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(54) **Space heating systems.**

(57) A space heating system employs a length of ductwork which is divided longitudinally by heat-conducting septum (12) into flow and return passages (18,20), which form a circulation loop for flow of a hot gaseous fluid whereby heat exchange can take place between the hotter and cooler gases on each side of the septum (12).

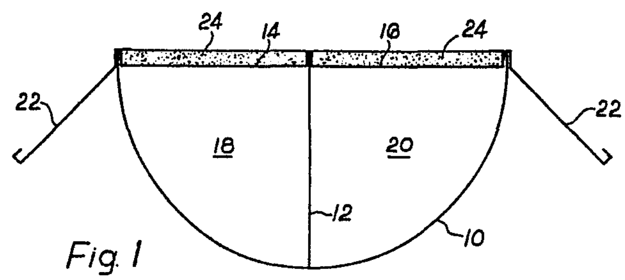

Fig. 1

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SPACE HEATING SYSTEMS

This invention relates to space heating systems of a kind in which hot gas or vapour (which may be air, the waste gases from a furnace, the combustion products of a heater, or any mixture of these) is circulated through ductwork located adjacent the space to be heated, so that the heating is primarily by radiation from the duct surfaces.

Such systems are particularly useful for large spaces - for example assembly halls, gymnasia and sports centres, factories and aircraft hangers. Because the heating medium has a low density very lightweight material ductwork can be used thus minimising structural work to support the ducts. The low thermal inertia provided by the lightweight ductwork results in rapid warmup and little delay in the establishment of the desired environmental conditions. In addition minor leakages present no problems and there is no risk of frost damage.

The output of radiant energy is proportional to the fourth power of the surface temperature of the radiating body. It is therefore necessary to run a radiant heating system at high temperature in order to get a useful heating effect. In practice, the temperature attainable is limited by the materials used, by the maximum working temperature of the fan used to circulate the gas, and so on.

As the heating medium yields up its energy by radiation, its temperature falls and the heating effect along the length of the duct falls considerably. For this reason, actual installations have often used banks of large diameter ducts, typically sets of three ducts of two feet or even four feet diameter per duct. Even then, the maximum length of duct between successive heat input sources has been limited, and problems may be encountered with uneven heating due to the temperature drop along the length of the path traversed by the heating fluid.

The uneven heating effect cannot be avoided simply by arranging the ductwork in the form of a loop (through which the heating fluid circulates substantially continuously) so that the loop has two parallel portions at such spacing relative to one another and to the ground that the beams of radiation from the two portions of the duct overlap at ground level. Although in such an arrangement, the hottest portion of the duct is opposite the coolest portion of the duct, this does not compensate for the temperature drop that occurs around the loop because of the fourth power effect mentioned above.

The object of the invention is to provide an improved radiant heating system which produces a radiant energy field whose intensity is more uniform.

In accordance with the invention, a space heating system comprises a length of ductwork containing at least one heat conducting septum which divides the interior of the ductwork into at least two passages which communicate with one another at or adjacent the ends of the ductwork whereby hot gaseous fluid can be passed along the ductwork from one end to the other to produce a circulatory flow.

By these means, the hottest fluid in one of the passages of the duct can be located opposite the coolest gas in the other of the divisions of the duct and the septum permits heat transfer from the hottest to the coldest and thus assists in rendering the overall temperature of the duct more uniform.

In one embodiment of the invention, the communication between said passages will be exclusively at or adjacent the ends of the length of ductwork and said passages will be substantially isolated from one another elsewhere along the length of the ductwork. In a modification, such communication may be primarily at or adjacent the end of the length of ductwork but provision may be made for some degree of communication at one or more intermediate positions along the length of the ductwork so that a proportion of the hot gas can be diverted from one passage to the other so as to mix with the cooler gas in the other passage.

Typical applications of the invention are now more particularly described by way of example only with reference to the accompanying diagrammatic drawings in which:-

Figure 1 is a cross section of a ductwork module;

Figure 2 is a side elevation showing part of a length of ductwork comprising a series of endwise connected modules;

Figure 3 is a plan view of the length of ductwork; and

Figure 4 is a plan view of a modification.

