(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 684 045 A2

(12) # EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.07.2006 Bulletin 2006/30

(51) Int Cl.:
F28F 21/06 *(2006.01)* ***F28F 9/02*** *(2006.01)*

(21) Application number: **05106995.3**

(22) Date of filing: **28.07.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **06.12.2004 IT FI20040251**

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(54) **Plastic modular radiator element for building heating systems**

(57) Plastic modular radiator element for building heating systems including two heat-carrier fluid distributor elements (1) at its ends. Said modular element is composed of two horizontal sleeves (6) and vertical ducts or branches (9), the ends of which are connected to said sleeves so as to enable the passage of the heat-carrier fluid, entering from one of these sleeves and exiting from the other, through said vertical branches. Ducts (8) branch radially from each sleeve to place the sleeve in communication with the vertical branches. The modular element offers a more uniform distribution of the flow of fluid, a homogeneous thermal output, a lighter weight, and more cost-effective transportation and installation.

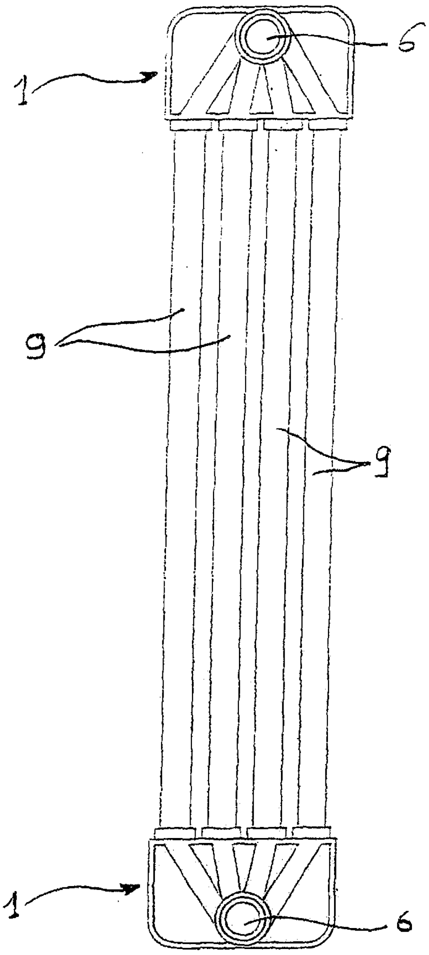

Fig. 7

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Description

[0001] The present invention relates to the building heating systems sector in general, and particularly concerns a plastic modular radiator element complete with a heat-carrier fluid flow distributor element.

[0002] In the present description, the term "heat emitter" is used, in accordance with the standard UNI EN 442, to mean a device having the purpose of releasing heat so as to obtain specific temperature conditions in a building, and the term "radiator" is used, again in accordance with the standard EN 442, to mean a heat emitter that emits heat by natural convection and irradiation, manufactured and sold in modular elements of identical dimensions that can be assembled in "batteries" to form an assembly providing the desired total thermal output.

[0003] It is common knowledge that modular radiator elements are now generally made by molding and/or extrusion of various metal materials (steel, aluminium alloys, extruded aluminium, cast iron, copper) and consist of tubular vertical elements (hereinafter called "branches") of variable number that converge above and below on a coupling, in the form of a horizontal portion of duct, also called a "hub". Several modular elements are combined together to form a battery (or radiator), defining a hydraulic circuit consisting of a top hub and a bottom hub (resulting from the connection of the couplings of the various modular elements) that are in communication with each other by means of a plurality of vertical columns or ducts or branches.

[0004] The resulting radiator battery is connected to a heat-carrier fluid distribution system by means of specific inlet and outlet flow control valves, through which the fluid is delivered to a first hub in the battery, respectively called top or bottom hub, consisting of a horizontal duct from which the vertical branches of the radiator depart, the latter providing the connection to a second hub, respectively called bottom or top hub. The radiator elements are hydraulically connected in parallel by the top and bottom hub and, given the manufacturing technologies used (which depend on the metal materials involved), the cross sections of the radiator branches - added together and placed in relation to the fluid flow rates through them - are comparable with the cross section of the hub. That is why any pressure drop of the fluid moving through a branch is much the same as the pressure drop through the hub. This gives rise to uneven heat-carrier fluid distributions that negatively affect the operation and thermal output of the radiator.

