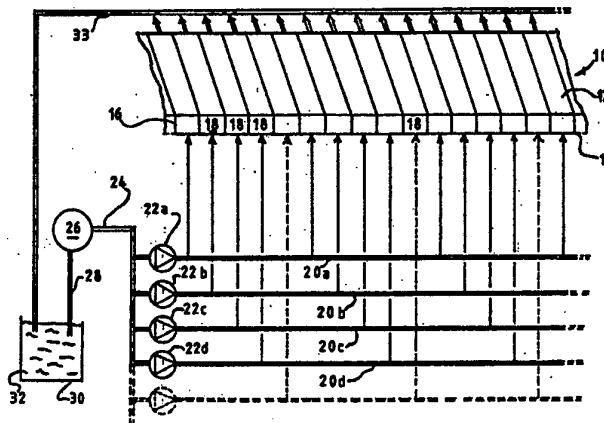




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(54) Title: METHODS AND APPARATUS FOR CONTROLLING TEMPERATURE**(57) Abstract**

A method and apparatus for controlling the temperature of (e.g. cooling and/or shading) an area is described. A hollow, translucent or transparent moulded acrylic material panel is mounted adjacent the area and fluid is passed through it at a rate proportional to the degree of temperature control required. The rate of fluid flow is adjusted by controlling the volume and/or speed of fluid passage through the panel in response to the temperature within the area. The fluid may be heated and/or cooled; it may be transparent, translucent or opaque; it may be coloured. The panel may be flat or curved and has in it a plurality of fluid tight passageways (generally linear or sinuous) coupled to fluid supply means energisable responsive to the temperature on one side of the panel. Control means are operative to determine to which passageways fluid is passed - the passageways being arranged in groups connected to said fluid supply means by respective flow control valves. The fluid supply comprises one or more pumps operable to draw fluid from one or a number of reservoirs and pass it to said passageways - the fluid thereafter returning to said reservoir(s). Flow control may be in response to the outputs of a number of temperature sensors causing different ones of said valves to open at different temperatures. Enclosures are described formed of a number of similar panels mounted in a framework, which enclosures comprise permanently or temporarily erectable buildings or other structures, or temporarily erectable extensions for buildings or vehicles.

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METHODS AND APPARATUS
FOR CONTROLLING TEMPERATURE

DESCRIPTION

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The invention relates to methods and apparatus for controlling temperature, more particularly but not exclusively methods and apparatus for controlling the temperature, and shading and/or cooling, of specific
20 areas.

To increase light levels within buildings many are provided with transparent or translucent roofs and/or walls. Such arrangements are of considerable advantage in increasing the amount of light entering the
25 building.

At the domestic level many houses have been provided with conservatories or the like - extensions having generally transparent walls and/or roofs.

Difficulties are encountered with such
30 arrangements when they fall in direct sunlight. In such cases the temperature within the conservatory may become excessive leading to discomfort and distress of its occupants, or the destruction of plants within it.

Ways of overcoming this problem have in the
35 past been proposed which included the provision of blinds or curtaining which may be stretched across a

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transparent or translucent wall or roof to screen, and so prevent, direct sunlight entering the building.

Such arrangements may be visually obtrusive and require action by one or more individuals to draw the
5 curtaining.

Another proposal was to include windows which may operate automatically - opening as the temperature within the enclosure increases. Such arrangements can lead to problems with security.

10 A first object of the present invention is to provide methods and apparatus effective to control the temperature of an area.

A second object of the invention is to provide methods and apparatus for enabling the automatic, or
15 semi-automatic, operation of means effective to reduce the amount of light passing through a wall or roofing panel used in such a building so as to control the temperature, cool and/or shade, the interior of the building when necessary.

20 A third object of the invention is to provide apparatus which provides for the ready cooling of an area bounded at least in part by a panel through which sunlight may pass.

A fourth object of the invention is to provide
25 an enclosure, which may be in the form of a temporary or permanent building, the temperature within which is controllable and/or the interior of which may be shaded from the effects of direct sunlight.

In one aspect the present invention provides a
30 method of controlling the temperature of an area which comprises the steps of mounting a structure comprising at least one translucent or transparent panel which is at least partially hollow adjacent the area and arranging for a fluid to be passed through the said at
35 least one panel at a rate proportional to the degree of temperature control required.

The rate at which fluid is passed through the or each panel is preferably adjusted by controlling the volume and/or speed of fluid passage therethrough. The adjustment of the volume or speed of fluid passing
5 through the at least one panel may be effected in accordance with a temperature monitored within the area.

The method may further provide that the fluid passed through the or each panel is heated and/or cooled.

10 A second aspect of the invention provides a method of cooling and/or shading an area from direct sunlight which comprises the steps of mounting a structure comprising at least one translucent or transparent panel which is at least partially hollow
15 adjacent the area to be shaded and/or cooled and arranging for a fluid to be passed through the or each said panel at a rate proportional to the degree of shading and/or cooling required.

In either of the above aspects the said fluid
20 may be opaque.

In another aspect the invention provides apparatus for controlling the temperature of an area, which apparatus comprises a structure including one or more at least partially hollow translucent or
25 transparent panels, means for coupling the hollow interior of the or each panel to fluid supply means and means responsive to the temperature on one side of the structure to energise said fluid supply means to pass fluid to said one panel, or to some or all of said
30 panels.

The interior of the or each panel is preferably provided with a plurality of elongate fluid tight passageways to which said fluid supply means is coupled.

Said apparatus preferably further includes
35 means for heating and/or cooling fluid passed by the fluid supply means to the or each said panel.

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The or each said panel is advantageously of a plastics material.

The fluid used in the apparatus is desirably opaque and/or coloured.

5 With advantage said fluid control means is operative to determine to which of said passageways fluid is passed.

The passageways of the or each panel are desirably arranged in groups, each group being connected
10 to said fluid supply means.

The connection of each group of passageways to said fluid supply means is preferably effected by a respective flow control valve.

The fluid supply means may comprise pump means
15 operable to draw fluid from a reservoir and pass it to said passageways when at least one of said valves is open.