Referring now to the drawings and particularly to Figure 1, the ductwork module comprises a first component 10 of sheet metal curved (in this instance) to a semi-circular shape. In general, radiation is normal to the surface, and hence the shape may be modified to produce a particular pattern of radiation to suit particular circumstances. A septum 12, also made of sheet metal, divides the module into two equal portions along its entire length. The septum 12 may be secured to the arcuate wall for example by spot welding.

Shallow trays 14, 16 are secured along lateral edges to the septum 12 and to the arcuate wall 10 so as to complete the flow passages 18 and 20, and these trays may be used to contain loose, for example fibrous, insulating material for the purpose of minimising upward radiation from the ductwork module. Convection flow suppressors 22, which may also be sheet metal panels, are fixed to the lateral edges of the module.

The modules are connected end-to-end as shown in Figures 2 and 3 and the ends of each module may be made so that they form spigot and socket connections with the adjacent modules and so that the individual septums 12 mate to form a continuous septum along the assembled ductwork. The convection flow suppressors 22 may terminate slightly short of each extreme end of the modules so as to create a series of gaps along the length of the assembled length of ductwork as seen in Figures 2 and 3 whereby suspension chains (not shown) can be looped about the ductwork to hang it in the space being heated. Figure 2 shows successive lengths of duct 24, 26, 28.

One end of the length of assembled ductwork is completed by a generally D-shaped chamber 30 (see Figure 4) by means of which passage 18 communicates with passage 20. At the opposite end, there is provided a casing 32 which accommodates a burner (not shown), which fires its hot combustion products into passage 18, and a fan (not shown) which is associated with passage 20 and serves to draw the hot gases along passage 18, around chamber 30 and along passage 20. The major proportion of the gas is then passed back into the passage 18 along with the freshly generated combustion gases from the burner. A small proportion of the gases is exhausted from the ductwork, e.g. at 34, to compensate for the additional gases introduced by the burner.

Thus, it will be noted that the major proportion of the gas is continuously circulated around a loop comprising the passages 18,20, chamber 30 and casing 32. The gases in passages 18 and 20 are isolated from each other by the septum 12 which nevertheless permits heat exchange between the two passages so that part of the energy in the hotter gases is transmitted to the cooler gases. In a modification, as well as heat exchange through the agency of the septum 12, provision may be made for transfer of hot gas from passage 18 to passage 20 especially in those regions where the gas in passage 20 is at its coolest, i.e. adjacent the casing 30. Such transfer of gas may be achieved by means of holes in the septum 12 at suitable locations along the length of the ductwork.

Figure 4 illustrates a modification in which more than one heat-conducting septum 12A, 12B is provided to subdivide the length of ductwork into more than two flow passages 18, 20A, 20B with each cooler gas passage 20A, 20B extending alongside a hotter gas passage 18 so that two or more gas circulation loops are produced. Each septum 12A, 12B may be apertured if desired to allow some degree of transfer of gas from a hotter gas passage 18 to a cooler gas passage 20A, 20B.

CLAIMS

1. A space heating system comprises a length of ductwork containing at least one heat conducting septum which divides the interior of the ductwork into at least two passages which communicate with one another at or adjacent the ends of the ductwork whereby hot gaseous fluid can be passed along the ductwork from one end to the other to produce a circulatory flow.

2. A system as claimed in Claim 1 including means for circulating hot gaseous fluid around the length of ductwork via said passages whereby heat transfer can take place between gas flowing in said passages via the or each heat-conducting septum.

3. A system as claimed in Claim 1 or 2 in which the ductwork includes a wall which bounds said passages and which forms an exposed radiant heat emitting surface.

4. A system as claimed in Claim 3 in which said wall is outwardly convex as seen in cross-section.

5. A system as claimed in any one of Claims 1-4 in which the ductwork is of D-section, the curved portion of which is exposed so as to form a radiant heat emitting surface and the remaining portion of which is provided with heat insulating material.

6. A system as claimed in any one of Claims 1-5 in which means is provided for enabling some degree of gas transfer between said passages at one or more locations intermediate the ends of

the length of ductwork to allow mixing of hotter gas from one passage with cooler gas in another passage.

7. A system as claimed in Claim 6 in which said gas transfer can take place via holes in the or each septum.

8. A system as claimed in any one of Claims 1-7 in which said length of ductwork comprises a series of endwise connected duct modules.