[0005] The object of the present invention is to provide a radiator for building heating systems characterized particularly by a light weight, adaptability to the space in which it is designed to operate, strength, insensitivity to stray and/or parasite currents (which tend to corrode the inside of the radiators) and to any agents that might corrode its outside surface.

[0006] A further object of the present invention is to provide a radiator of the above-mentioned type that is less complex and more cost-effective to manufacture and assemble in batteries.

[0007] Another object of the present invention is to provide a radiator of the above-mentioned type in which the fluid flow is evenly distributed so as to result in uniform pressure drops and equal thermal outputs for each element or module.

[0008] These objects are achieved by the modular element for a building heating radiator according to the present invention, the essential features of which are set forth in claim 1.

[0009] Other characteristics and advantages of the plastic modular radiator element for heating systems according to the present invention will appear more clearly from the following description of an embodiment, given as a nonlimiting example with reference to the attached drawings, wherein:

- figure 1 shows a front view of a heat-carrier fluid distributor element for a modular radiator element according to the present invention,
- figure 2 shows a side view of the distributor element of figure 1,
- figure 3 shows a cross section taken along the line III-III of figure 1,
- figure 4 shows a top view of the modular element of figure 1,
- figure 5 is a longitudinal section taken along the line V-V of figure 4,
- figure 6 is a longitudinal section taken along the line VI-VI of figure 4,
- figure 7 shows a front view of a modular radiator element with a heat-carrier fluid distributor according to the present invention,
- figure 8 shows a diagram of the hydraulic circuit for a radiator.

[0010] With reference to figures 1-6, the numeral 1 is used to indicate the heat-carrier fluid distributor for a modular building heating radiator element consisting of a generically four-sided plate 2 and, more precisely, substantially rectangular, delimited by a perimetrical edge 3 orthogonal to the plate. Along one of the two longer sides of the plate 2, said edge 3 has four nozzles 4 with holes 5 in the middle (figure 4). A through sleeve 6 is also connected perpendicularly to the plate 2, projecting from both sides thereof. The sleeve 6 is situated about halfway along the edge opposite the nozzles 4 and terminates on one side with a tapered, narrower portion 7, the outer diameter of which substantially coincides with the inner diameter of the sleeve 6 before said tapering.

[0011] In particular, the plate 2 can be composed of two plate portions, coupled and molded so as to define four channels 8 which, after joining the two plate portions, give rise to a corresponding number of tubular ducts that place the sleeve 6 in communication with the nozzles 4. Preferably, the plate 2 with the edge 3, the nozzles 4 and the sleeve 6 are molded in a single piece. In an embodiment of the invention, the distributor can consist of the edge 3, acting as a supporting frame, the nozzles 4 and the sleeve 6 connected to the edge 3 and communicating with the nozzle 4 via radial ducts 8, all molded in a single piece.

[0012] The modular radiator element consists, in the example of an embodiment illustrated in figure 7, of four parallel radiator branches 9 and two heat-carrier fluid distributors attached to the respective ends thereof. Said branches are lengths of piping that, being connected at the top and bottom to the distributors by means of the nozzles 4, place the top and bottom sleeves 6 in communication with one another.

[0013] Several modular elements are joined together to form a radiator by inserting the tapered portion 7 of the sleeve 6, in the sleeve 6 of the next modular element, in this way also assembling the top and bottom hubs of the radiator battery.

[0014] Connecting several modular elements together gives rise to radiator batteries with different thermal outputs; figure 8 shows the hydraulic circuit of a battery of nine modules or elements. A heat-carrier fluid inlet A, which in this figure is situated at the bottom, and a corresponding outlet L are shown therein. The various vertical lengths represent the single modules, while the two horizontal sections (AI and LT) represent the top and bottom hubs. The letters indicate the top and bottom joints between each module and the two hubs.

[0015] As it flows through a length of piping, a fluid undergoes a pressure drop that is inversely proportional to the fifth power of the pipe diameter, so a reduction of the pipe diameter results in an increase of the pressure drop. Moreover, there are pressure drops proportional to the kinetic energy of the fluid due to the fluid entering and exiting through the hubs and branches. To make the heat-carrier fluid flow smoothly through the radiator, given the configuration of the hydraulic circuit of figure 8, it is essential to increase the pressure drops in the fluid flowing through the branches to a sufficient degree so that the pressure drop through the hubs is negligible, or at least substantially lower.

