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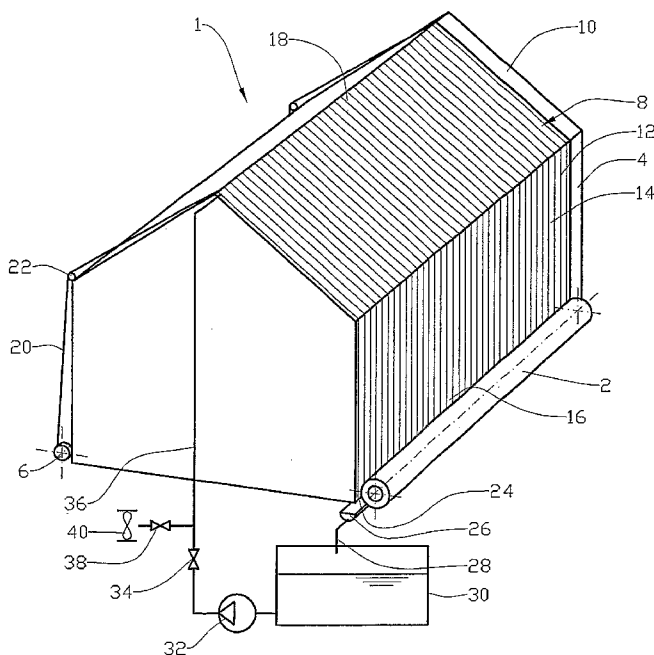
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(54) Title: A CLIMATE CONTROL DEVICE FOR A GREENHOUSE



(57) Abstract: A climate control device for a greenhouse (1) comprising a double plastic foil (8) provided with channels (14), the foil being placed, in its active position, on the greenhouse (1), the channels (14) of the plastic foil (8), which are arranged to be flowed through by fluid, extending in a direction between different height levels, the plastic foil (8) being windable.

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## A CLIMATE CONTROL DEVICE FOR A GREENHOUSE

This invention relates to a climate control device for a greenhouse. More particularly, it relates to a climate control device for a greenhouse, the climate control device comprising a double plastic foil provided with channels, the foil being placed, in its active position, on the greenhouse, the channels of the plastic foil, which are arranged to be flowed through by fluid, extending in a direction between different height levels, the plastic foil being windable.

Control of the indoor climate in a greenhouse can contribute to a substantial increase in growth for plants in the greenhouse. Conventionally, the indoor temperature in the greenhouse is adjusted by means of heating in cool periods and cooling by means of airing and shading against sunlight in warmer periods.

It is known that an increase in the proportion of carbon dioxide (CO<sub>2</sub>) in the indoor air from the normal level of 0.038 per cent by volume to, for example, 0.080 per cent by volume, can contribute to a substantial increase in the growth rate of the plants. An elevated proportion of CO<sub>2</sub> in the indoor air is maintained by means of supplied CO<sub>2</sub> gas and is difficult to combine with airing of the greenhouse.

It is known to dispose channels for flow-through by fluid on the roof of a greenhouse to regulate radiation into the

greenhouse. Thus, US patent 4108373 discloses a greenhouse, in which transparent channels are arranged in the roofing structure for the pumping-through of a fluid, which is arranged to absorb light of certain wavelengths. According to  
5 the document permanently mounted channels are involved.

US patent 4012867 deals with a greenhouse, in which the roof is formed by a double sheet structure, and in which the outer sheet is designed to resist the flow-through of CO<sub>2</sub> gas, whereas the inner sheet is designed to allow a greater flow-  
10 through of this gas. The two sheets are joined, so that horizontal channels are formed, which are filled with CO<sub>2</sub> gas. Some of this gas "leaks" into the interior space of the greenhouse.

As mentioned above, it is known to shade parts of a  
15 greenhouse to reduce heating. US patent 6282834 discloses a greenhouse, which is provided with a windable double foil, the foil being provided with gas-filled pockets to insulate the greenhouse better.

According to the prior art, growth-enhancing channel devices,  
20 which are arranged to be flowed through by fluid, are formed as fixed structures and are thereby difficult to remove in periods when they are an obstacle to improved indoor climate in the greenhouse.

The invention has as its object to remedy or reduce at least  
25 one of the drawbacks of the prior art.

The object is achieved in accordance with the invention through the features specified in the description below and in the claims that follow.