The means coupling the fluid supply means to said groups of passageways is provided with individually
20 operable heating and/or cooling devices such that selected groups of passageways may selectively be heated and/or cooled.

Desirably the apparatus includes a plurality of temperature sensing devices each operable to control a
25 different one of said valves and each of which is pre-set to open, in use, its associated valve at a selected one of a number of different temperatures.

The pump means, if provided, may be arranged to operate at constant speed and provide a variable flow
30 rate dependent upon the number of groups of passageways coupled thereto by the opening of the respectively associated valves.

In one embodiment of the invention the inner surfaces of the passageways are coated with a material
35 which is normally translucent or transparent but which, when contacted by the fluid used in the apparatus

becomes coloured.

In this embodiment the colours of said different groups of passageways when contacted by fluid therein may be the same or different.

5 In another embodiment of the invention each of said groups of passageways is coupled by a respective valve to an individually associated pump arranged to draw coloured fluid from an individually associated reservoir and pass that fluid to said passageways of
10 that group.

Desirably the ends of said passageways remote from said valves are coupled to one or more fluid return lines operable to carry fluid passing from the passageways to the or each respective reservoir.

15 Different embodiments of the invention provide that the or each panel is generally planar or curved in one or two dimensions.

The passageways in the or each said panel may be generally linear or be of a generally sinuous or
20 curvilinear form.

The or each panel is desirably of a moulded acrylic material.

A further aspect of the invention provides a plurality of similar panels mounted in a framework to
25 form an enclosure.

The enclosure may comprise a permanently or temporarily erectable building.

Alternatively the enclosure may comprise a temporarily erectable extension for a building or
30 vehicle.

In such an enclosure it is preferably provided that the elongate fluid tight passageways in the or each panel which extend in use at an angle to the horizontal are supplied with fluid at their uppermost ends by the
35 fluid supply means.

The said fluid supply means may comprise

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conduits in the said framework via which fluid may be passed to a manifold forming part of said framework and to which the said panels are coupled.

Alternatively, said fluid supply means may
5 comprise a manifold formed as part of said panel and to which fluid is passed via one or more of the passageways in the said panel.

In either application the fluid is preferably passed from said manifolds to the passageways in the or
10 each said panel via a spigot or jet which acts to direct fluid onto a wall of its associated passageway.

The above and other aspects, features and advantages of the invention become more apparent from the following description of embodiments thereof now
15 made with reference to the accompanying drawings; in which:-

Figure 1 diagrammatically illustrates apparatus embodying the invention,

Figure 2 illustrates a first arrangement for
20 use with the apparatus of Figure 1,

Figure 3 illustrates a modified form of the arrangement of Figure 2,

Figure 4 illustrates schematically a first enclosure embodying the invention, in the form of a
25 marquee, and

Figure 5 illustrates schematically a second enclosure embodying the invention, in the form of a cloche.

With reference now to the drawings. Figure 1
30 shows an arrangement embodying the invention to include a transparent acrylic or other suitable plastics material panel 10 formed of two outer layers 12 and 14 spaced apart by a number of interconnecting webs 16 defining a plurality of fluid tight passageways 18
35 extending the length (or breadth) of the panel 10.

The passageways 18 are coupled in groups to

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various manifolds 20A, 20B, 20C and 20D and each manifold is coupled to an electrically operable flow control valve 22A, 22B, 22C, 22D.

The inputs to valves 22 are coupled to receive the output 24 of a fluid pump 26.

The input to pump 26, shown at 28, is taken from a reservoir 30 containing a fluid 32.

The fluid may with advantage be a liquid such as water.

10 The ends of the passageways 18 remote from the valves 20A, 20B, 20C, 20D, are coupled to a fluid return line 33 carrying fluid passing from those passageways back to reservoir 30.

It will be appreciated that when the pump 26 is working fluid 32 will be drawn from reservoir 30 and passed through ones of the passageways 18 coupled to which ever of the valves 22A, 22B, 22C and 22D, are at that time open.

With reference now to Figure 2, it will be seen 20 the valves 22 are coupled to receive outputs of temperature sensing devices 34A, 34B, 34C and 34D respectively.

When energised by an output from its associated temperature sensors 34A, 34B, 34C or 34D a valve 22A, 25 22B, 22C or 22D will open.

The temperature sensors may take any suitable form. The sensors 34 are coupled to a power supply 36. Each of the sensors 34 is set to operate - provide an output energising its associated valve to open - at a 30 different temperature. Furthermore, the temperatures at which they operate are selected such that sensor 34A will operate at a first temperature, sensor 34B will operate at a second temperature greater than the first, sensor 34C will operate at a third temperature greater 35 than the second and sensor 34D will operate at a fourth temperature greater than the third.

For example temperature sensor 34A may be set to provide an output to its associated valve 22A at 20°C, sensor 34B may be set to provide an output opening valve 22B at a temperature of say 23°C, sensor 34C may be set to provide an output opening valve 22C at say 26°C, sensor 34D may be set to provide an output opening valve 24C at say 29°C and so on for each of the valves 22 and sensor 34 associated therewith.

Thus it will be appreciated that the temperature sensors 34A, 34B, 34C and 34D operate in cascade mode - that is to say the first of them (34A) will begin to operate at a temperature lower than that at which the second and then subsequently the third will begin to operate.

It will further be seen that the outputs of the temperature sensors 34A, 34B, 34C and 34D are operable to energise a relay 40 (via diode 42A, 42B, 42C and 42D and resistors 44A, 44B, 44C and 44D respectively) coupling the pump 26 to the power supply 36.

This arrangement provides that as soon as the temperature sensor device 34A is operable to open the valve 22A - that is to say the temperature at which the system is set to start operation - pump 26 is energised to pump fluid from reservoir 30 to the passageways 18 coupled to the valve 22A.

If the temperature continues to increase and exceeds the temperature set for sensor 34B then pump 26 will pump fluid to the passageways coupled to both valves 22A and 22B.

If the temperature further increases valves 22C and then 22D will open allowing fluid to flow through the passageways is associated with those valves.