[0016] In the above-described heat-carrier fluid distributor, the diameter of the four channels 8 departing from the sleeve 6, which is approximately 30 mm, is reduced to 6 mm (as opposed to the approximately 23 mm obtainable in steel radiators), so the pressure drops are considerably increased. Thus, for the same total flow rate, each of the hydraulic circuits of figure 8 (A-L, A-B-M-L, A-B-C-N-M-L, and so on) connecting the fluid inlet A to the outlet L carries the same fluid flow rate, thereby ensuring an even thermal output from the single radiator elements.

[0017] A particularly preferred embodiment for achieving the objects of the invention involves making the modular element out of a plastic material, e.g. polypropylene, such as a polypropylene random copolymer (PP-R), with or without reinforcing fibers, or a polyester. The plastic material used is characterized by a thermal conductivity of at least 0.15 W/m°K and a thermal dilation coefficient of no more than $3.5.10^{-5}°K^{-1}$, can be injection molded or extruded with a reflecting surface finish, can be heat-welded, has a useful working temperature of at least 90°C, and can withstand a working pressure of at least 3.5 bar.

[0018] Using this raw material enables the industrialization of a single-stage production of both the distributor and the columns. In fact, said operation would pose considerable machining difficulties if steel were used, in terms of the welding of the branches to the distributor. If the molding of other metal materials were attempted, on the other hand, this would considerably increase the costs, due to the need to raise the molding pressures to achieve branches with a narrower diameter than those of the known art.

[0019] In addition, joining the various component parts of a modular element, and joining several modules together to form a radiator can be done economically and with a limited energy absorption by heat-welding the plastic using Teflon-coated aluminium calibrators or templates of suitable dimensions heated to the melting temperature of the plastic raw material. In fact, it is sufficient to insert the parts to weld (for spigot and socket joints) or rest them (for end-to-end joints) against the calibrators for a suitable time and then apply a certain pressure. Then it is sufficient to simply extract (spigot and socket joints) or separate (end-to-end joints) the parts and place them in contact with one another for an established time interval under an adequate contact pressure, as a function of the material being used, in order to achieve a permanent joint.

[0020] Moreover, the raw material used makes it unnecessary to provide for any surface treatments to protect either the inside (against stray and/or parasite currents) or the outside (against rust or magnetic pollution).

[0021] No painting treatment is needed because the required color can be obtained already in the previously-specified raw material. The wide range of colors that it is possible to choose also enables the design to be better customized.

[0022] Using a raw material of lower specific weight as compared to the various metals conventionally used enables the manufacture of lighter-weight elements (approximately 60% lighter than steel or aluminium and 80% lighter than cast iron), which makes their transportation and installation more straightforward and economical.

[0023] The hardness and stiffness of the raw material used in this invention are lower than those of the metal materials normally used, thus reducing any damage caused by accidental shocks.

[0024] The raw material used in this invention also adapts to the use of all the standard accessories for completing a battery of radiators.

[0025] Finally, the raw material identified drastically reduces the noise levels due to the fluid flowing in poorly-dimensioned systems, especially in the case of radiators made of extruded and die-cast aluminium.

[0026] There may be variants of and/or modifications to the plastic modular radiator element for room heating systems according to the present invention without departing from the scope of the present invention.

Claims

1. Modular radiator element for building heating systems **characterized in that** it is made of a plastic material.

2. Modular element as in claim 1, **characterized in that** said plastic material has a thermal conductivity of at least 0.15 W/m°K, a thermal dilation coefficient of no more than $3.5 \cdot 10^{-5}$°K^{-1}, is suitable for injection molding or extrusion, and has a reflecting, heat-weldable surface finish.

3. Modular element as in claims 1 or 2, **characterized in that** said plastic material has a useful working temperature of at least 90°C and can withstand a working pressure of at least 3.5 bar.

4. Modular element as in any of the claims 1, 2 or 3, **characterized in that** the plastic material is a polypropylene or a polyester.

5. Modular element as in claim 4, **characterized in that** said plastic material is reinforced with fibers.

6. Modular element as in claim 5, **characterized in that** said plastic material is a random polypropylene copolymer (PP-R).

7. Modular element as in any of the previous claims, comprising two horizontal sleeves (6) and at least one vertical duct or branch (9) connected at either end to said sleeves so as to enable the passage through said duct of an heat-carrier fluid, entering through one of said sleeves and departing through the other, and in which at least one duct branches radially from each sleeve so as to place said sleeve in communication with said at least one vertical branch.

