

[54] DAMPER SEQUENCER

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137/607, 251/250, 251/297, 251/298

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[58] Field of Search 137/607, 601, 595;
251/250, 297, 298; 165/103

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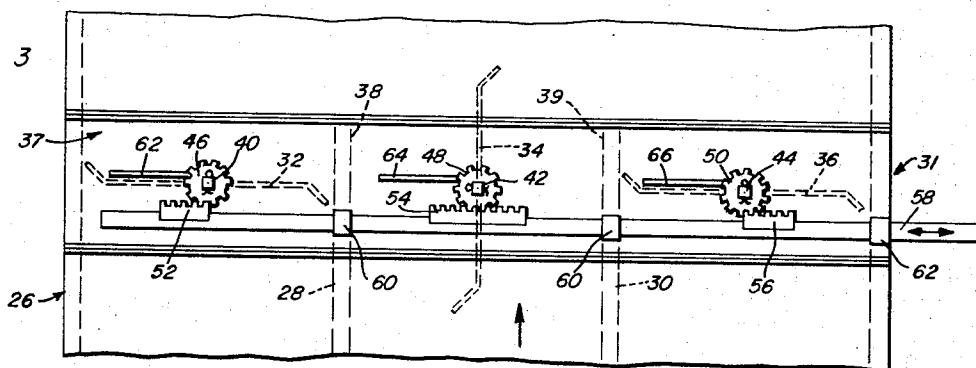
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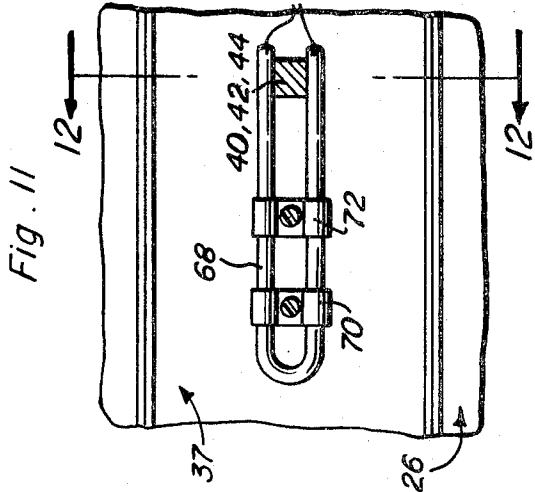
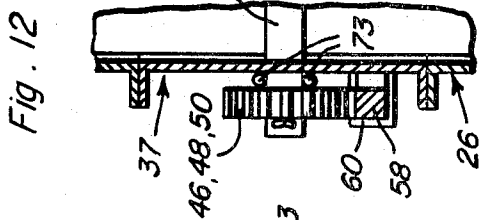
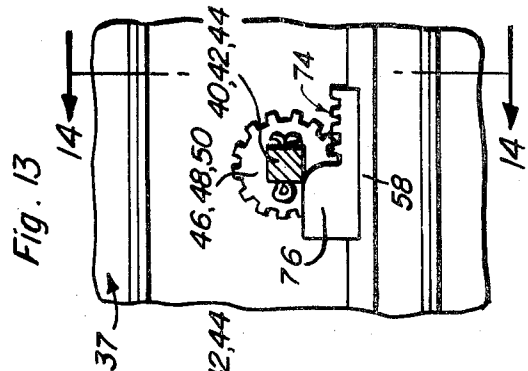
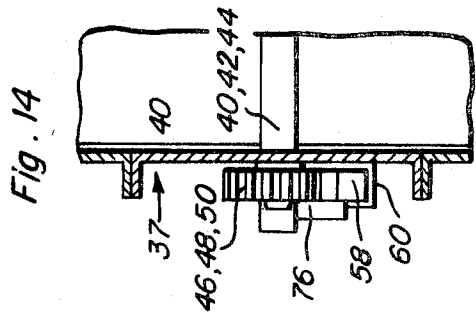
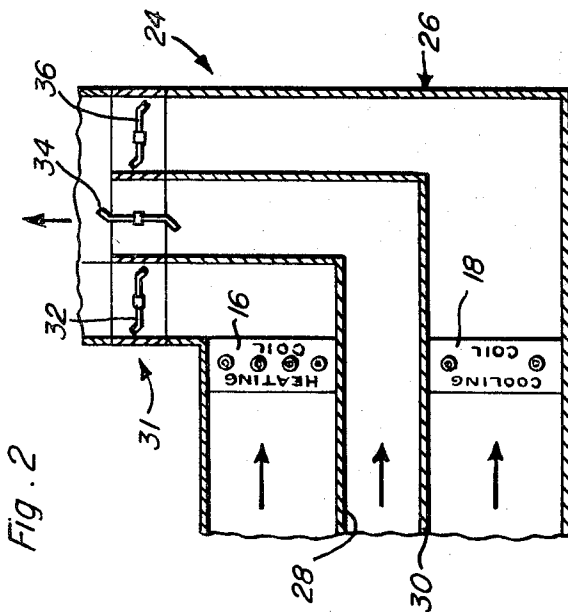
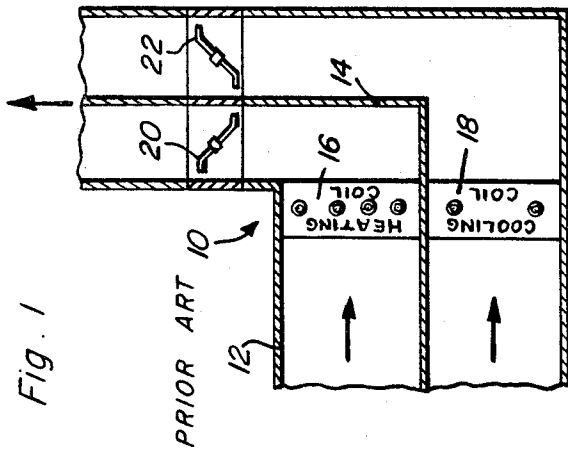
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[57] ABSTRACT