It is to be noted that in the arrangement described with reference to Figure 2, pump 26 is capable of supplying sufficient fluid to pass through each of the passageways 18 in panel 10 should all the valves be

open at the same time.

A modified form of the arrangement of Figure 2 is shown in Figure 3, in which parts similar to the arrangement of in Figure 2 are given the same reference numerals.

In the arrangement of Figure 3 it will be noted the outputs of the sensors 34A, 34B, 34C and 34D in addition to controlling operation of their associated valves 22A, 22B, 22C and 22D, are used to increase the current input to pump 36 - the respective outputs of the sensors 34A, 34B, 34C and 34D being fed via the resistors 42A, 42B, 42C and 42D and diodes 44A, 44B, 44C and 44D to form the electrical supply to the pump as shown.

In this form of the system the electrical current to pump 36 is increased as more passageways 18 are opened (by the opening of their associated valve, (22) thus providing that more fluid may be pumped through the panel.

Arrangements embodying the invention may be used in many different ways.

If desired the arrangement may be operated in a reverse mode - that is to say the temperature sensors may be operable at successively lower temperatures to pump a generally dark, heat attracting fluid through the passageways - in this way the arrangement may be used to draw heat to an area shaded by it.

In an alternative form of the arrangement of Figures 2 and 3 (not shown) each of the groups of passageways associated with the fluid control valves receive fluid from a separate reservoir via a separate pump (again energised by the temperature sensing devices acting in a cascade manner) - the fluid in each of the reservoirs being differently coloured to provide the effect already described.

It will be appreciated that the particular

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arrangements shown in Figures 2 and 3 are simply examples of the way in which control of fluid to the panels may be effected - any suitable electrical, electronic or electro-mechanical control system may be
5 used.

One particularly advantageous arrangement which is envisaged is the provision of the readily mountable and demountable building formed on a number of members arranged as a framework. To the members would be
10 mounted a plurality of panels 10 each as described with reference to Figure 1, perhaps with some of the panels coupled to one another to form a larger, composite, panel as required.

The groups of passageways in each of the panels
15 would then be coupled to receive the outputs of a plurality of pumps each drawing fluid from a different reservoir - the fluids in the different reservoirs possibly being of different colours. In this way the walls and roof of a building could, as the temperature
20 sensors associated with the pumps begin to operate, become differently coloured. It is believed that such an arrangement - particular as it provides for the ready and systematised approach to the construction of the building is of particular advantage and could be used on
25 any occasion when a large marquee might be used - the building being readily assembled and then, after use, disassembled as required.

The arrangement shown in Figure 4 shows such an arrangement to comprise a plurality of panels 100 each
30 having substantially the form of a panel 10 as described above. The panels 100 form the walls and roof of an enclosure in the form of a marquee.

The panels 100 are mounted in a framework comprising a number of frame elements which act both to
35 support the panels 100 and as conduits for fluid to be passed to and from those panels from a fluid supply

means 102.

In the arrangement illustrated the elongate fluid tight passageways 104 in each panel 100 extend generally vertically (in the walls) and at an angle to the horizontal (in the roof) of the marquee. The fluid supply to the uppermost panels in the 100A in the roof of the marquee is via a frame element 106 forming the ridge of the framework/marquee.

Fluid from frame element 106 passes generally downwardly through the panels 100A and out of those panels to frame elements 108 positioned as shown.

As well as acting to carry fluid from panels 100A frame elements 108 act to supply fluid to a second tier of panels 100B forming the roof of the marquee.

Fluid passing from panels 100B is returned to the fluid supply means via frame elements 110 at the top of the side walls of the marquee, which further act to pass fluid to panels 100C forming the upper parts of the side walls of the marquee.

As illustrated the side walls are divided by further frame elements 112 which act to pass fluid from panels 100C and supply fluid to panels 100D forming the lowermost part of the side walls of the marquee. Fluid passing from panels 100D is returned to the fluid supply means via frame elements 114 at the base of the side walls.

The gable end of the marquee shown in Figure 4 is provided with a panel 116 which is triangular in form and receives fluid via frame elements 118 physically coupled to and running across the ends of the elements 106, 108 and 110 and passes fluid to a frame element 120 similar to the frame elements 110.

The end wall of the marquee is completed by panels 100E and 100F similar to panels 100C and 100D and supported by the frame elements 120 and by frame elements 122 and 124 similar to the frame elements 112

and 114.

As shown in Figure 4 the marquee is provided with an aperture 126 in one end wall which may be considered as an open portal or be provided with a door of standard form if desired.

Each frame element 106, 108, 110, 112, 114, 118, 120, 122 and 124 is individually coupled to the fluid supply means 102 which may be operated to supply fluid at different rates to different ones of the panels 100 (for example applying more fluid to cool the side of the enclosure in direct sunlight), and/or to supply differently coloured fluids to different one of the panels (so that a pleasing or striking appearance is perceived as individuals approach the enclosure).

The fluid passed to the different panels forming the enclosure may be transparent or coloured as desired and may be more or less opaque as desired to enhance the screening effect as it passes through the passageways in the panels.

The fluid supply means passing fluid to those panels may also include means operable to heat and/or cool the fluid so that the enclosure is heated and/or cooled as desired.

It is further possible to arrange for differently coloured fluids to be passed to different panels 100 - or to different groups of passageways 102 within the panels 100 - in order that the outward, visible appearance of the enclosure is aesthetically pleasing or visually striking as desired.

It will be appreciated the provision of the fluid supply to the uppermost ends of the passageways 102 in the panels 100 means the flow of fluid through the panels will be continuous as soon as fluid is passed to them.

It will, however, further be appreciated that the effectiveness of the arrangement is enhanced by

passing the fluid to the tops of the panels - the panels will effect a shading, cooling and/or heating, or screening function even if the fluid tight passageways are not completely filled with fluid.

5 In this way the degree of temperature control and/or shading which may be provided can be increased. If little cooling is required the flow of fluid through the panels may be reduced to an extent, say, that the passageways are no more than half full at any time.
10 Again, if more heating/cooling is required then the rate of supply of fluid to the passageways may be increased until they are completely full of liquid - before it is necessary to increase the extent to which the fluid is heated or cooled.