9. A space heating system substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

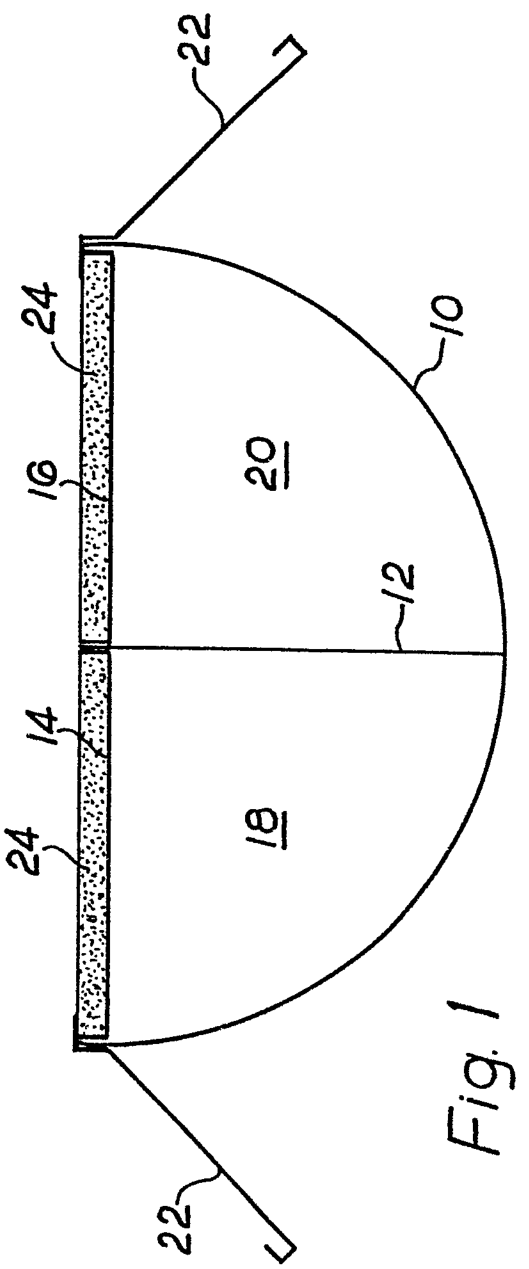

Fig. 1

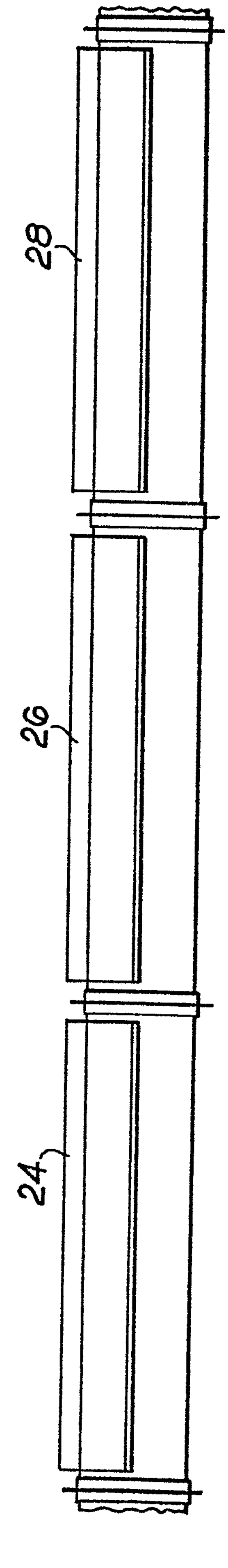

Fig. 2

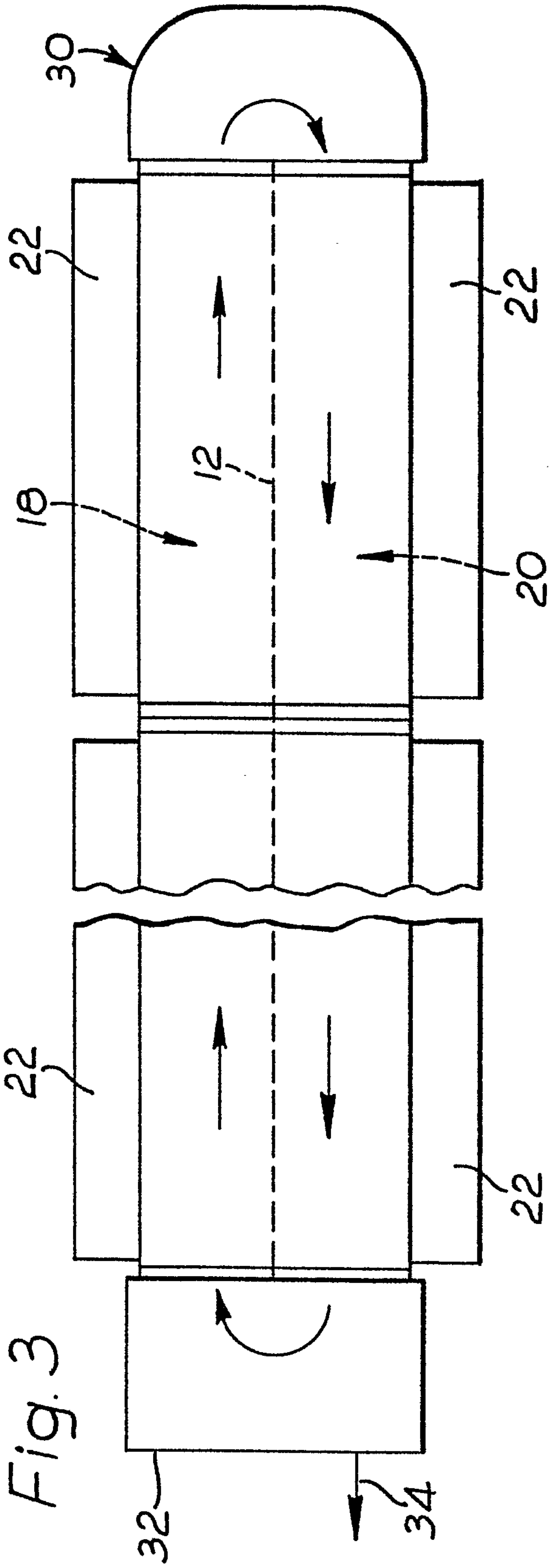

Fig. 3

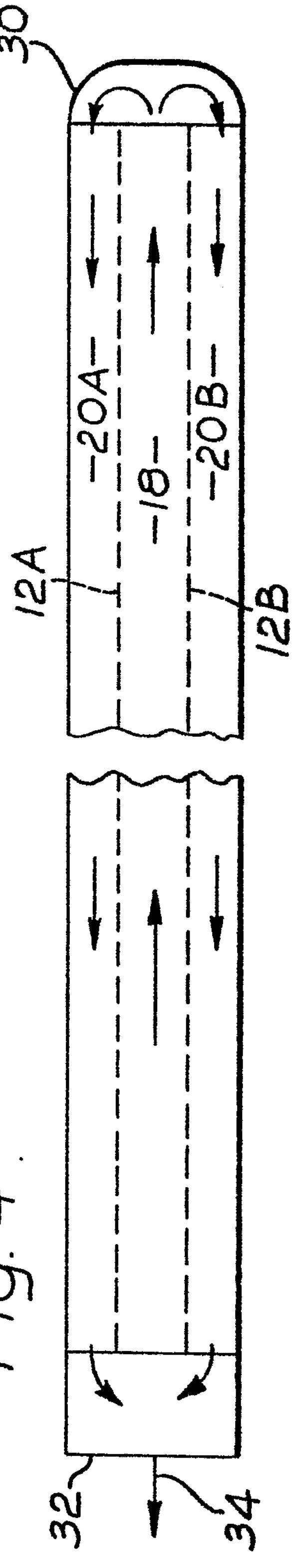

Fig. 4

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EUROPEAN SEARCH REPORT

Application number

EP 82 30 5698

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
			F 24 D 5/08
X,Y	FR-A-1 127 505 (LEJAY) * Page 2, left-hand column, paragraphes 2, 3, 5 * ---	1-4,6, 7	
X,Y	AT-B- 259 182 (HÄLG & CO.) * Page 1, line 27 - page 2, line 17 *	1-3,6, 7	
A	* Figure 2, reference 4; page 2, lines 29-33 * ---	5,8	
Y	GB-A-1 207 270 (LUFTKONDITIONERING AB) * Page 2, lines 126-130 * ---	6,7	TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
A	FR-A- 511 163 (MILLE) * Figures 1, 2, references R, C * -----	1	F 24 D 5/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	14-06-1983	PIEPER C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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