A fluid-flow apparatus having a damper frame provided with walls forming separate side-by-side flow paths for hot, cold and bypass air. Damper elements are pivotally mounted on shafts and arranged in the flow paths for blocking and unblocking same. Each shaft has a pinion gear mounted thereon for pivotal movement with the shaft and associated damper element. Rack gear segments are provided on a longitudinally slidably mounted carrier bar for engaging the pinion gears in a predetermined sequence which places in a blocked position one of the hot and cold air flow paths whenever the other flow path of that pair is simultaneously in an unblocked position. The bypass air flow path is unblocked when either the hot or cold air flow path is only partially unblocked. Spring or cam elements cooperate with flats on the damper element shaft for releasably retaining them in preselected positions.

9 Claims, 14 Drawing Figures





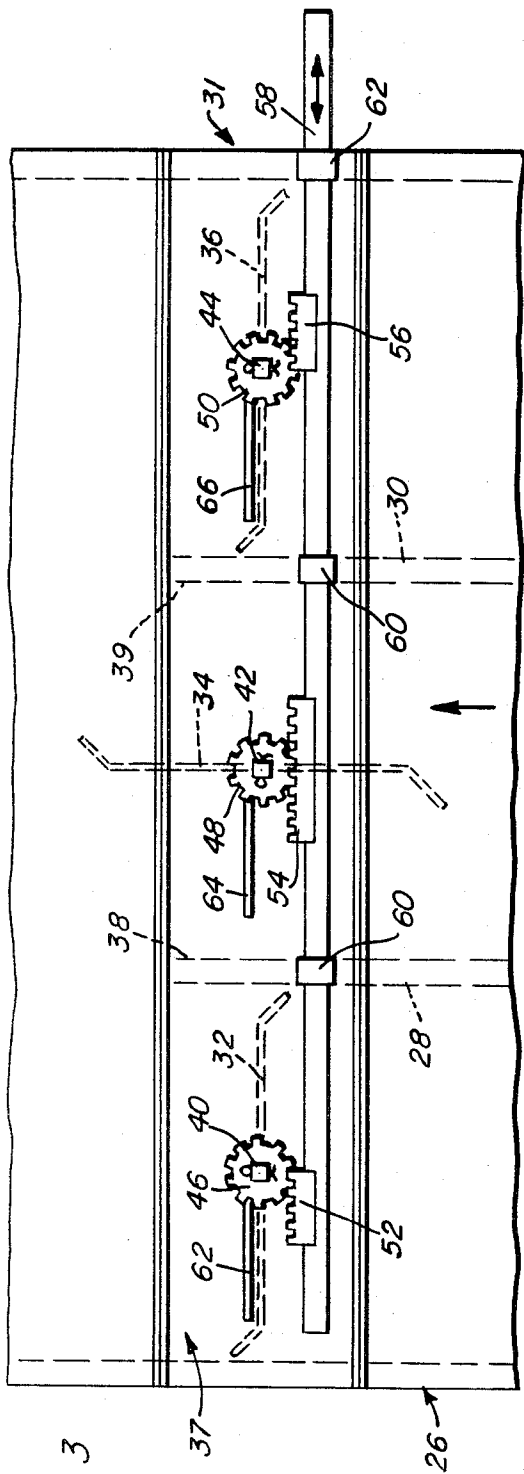


Fig. 3

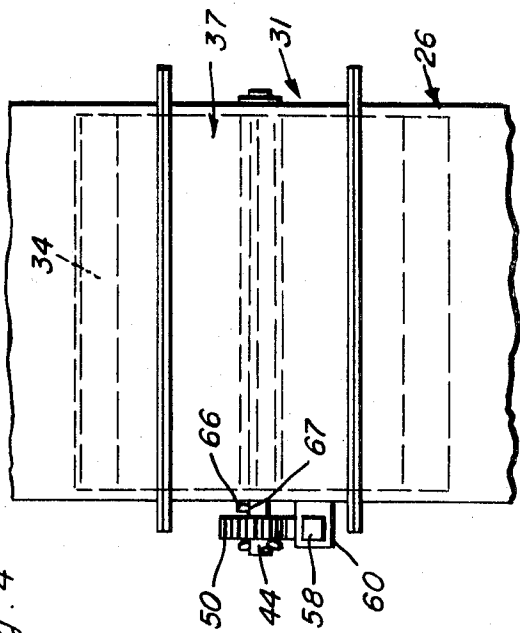
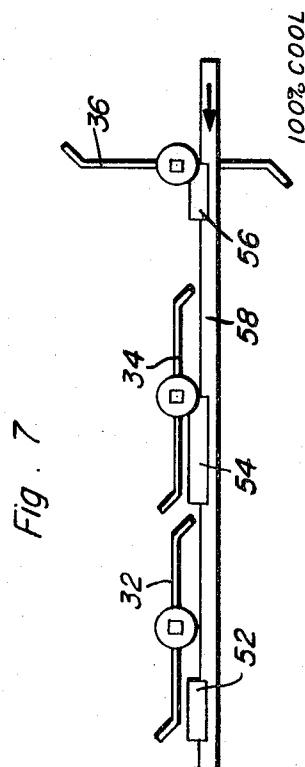
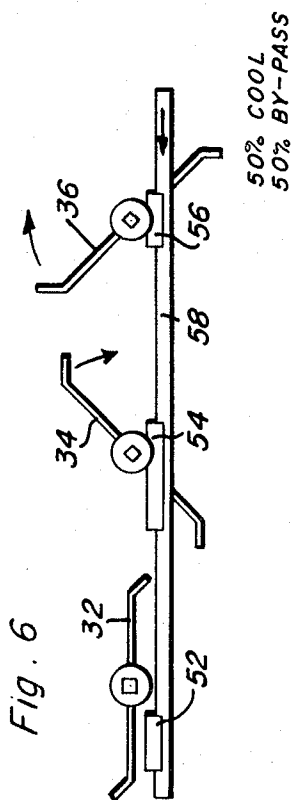
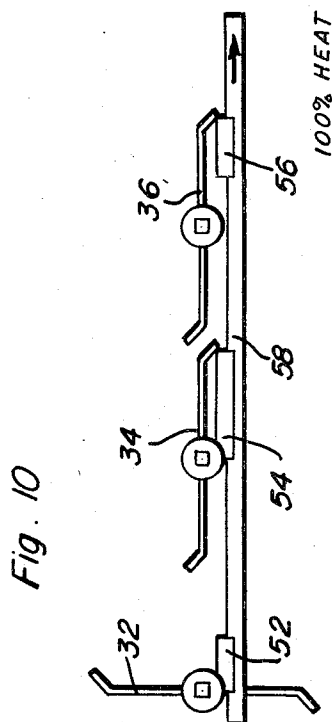
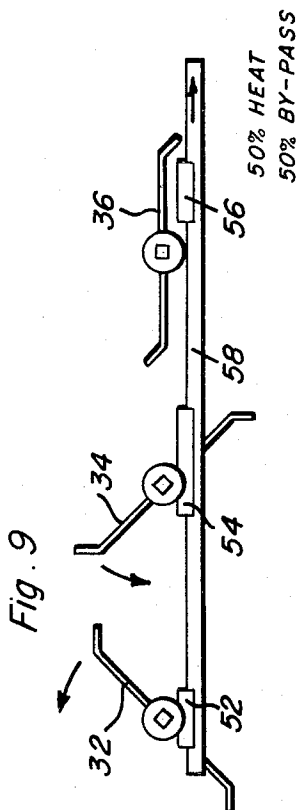
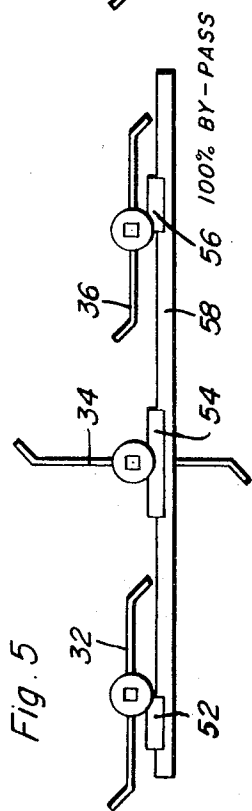
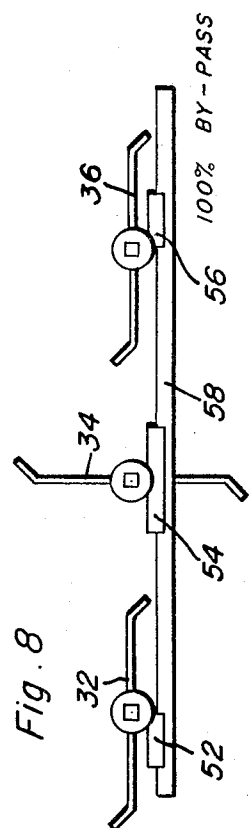