15 Another advantage of operating in this way is that the weight of the enclosure may be, if desired, significantly reduced - the weight of the fluid in the passageways of the panels being directly proportional to the volume of the fluid there is there at any time.

20 Although as described making use of different panels 100A and 100B for the roof and 100C and 100D, and 100E and 100F for the side and end walls it will be appreciated that frame elements 108, 112 and 122 may be omitted and the roof be formed by a plurality of panels
25 extending the combined length of panels 100A and 100B, the side walls be formed by a plurality of panels extending the combined length of panels 100C and 100D and the end walls be formed by a plurality of panels extending the combined length of panels 100E and 100F.
30 Whilst such an arrangement has possible advantages it will be less controllable by a user to effect any desired shading, heating and/or cooling or screening.

 If desired the end walls of the enclosure may be simply provided as structural elements.

35 Although described as a marquee the enclosure of Figure 4 may be of any devised size and used as a

greenhouse, free standing conservatory or the like.

Figure 5 illustrates another enclosure embodying the present invention and in the form of a cloche formed of three panels, two of which, shown at 5 130, act as side walls for the cloche whilst the third 132 acts as a roof for the cloche.

In this arrangement the passageways 134 and 136 in the panels 130 and 132 respectively extend generally horizontally. The panels are supported in a framework 10 comprising simple support members 148 coupling the upper edges of the panels 130 and the side edges of the roof panel 132 and by end frame elements 150 which are generally as shown and which are operable to pass fluid to and from each of the panels 130 and 132.

15 The ends of the cloche are open.

It will be appreciated that fluid may be passed from one of the end members 150 through the panels 130 and 132 to the other end member 150 and that the cloche can be used to shade plants or seedling beneath it.

20 Fluid passed to one end member 150 of the cloche is taken via a heater and/or cooler device shown at 152 in a fluid supply means 154 incorporating a reservoir 156.

The cloche may be used to force crops if 25 desired by providing device 152 heats fluid passed to the cloche and in this way the temperature of plants or seedling beneath the cloche will be raised ensuring their quicker development.

The arrangement may also be used, if desired, 30 to check the growth of plants or seedlings by providing that device 152 cools fluid passing therethrough. To enhance this effect it is possible for fluid passed to the cloche to act to shade plants as well as cooling them, for a given period of the day.

35 In this way, cloche may be used to extend the period in which a crop may be harvested - by forcing

plants for an early crop and checking plants to delay their growth in response to both temperature and hours of sunlight falling upon them.

As with the other arrangements now disclosed the panels 130 and 132 may be individually coupled to the fluid supply means 154 and provided with different rates of fluid supply, differently coloured fluids and with fluids which are heated and/or cooled to different extents.

10 It will be appreciated the enclosures shown in Figures 4 and 5 are simply two examples of uses to which the arrangement disclosed above may be put.

In addition to forming temporary or permanent buildings (or parts therefore) embodiments of the 15 invention may provide arrangements which are permanently mounted on a building or a vehicle and which may be moved between a first position in which they are inoperative to a second position in which they are operative to provide desired screening, heating and/or 20 cooling, or shading.

Such arrangements are of particular utility in for example vehicles which are taken to exhibitions (where the arrangement would be folded against the side of the vehicle whilst the vehicle was moving and not on 25 the exhibition site and then extended to form an awning once the vehicle was on site) or when attached to a permanent building to allow a householder to put up and down an awning as desired.

The members used to support the panels in the 30 arrangements of Figures 4 and 5 act, it will be appreciated, as manifolds for supplying fluid to and taking fluid from the panels. To enhance the effectiveness of the fluid distribution within the passageways of a panel the support members which supply 35 fluid to the panels may be provided with outlets in the form of small spigots or jets positioned to direct the

fluid onto the lowermost wall of the passageway (or an outer wall if the panel is mounted vertically).

In this way the volume required to cover a wall is less than may otherwise be the case and the weight of the complete structure - when fluid is passing through it - is reduced.

Another modification which may be made to the described arrangements, if desired, is that the panels can be formed with integral supply manifolds - manifolds which form part of the panels.

Furthermore it is envisaged that the fluid supply to these manifolds may be, if desired, via one or more of the passageways themselves. In this way the complexity of the fluid supply to the various panels forming the structure may be reduced and the overall aesthetic appearance of the structure enhanced.

It will be appreciated that various modifications may be made to the above described arrangements without departing from the scope of the present invention.

In all the arrangements described the inner surfaces of the passageways may be coated with materials, which when not in contact with the fluid being used, are transparent but which, when in contact with that fluid, adopt a particular translucent colouring (e.g. green, blue, red or the like). The colour selected may be chosen to enhance the cooling effect of the structure if desired.

To increase the cooling effect of a structure formed of panels as described the fluid used may be opaque or translucent or reflective or cause material painted on the inner surfaces of the passageways to be so.

If desired the degree of cooling and/or shading may be controlled in response to the difference in temperature on either side of the structure and not

simply the temperature on one side thereof.

As described the passageways in the panels 10, 100 are all generally linear, however, it will be appreciated, that if desired, those passageways may be of any sinuous or curvilinear form a user may desire.

As described the panels 10, 100 are generally planar, however, it will be appreciated that their shape may be curved in one or two dimensions.

It will be appreciated that arrangements embodying the invention provide for the temperature control of an area which operates automatically upon a change in temperature of the area and requiring no manual intervention.

Although the panels 10, 100 described have a single part or layer of passageways it will be appreciated that embodiments of the invention provide for the use of panels having two, three or more superimposed layers of passageways.

It will be appreciated that arrangements embodying the invention will have a variety of other uses when it is desired to control the temperature within a defined area and shade and/or cool that area.

CLAIMS

1. A method of controlling the temperature of an area which comprises the steps of mounting a structure comprising at least one translucent or transparent panel which is at least partially hollow, adjacent the area and arranging for a fluid to be passed through the said at least one panel at a rate proportional to the degree of temperature control required.