8. Modular element as in claim 7, wherein each sleeve (6) extends orthogonally and integrally through a plate (2), said plate being composed of two plate portions that are joined and molded together so as to define on each of them at least one channel (8) that, after the two plate portions have been joined together, constitutes at least one tubular duct placing said sleeve in communication with said at least one vertical branch (9).

9. Modular element as in claim 7, wherein each sleeve (6) extends orthogonally and integrally through a plate (2), at least one duct (8) being obtained within said plate so as to extend radially from said sleeve to place said sleeve in communication with said at least one vertical branch.

10. Modular element as in claim 7, wherein there is at least one nozzle (4) on one side of said plate (2) that communicates with said at least one tubular duct (8) formed within said plate and with a corresponding vertical branch (9) to which it is connected.

11. Modular element as in claim 7 or 8, wherein said at least one tubular duct (8) has a substantially narrower cross-section than that of the corresponding vertical duct (9).

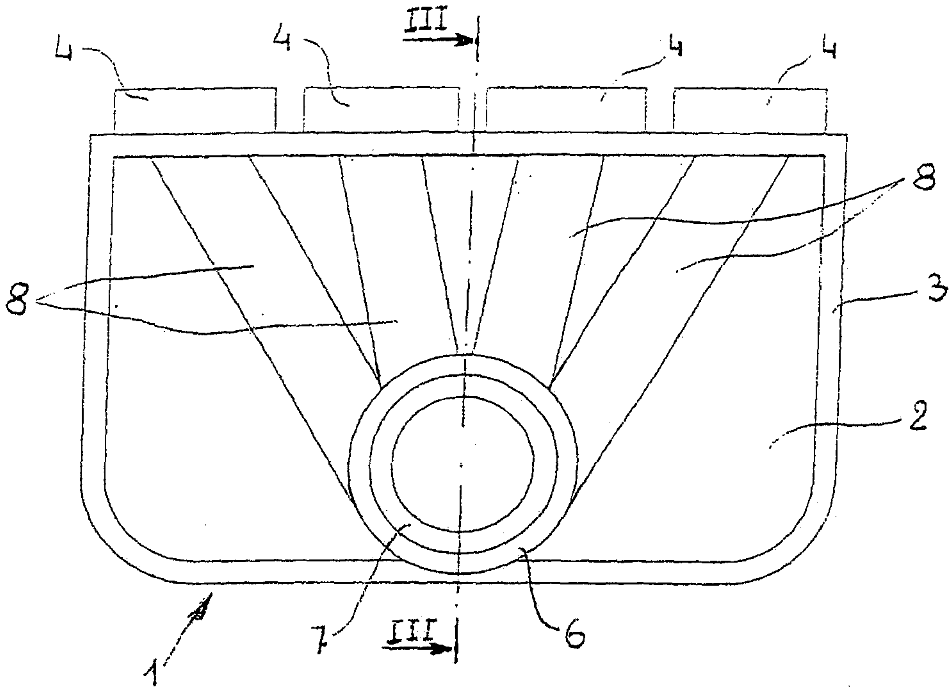

Fig. 1

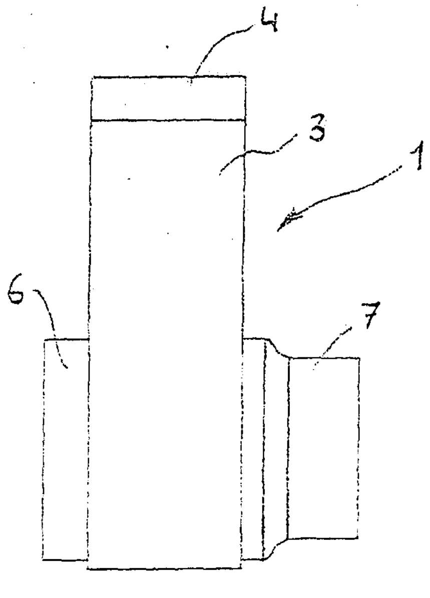

Fig. 2

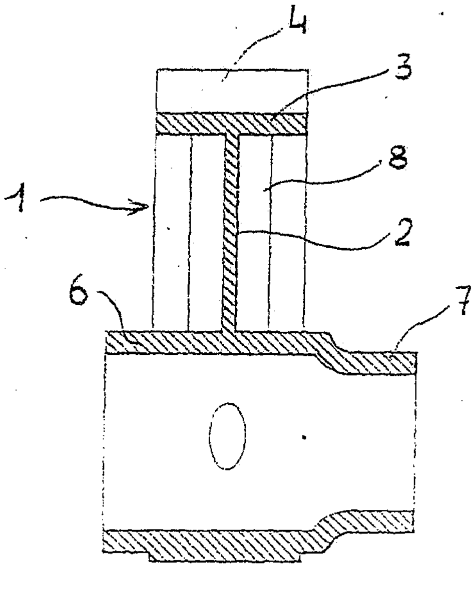

Fig. 3

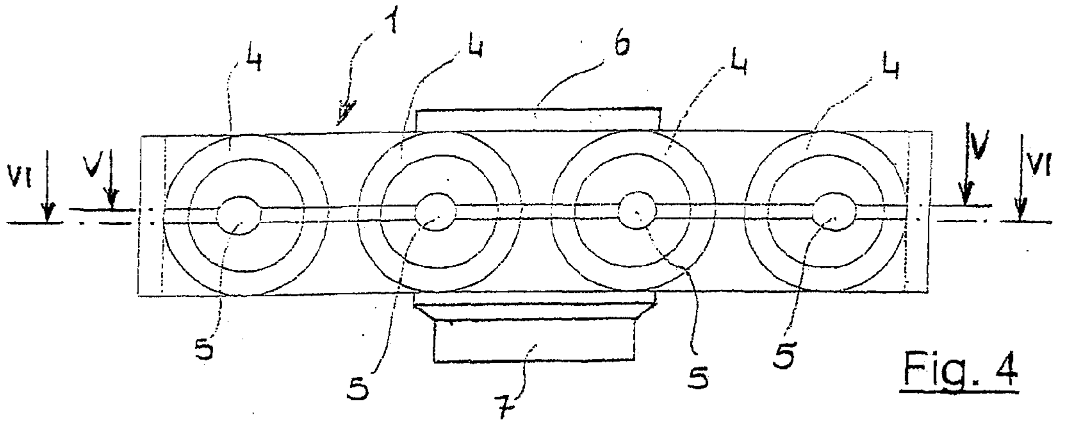

Fig. 4

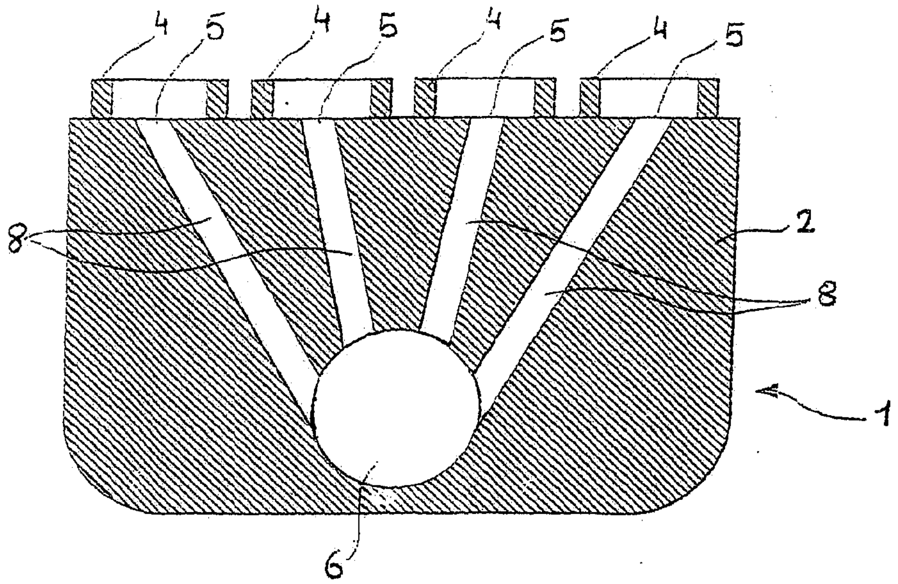

Fig. 5

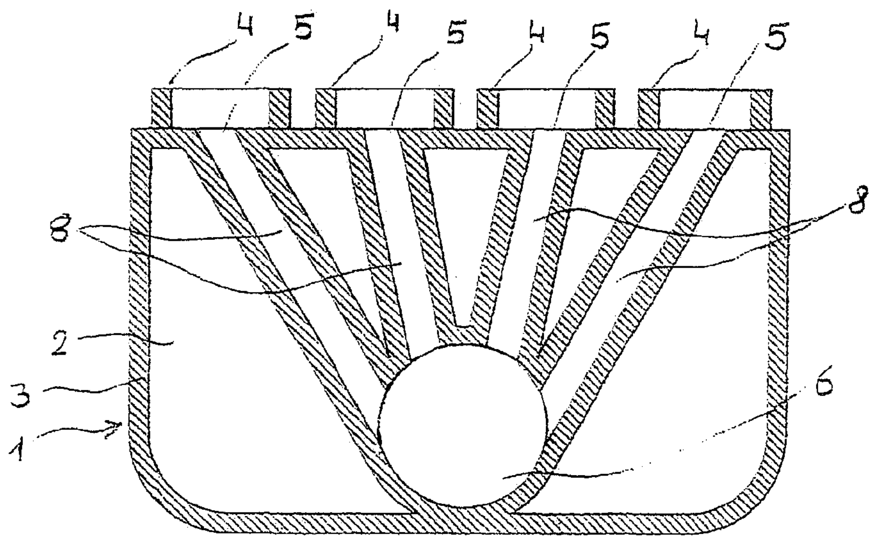

Fig. 6

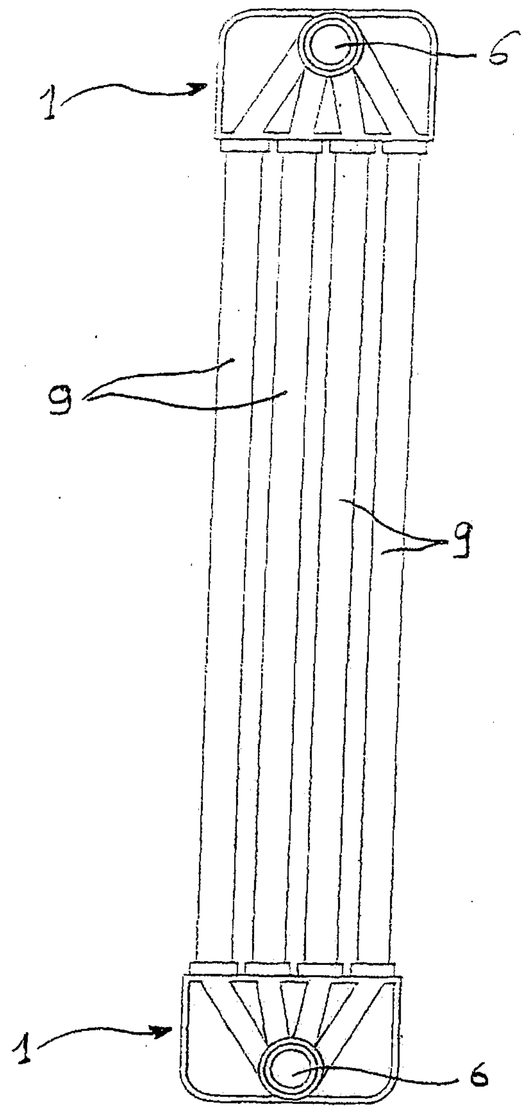

Fig. 7

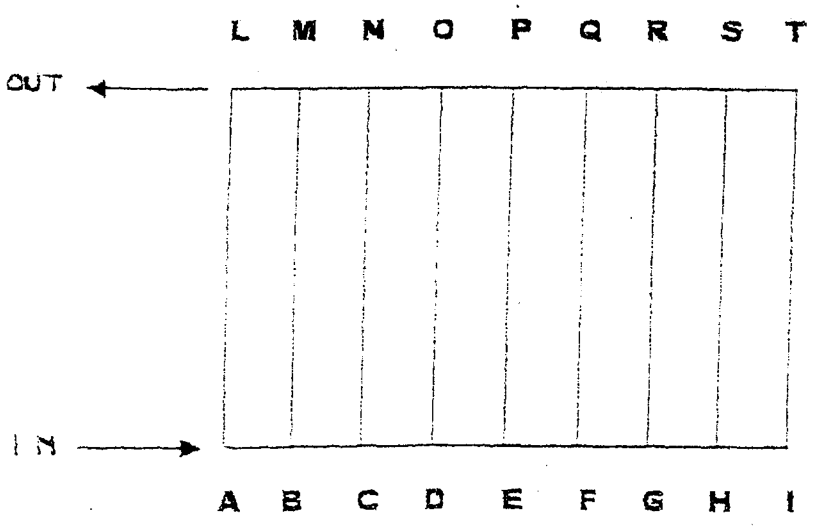

Fig. 8