Fig. 4



DAMPER SEQUENCER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to fluid-flow control apparatus and, in particular, to a damper unit having separate hot, cold, and bypass air flow paths.

2. Description of the Prior Art

Air conditioning systems are known which employ a damper system having hot and cold air flow paths arranged side-by-side. When a cold air flow-path damper is fully open, the hot air flow-path damper is closed, and vice versa. However, in order to control the temperature of the air passing from the damper system into a room, and the like, to be conditioned, the hot and cold air is mixed in the manner of, for example, hot and cold water from a tap. This mixing wastes energy and is inherently inefficient, and results in uneven mixing and poor temperature control in the space to be conditioned.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a hot-cold deck damper system in which only one of the hot deck and cold deck dampers may be simultaneously opened.

It is another object of the present invention to provide a hot-cold deck damper system having bypass air mixable with either the hot or cold air for effective temperature control.

It is a further object of the present invention to provide a damper system which will emit a constant volume of air at all times; the hot, cold, and bypass air flows being designed to have the same static pressure drop.

It is yet another object of the present invention to provide an efficient damper system which will be simple and reliable in design, easy to install even in relatively inaccessible areas, comparatively maintenance free, and adaptable to all presently used damper operating devices, including electric, electronic, and fluid actuated automatic types with either push-pull or rotating power strokes.

These and other objects are achieved according to the present invention by providing a fluid-flow control apparatus having a damper unit with dampers associated with a plurality of fluid flow paths for blocking and unblocking same, and an arrangement for selectively actuating the dampers in a predetermined sequence placing in a blocked position one of a pair of the flow-paths whenever the other flow-path of the pair is simultaneously in an unblocked position.

The pair of flow-paths referred to above are preferably the hot and cold air flow-paths.

According to a preferred embodiment of the present invention, the dampers are mounted on pivotally mounted shafts for movement therewith. Pinion gears are also mounted on the shafts for movement therewith, and are sequentially engaged by rack gear segments mounted on a longitudinally slidably mounted carrier bar which may be actuated in a known manner by a conventional thermostatic operator. Any desired sequence of the dampers may be realized by proper arrangement of the rack gear segments on the carrier bar.