2. A method as claimed in Claim 1, wherein the rate at which fluid is passed through the or each panel is adjusted by controlling the volume and/or speed of fluid passage therethrough.

3. A method as claimed in Claim 2, wherein adjustment of the rate of fluid passing through the at least one panel is effected in accordance with a temperature monitored within the area.

4. A method as claimed in any one of claims 1 to 3, wherein the fluid passed through the or each panel is heated and/or cooled.

5. A method of cooling and/or shading an area from direct sunlight which comprises the steps of mounting a structure comprising at least one translucent or transparent panel which is at least partially hollow, adjacent the area to be shaded and/or cooled and arranging for a fluid to be passed through the or each said panel at a rate proportional to the degree of shading and/or cooling required.

6. A method as claimed in any one of claims 1 to 5, wherein said fluid is opaque.

7. Apparatus for controlling the temperature of an area, which apparatus comprises a structure including one or more at least partially hollow translucent or transparent panels, means for coupling the hollow interior of the or each panel to fluid supply

means and means responsive to the temperature on one side of the structure to energise said fluid supply means to pass fluid to said one panel, or to some or all of said panels.

8. Apparatus as claimed in Claim 7, wherein the interior of the or each panel is provided with a plurality of elongate fluidtight passageways to which fluid supply means is coupled.

9. Apparatus as claimed in Claim 7 or Claim 8, further including means for heating and/or cooling fluid passed by the fluid supply means to the or each said panel.

10. Apparatus as claimed in Claim 7, Claim 8 or Claim 9, wherein the or each said panel is of a plastics material.

11. Apparatus as claimed in any one of claims 7 to 10, wherein said fluid is opaque.

12. Apparatus as claimed in any one of Claims 7 to Claim 11, wherein said fluid is coloured.

13. Apparatus as claimed in Claim 8 and any one of Claims 9 to Claim 12, wherein said fluid control means is operative to determine to which of said passageways fluid is passed.

14. Apparatus as claimed in Claim 13, wherein the passageways of the or each panel are arranged in groups, each group being connected to said fluid supply means.

15. Apparatus as claimed in Claim 14, wherein each group of passageways is connected to said fluid supply means by a respective flow control valve.

16. Apparatus as claimed in Claim 15, wherein said fluid supply means comprises pump means operable to draw fluid from a reservoir and pass it to said passageways when at least one of said valves is open.

17. Apparatus as claimed in Claim 9 and any one of claims 14, 15 and 16, wherein said means coupling

the fluid supply means to said groups of passageways is provided with individually operable heating and/or cooling devices such that selected groups of passageways may selectively be heated and/or cooled.

18. Apparatus as claimed in Claim 15 and Claim 16, or Claim 15 and Claim 17, further including a plurality of temperature sensing devices each operable to control a different one of said valve and each of which is pre-set to open, in use, its associated valve at a selected one of a number of different temperatures.

19. Apparatus as claimed in Claim 16 and Claim 17, or claim 16 and Claim 18, wherein said pump means comprises a pump arranged to operate at constant speed and provide a variable flow rate dependent upon the number of groups of passageways coupled thereto by the opening of the respectively associated valves.

20. Apparatus as claimed in Claim 8 and any one of Claims 9 to 19, wherein inner surfaces of passageways are coated with a material which is normally translucent or transparent but which, when contacted by the fluid used in the arrangement, becomes coloured.

21. Apparatus as claimed in Claim 20, wherein the colours of said different groups of passageways when contacted by fluid therein is different.

22. Apparatus as claimed in Claim 8 and any one of claims 9 to 19, wherein each of said groups of passageways is coupled by a respective valve to an individually associated pump arranged to draw coloured fluid from an individually associated reservoir and pass that fluid to said passageways of that group.

23. Apparatus as claimed in Claim 8 and any one of claims 9 to 22, wherein the ends of said passageways remote from said valves are coupled to one or more fluid return lines operable to carry fluid passing from the passageways to the or each respective reservoir.

24. Apparatus as claimed in any one of claims 7 to 22, wherein said panel is generally planar.

25. Apparatus as claimed in Claim 8 and any one of claims 9 to 24, wherein said passageways in said panel are generally linear in form.

26. Apparatus as claimed in Claim 8 and any one of claims 9 to 24, wherein said passageways in said panel are generally sinuous or curvilinear in form.

27. Apparatus as claimed in any one of claims 7 to 26, wherein said panel is of a moulded acrylic material.

28. Apparatus as claimed in any one of claims 7 to 27, and comprising a plurality of similar panels mounted in a framework to form an enclosure.

29. Apparatus as claimed in Claim 28, wherein said plurality of said panels forms a permanently or temporarily erectable building.

30. Apparatus as claimed in Claim 28, wherein said plurality of said panels forms a temporarily erectable extension for a building or vehicle.

31. Apparatus as claimed in Claim 8 and any one of claims 28, 29 and 30, wherein the or each panel is mounted in said framework such that the elongate fluid tight passageways therein which extend in use at an angle to the horizontal are arranged supplied with fluid at their uppermost ends by said fluid supply means.

32. Apparatus as claimed in Claim 31, wherein said fluid supply means comprises conduits in the said framework via which fluid may be passed to a manifold forming part of said framework and to which the said panels are coupled.

33. Apparatus as claimed in Claim 31, wherein said fluid supply means comprises a manifold formed as part of said panel and to which fluid is passed via one or more of the passageways in the said panel.

34. Apparatus as claimed in Claim 32 or Claim 33, wherein fluid is passed from said manifolds to the passageways in the or each said panel via a spigot or jet which acts to direct fluid onto a wall of its associated passageway.

35. A method of controlling the temperature of an area as claimed in Claim 1, and substantially hereinbefore described.

36. Apparatus as claimed in Claim 8, and substantially as herein described with reference to Figure 1 of the drawings.

37. Apparatus as claimed in Claim 8, and substantially as herein described with reference to Figure 2 or Figure 3 of the accompanying drawings.

