deflector blades in like directions;

a pair of concave walls within said plenum chamber to define deflector chambers, each wall symmetrically facing one of said deflector blades and located closely adjacent the path of that portion of such deflector blade remote from its pivotal mount, said concave walls being spaced apart at their back sides to define a fan chamber; and

wall means in the fan chamber forming open-ended air passages between the deflector chambers and including a fan in each passage to induce air movement through said passages between said deflector chambers and the opposed dual adit and dual exit apertures.

2. The structure according to claim **1** in which there are at least three open-ended passages.

3. The structure according to claim **2** in which there are at least three pairs of open-ended passages, and the ends of each pair of passages are separated by a narrow dividing wall.

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