Spring or cam elements are advantageously provided for cooperating with planar surfaces, or flats provided on the shafts and releasably retain the shafts in predetermined positions.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary, schematic, vertical, longitudinal sectional view showing a prior art fluid-flow control system.

FIG. 2 is a fragmentary, schematic, vertical, longitudinal sectional view similar to FIG. 1, but showing a fluid-flow control system according to the present invention.

FIG. 3 is a fragmentary, side elevational view showing a preferred embodiment of a damper system according to the present invention.

FIG. 4 is a fragmentary, end elevational view of the apparatus of FIG. 3.

FIGS. 5 to 7 are schematic representations of apparatus according to the present invention in bypass and cooling modes.

FIGS. 8 to 10 are schematic representations of apparatus according to the present invention in bypass and heating modes.

FIG. 11 is a fragmentary, side elevational view showing a modified shaft indexing arrangement according to the present invention.

FIG. 12 is a fragmentary sectional view taken generally along the line 12—12 of FIG. 11.

FIG. 13 is a fragmentary, side elevational view showing yet another modified shaft indexing arrangement according to the present invention.

FIG. 14 is a fragmentary, sectional view taken generally along the line 14—14 of FIG. 13.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 of the drawings shows a prior art hot-cold deck unit 10 having a conduit 12 provided with a wall 14 forming two side-by-side flow paths. A heating coil 16 and a cooling coil 18 are arranged in respective flow paths, together with dampers 20 and 22. This unit 10 controls temperature in a space (not shown) to be conditioned by mixing air from each flow path, as discussed above.

Coils 16, 18 may be, for example, fluid coils as are well known, or alternatively, a conventional central station air handling unit (not shown) can condition the air in a known manner and supply it to conduit 12. Further, various electrical heating and cooling devices can be arranged in the respective flow paths.

FIG. 2 of the drawings shows a fluid-flow control system 24 according to the present invention. This system 24 includes fluid passage forming conduit 26 having interior walls 28 and 30 defining hot, cold, and bypass air flow paths in side-by-side arrangement. A damper unit 31 has damper elements 32, 34, and 36 associated with the hot, bypass, and cold flow paths, respectively. The conditioned air may be supplied as set out above for the prior art embodiment shown in FIG. 1.

System 24 also includes an arrangement to be set out below for selectively moving damper elements 32, 34 and 36 in a predetermined sequence which places in a blocked position one of the hot and cold flow paths whenever the other flow path of the pair is simultaneously in an unblocked position.

Referring now to FIGS. 3 and 4 of the drawings, damper unit 31 has a frame 37 of conventional construction and connected to conduit 26 as by, for example, flanges and known fasteners (not shown). Walls 38, 39 cooperate with walls 28, 30 to define the flow path through unit 31. Shafts 40, 42 and 44 are pivotally mounted in a conventional manner to outer walls of frame 37 and damper elements 32, 34, and 36 are mounted on the shafts 40, 42, and 44, respectively, in a conventional manner for movement therewith. The outer walls of frame 37 may be formed in a suitable, known manner as from, for example, a sheet metal. Pinion gears 46, 48 and 50 are also mounted on respective shafts 40, 42 and 44 for movement therewith. Associated with these pinion gears 46, 48 and 50 are rack gear segments 52, 54, and 56, respectively, fixedly mounted on a longitudinal carrier bar 58 arranged in bracket 60 for longitudinal sliding movement with respect to frame 37. Only one of segments 52 and 56 engage their associated pinion gears 46 and 50 at a time.

Leaf springs 62, 64, and 66 are cantilever mounted on frame 37 in a suitable, known manner, and are arranged for cooperating with shafts 40, 42 and 44, respectively, for indexing the shafts and their associated damper elements by sequentially engaging planar surfaces 67 provided on at least a portion of the shafts and releasably retaining same in one of a plurality of predetermined positions corresponding to desired damper element positions. As illustrated, shafts 40, 42, and 44 are round in cross-section with a square portion at the one end extending beyond frame 37 adjacent the pinion gears and rack segments.

FIGS. 5 to 7 show schematically the positions and relationships of damper elements 32, 34, and 36 for, respectively, 100 percent bypass air, 50 percent cool air and 50 percent bypass air, and 100 percent cool air being passed through unit 31. FIGS. 8 to 10 show the comparable positions and relationships for bypass and heating modes.