38. An enclosure as claimed in Claim 28, and substantially as herein described with reference to Figure 4 of the accompanying drawings.

39. An enclosure as claimed in Claim 28, and substantially as herein described with reference to Figure 5 of the accompanying drawings.

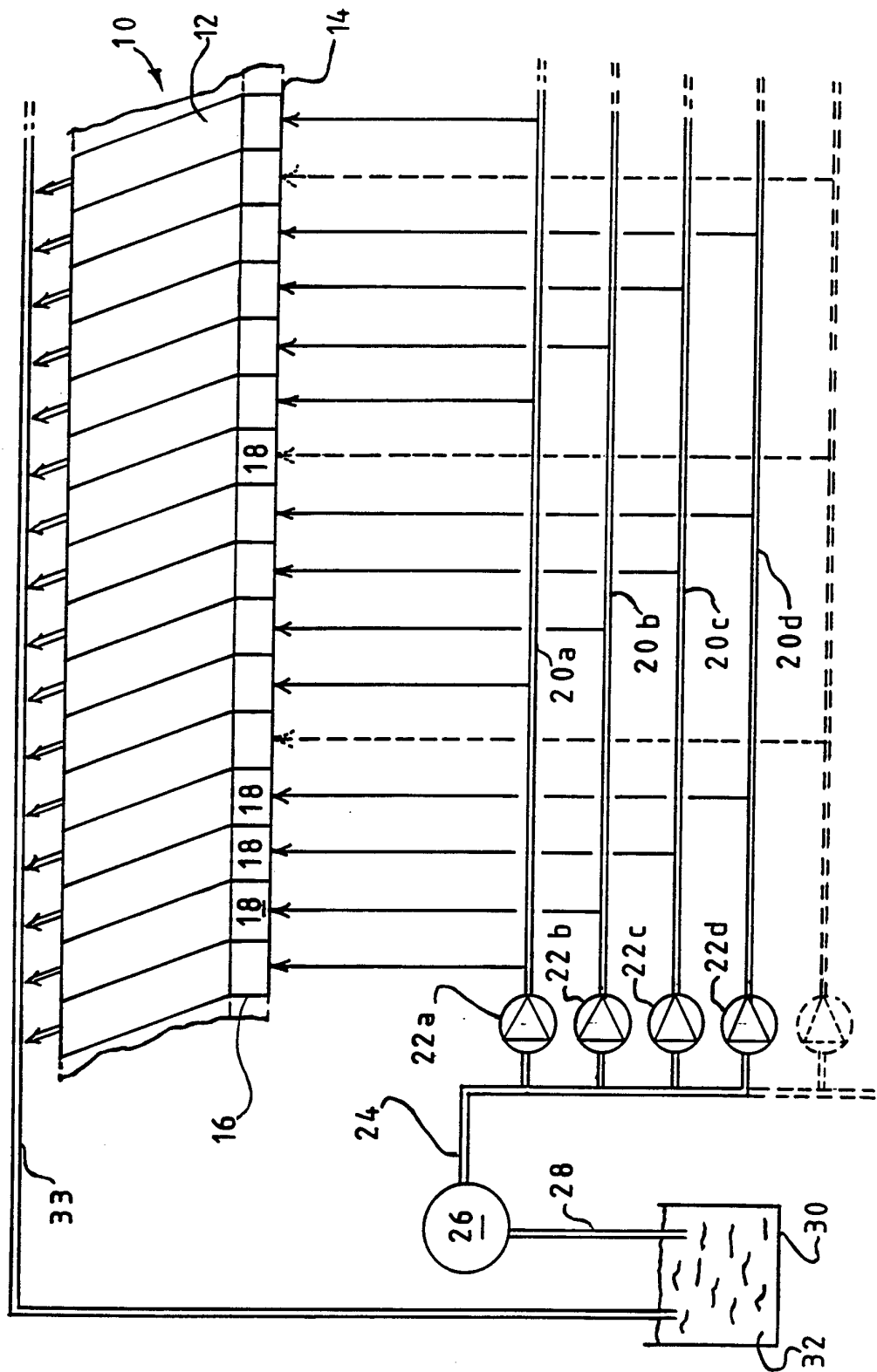
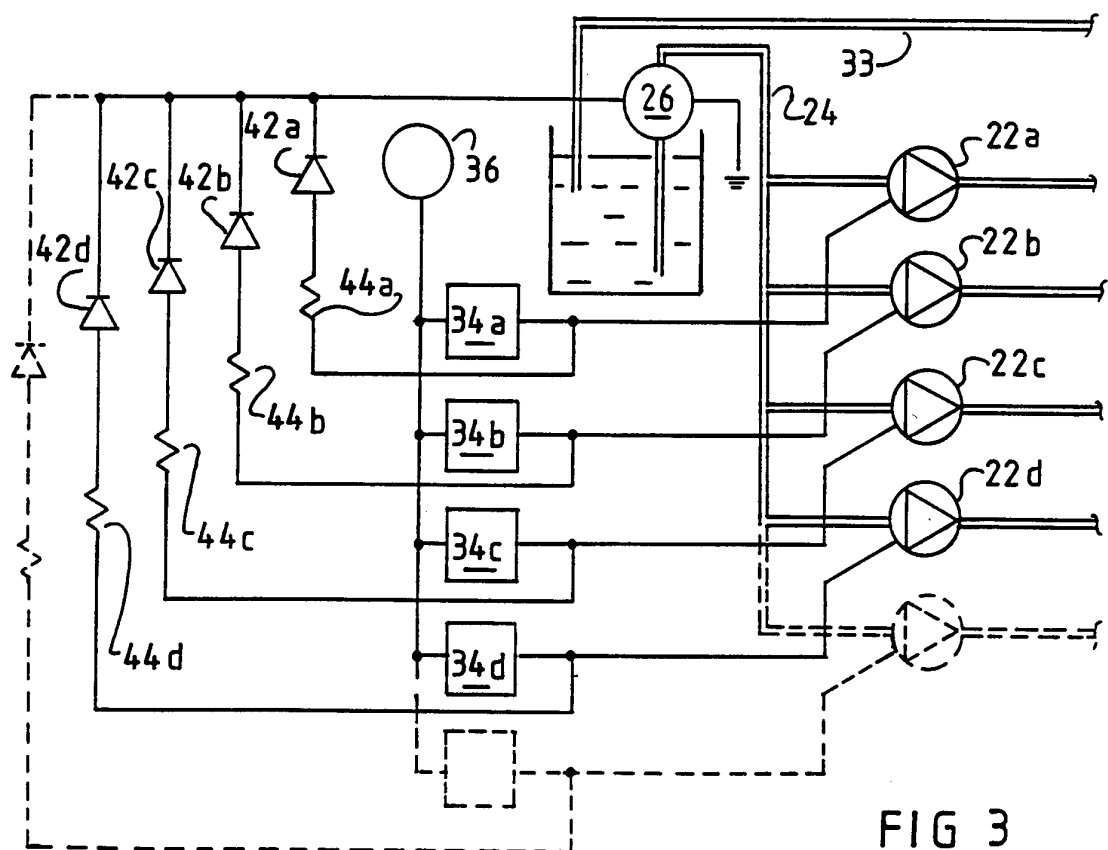
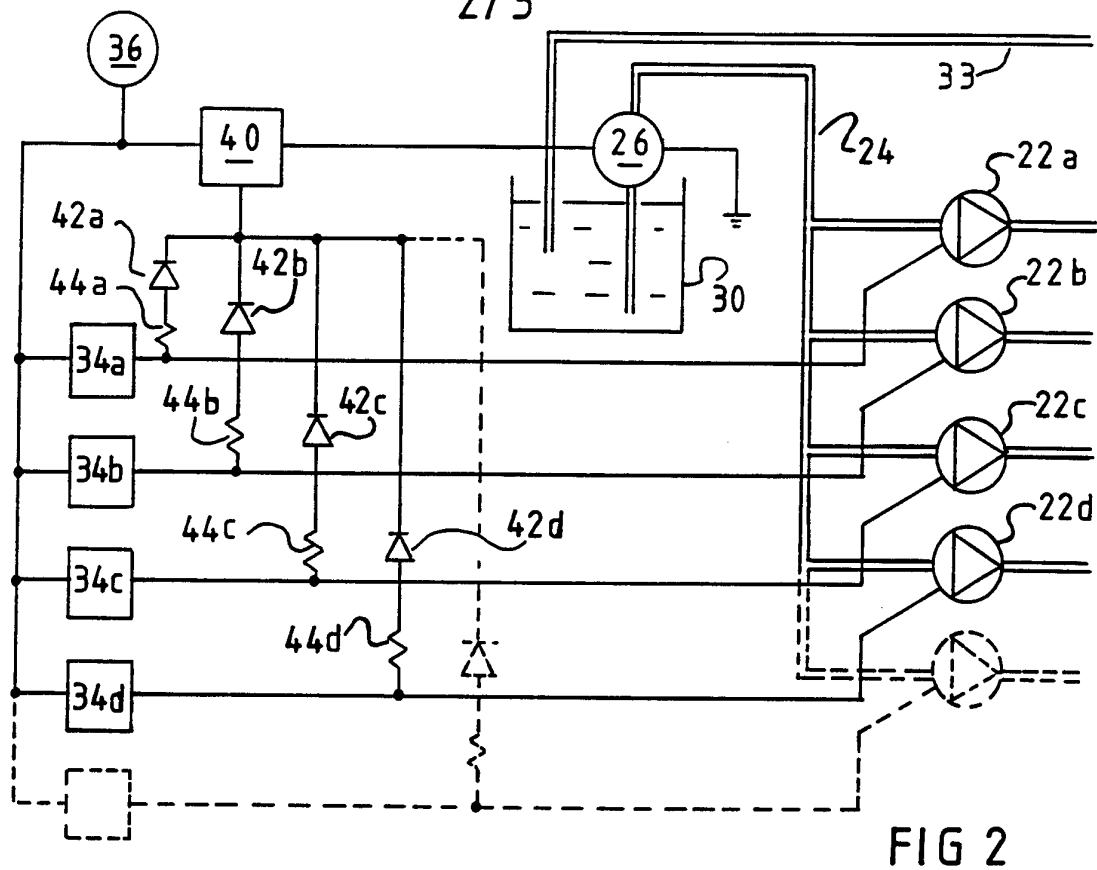


FIG 1.



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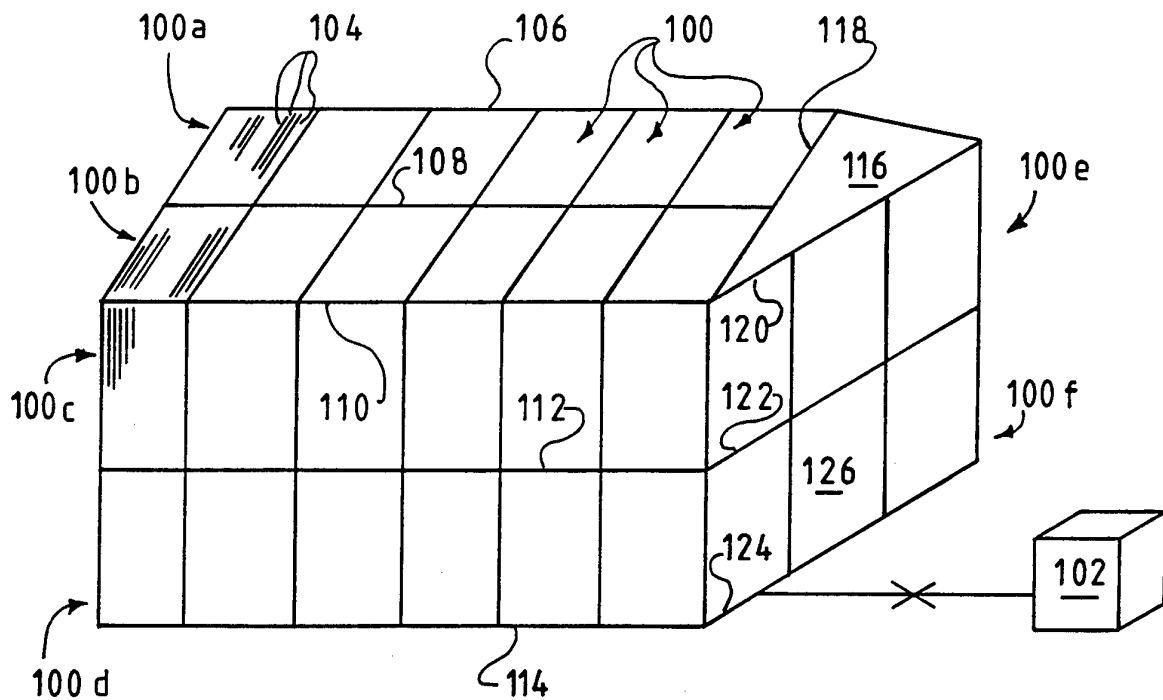