FIGS. 11 and 12 of the drawings show a modified shaft indexing arrangement. A, for example, U-shaped spring 68 is mounted on an outer wall of frame 37 as by clips 70, 72 retained by, for example, screw fasteners. The legs 73 of spring 68 will simultaneously engage opposed planar surfaces 67 of the associated shaft for insuring positive indexing of that shaft.

Yet another modified shaft indexing arrangement is shown in FIGS. 13 and 14 of the drawings. Here, a rack gear segment 74, which may be substituted for any of the segments 52, 54 and 56, is provided with a cam portion 76 for engaging surfaces 67 of the shafts and holding a damper element in a closed or flow path blocking position. The rack gear teeth will tend to hold the damper elements in an open or flow path unblocking position, since cam portion 76 will only releasably engage surfaces 67 when the associated damper element is in a flow path blocking position.

A damper unit 31 according to the present invention simply and efficiently controls fluid flow by passing hot, cold, and bypass air along their associated flow paths,

and blocking and unblocking the hot and cold air flow paths whenever the other flow path of this pair is simultaneously in the opposite mode so that the hot and cold air flow paths are never simultaneously unblocked. However, the bypass air flow path may be unblocked when either of the flow paths is only partially unblocked, as shown in FIGS. 6 and 9. By providing each flow path with the same pressure drop, a constant air flow into the space (not shown) to be conditioned is accordingly assured. This is due to the constant flow path area presented by the different damper element positions as is illustrated in FIGS. 5 to 10 of the drawings. That is, either only one of the damper elements is in a fully open position with the other two in closed or blocked positions, or two of the damper elements are in, for example, half open positions resulting in the same volume of air being passed thereby as if one damper element was fully open and the other two damper elements closed.

A damper unit 10 according to the present invention will operate at increased efficiency compared to known damping devices, and will reduce energy expenditures and cost, thereby saving the operator expense and alleviating power shortages.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. A fluid-flow apparatus, comprising, in combination:
 - a. damper means associated with three fluid-flow paths for moving between a position blocking each flow path and a position unblocking same, two of the paths normally blocked and one of the paths normally unblocked, the damper means including a frame provided with wall portions forming the flow paths, damper elements arranged in the flow paths, and shafts pivotally mounted to the frame, said damper elements mounted on the shafts for pivotal movement therewith,
 - b. means for selectively moving the damper elements in a predetermined sequence retaining in a blocked position one of the two normally blocked flow paths whenever the other flow path of the pair is in unblocked position, the moving means including pinion gears mounted on said shafts for movement therewith, rack gear segments associated with said pinion gears, and a longitudinal carrier bar mounted on said frame for longitudinal movement with respect thereto, said gear segments mounted on said carrier bar for movement therewith, and a pair of the gear segments arranged for always movably engaging the pinion gear associated with the normally unblocked one of the flow paths and sequentially engaging only one of the other, normally blocked flow paths for obtaining a constant flow from the three paths, the damper element of the flow path associated with the disengaged pinion gear being arranged in a position blocking the flow path associated therewith.

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2. A structure as defined in claim 1, further including means for releasably retaining said shafts in one of a plurality of predetermined positions.

3. A structure as define in claim 2, wherein each of said shafts is provided with a plurality of planar surfaces, and the retaining means is springs mounted on said frame and arranged for engaging the planar surfaces.

4. A structure as defined in claim 2, wherein each of said shafts is provided with a plurality of planar surfaces, and the retaining means is cam portions provided on the gear segments and arranged for engaging the planar surfaces.

5. A structure as defined in claim 1, wherein the three fluid flow paths are one each for hot, cold, and bypass air, and the two normally blocked flow paths are those for hot and cold air.

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6. A structure as defined in claim 5, further including fluid passage means including a conduit having walls defining the flow paths in side-by-side arrangement.

7. A structure as defined in claim 6, wherein each of said shafts is provided with a plurality of planar surfaces, and the retaining means is springs mounted on said frame and arranged for engaging the planar surfaces.

8. A structure as defined in claim 6, wherein each of said shafts is provided with a plurality of planar surfaces, and the retaining means is cam portions provided on the gear segments and arranged for engaging the planar surfaces.

9. A structure as defined in claim 1, further including fluid passage means including a conduit having walls defining the flow paths in side-by-side arrangement.

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