FIG 4

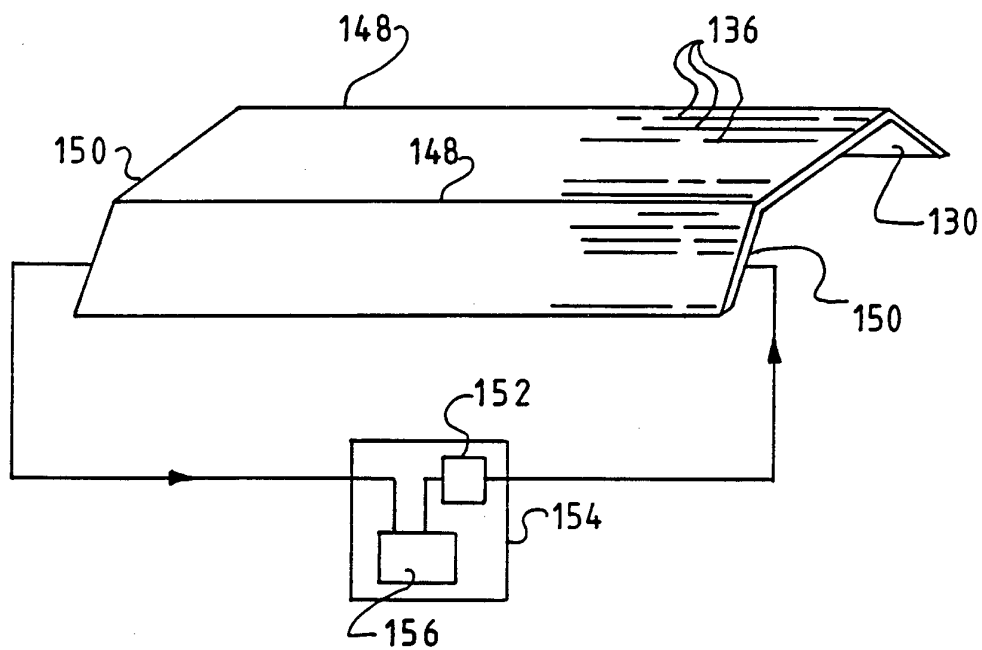


FIG 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB 93/01927

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: G05D 23/00, A01G 9/24, F24J 2/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: A01G, E04B, F24J, G05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 3981294 (C. DEMINET ET AL), 21 Sept 1976 (21.09.76), column 2, line 39 - column 5, line 6, figures 1-9 --	1-19,22-34
X	US, A, 4044519 (W.F. MORIN ET AL), 30 August 1977 (30.08.77), column 1, line 23 - column 4, line 6, figures 1-2 --	1-19,22-34
X	US, A, 4108373 (J.-P.J. CHIAPALE ET AL), 22 August 1978 (22.08.78), column 4, line 33 - column 9, line 35, figures 1,3-6 --	1-19,22-34

☒ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

3 December 1993

06.01.94

Name and mailing address of the International Searching Authority

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB 93/01927

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 4291674 (P.Y. COMTE ET AL), 29 Sept 1981 (29.09.81), column 4, line 33 - column 9, line 33, figures 1-7 --	1-19,22-34
X	US, A, 4515150 (J.J. MCGLEW ET AL), 7 May 1985 (07.05.85), column 2, line 49 - column 6, line 22, figures 1-7 --	1-19,22-34
X	DE, A1, 2711504 (TRIMBOLI-LONGETTO, A.A.), 29 Sept 1977 (29.09.77), page 4, line 7 - page 7, line 11, figures 1-6 --	1-19,22-34
X	EP, A1, 0014663 (TOUPIN, J.F.), 20 August 1980 (20.08.80), page 7, line 1 - page 21, line 28, figures 1-4, claim 7 --	1-19,22-34
A	Patent Abstracts of Japan, Vol 14, No 281, M-986, abstract of JP, A, 2-85646 (KOMATSU LTD), 27 March 1990 (27.03.90) -- -----	8,14

INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB 93/01927

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 35-39
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Claims 35-39 rely on reference to the description and drawings. See Rule 6.2(a) and Article 17.2(a)ii.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

16/10/93

International application No.

PCT/GB 93/01927

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US-A-	3981294	21/09/76	US-I-	B512745	13/01/76
US-A-	4044519	30/08/77	NONE		
US-A-	4108373	22/08/78	AU-A-	8125875	25/11/76
			BE-A-	829180	15/09/75
			CA-A-	1025214	31/01/78
			DE-A-	2522791	04/12/75
			FR-A,B-	2271763	19/12/75
			GB-A-	1506291	05/04/78
			NL-A-	7505792	25/11/75
			FR-A,B-	2304278	15/10/76
US-A-	4291674	29/09/81	EP-A,B-	0003944	05/09/79
			FR-A,B-	2417253	14/09/79
US-A-	4515150	07/05/85	NONE		
DE-A1-	2711504	29/09/77	FR-A,B-	2344217	14/10/77
EP-A1-	0014663	20/08/80	FR-A-	2448748	05/09/80