A climate control device in accordance with the invention for  
30 a greenhouse comprises a double plastic foil provided with

channels, which is placed, in its active position, on the greenhouse and characterized by the channels of the plastic foil, which are arranged to be flowed through by fluid, extending in a direction between different height levels, the plastic foil being windable.

The double plastic foil is joined along parallel lines suitably spaced apart, the space between the joints constituting a channel. The distance between the joining lines is typically between 1 and 10.

The channels of the plastic foil are selectively connected, by means of a first valve and a second valve, respectively, to a water supply and to an air supply.

With advantage, the channels of the plastic foil are provided with a flow controller at their outlets to be able to adjust the flow rate through the channels or to close them completely, for example to increase the volume of air in the channels if better heat insulation is desirable.

At its first end portion the plastic foil is connected to a wind-up roller. The wind-up roller is disposed in a suitable place relative to the greenhouse, for example near the ground on the southward-facing side of the house. At its second end portion the plastic foil is, with advantage, connected to a winch which is arranged to pull the foil out of the wind-up roller, thereby moving the foil relative to at least the wall or roof of the greenhouse.

A device according to the invention enables, relative to the prior art, improved climate control in the greenhouse by, firstly, enabling control of heat radiation by water, which has the property of absorbing heat radiation without shading to a substantial degree the photosynthetically active light typically having wavelengths of 400 to 700 nm, flowing

through the channels. Further, the channels may be filled with air to form a heat-insulating layer. If desirable, the foil or the fluid can be provided with a colour to limit the inflow of light of particular wavelengths. Additionally, the foil can be removed whenever desirable.

As a result of this the need for airing the greenhouse is considerably reduced, whereby an internal atmosphere with an elevated CO<sub>2</sub> content can more easily be maintained.

In what follows, is described a non-limiting example of a preferred embodiment which is visualized in the accompanying drawings, in which:

Figure 1 is a principle drawing of a greenhouse, which is provided with a plastic foil according to the invention;

Figure 2 shows, on a larger scale, a cross-section of the plastic foil; and

Figure 3 shows a flow controller arranged at the plastic foil.

In the drawings the reference numeral 1 indicates a greenhouse, where, from a wind-up roller 2 which is disposed at ground level along one sidewall 4 of the greenhouse 1, a double plastic foil 8 has been pulled up, by means of a winch 6, over the sidewall 4 and over a portion of the roof 10 of the greenhouse 1.

The double plastic foil 8 is joined along lines 12, the spaces between the lines 12 constituting channels 14, see figure 2. When the plastic foil 8 is in its active position, as it is shown in figure 1, the channels 14 extend from a first height level at the first end portion 16 of the plastic

foil 8 up to a second height level at the second end portion 18 of the plastic foil 8.

In this preferred embodiment the plastic foil 8 is connected at its first end portion 16 to the wind-up roller 2, whereas, at its second end portion 18, it is connected to the winch 6 via rope elements 20 extending over pulleys 22.

At the first end portion 16 of the plastic foil 8 the outlet 24 of the channel 14 discharges into a collecting conduit 26 connected via a pipe 28 to a water tank 30. Via a first valve 34 and a hose connection 36 a pump 32 pumps water from the water tank 30 to the channels 14 at the second end portion 18 of the plastic foil 8, from where the water flows through the channels 14 to the first end portion 16. The water tank 30, pump 32, first valve 34 and hose connection 36 thus constitute a water supply for the plastic foil 8.

The circulating water absorbs thermal energy in periods when solar energy is supplied to it, and gives off thermal energy in periods when this is needed.

When there is a need for thermal insulation of the sidewall 4 and roof 10, the first valve 34 is closed while a second valve 38, connecting the hose connection 36 to an air pump 40, is opened. The air pump 40, second valve 38 and hose connection 36 thereby constitute an air supply for the plastic foil 8.

In combination with a flow controller 42 at the outlets 24 being closed, the blow-in of air causes the channels 14 to fill with air, thereby forming an adjustable thermal insulation.

The flow controller 42 comprises two clamping strips 44 which are movable relative to each other, reducing the cross-

section of the channels 14 at the flow controller 42 when being moved closer to each other. One of the clamping strips 44 may, with advantage, be formed by the wind-up roller 2.

When the plastic foil 8 is to be removed from the side wall 8 and roof 10, the wind-up roller 2 is rotated about its  
5 longitudinal axis so that the plastic foil 8 is wound onto the wind-up roller 2, while the winch 6 is brought to reel out the rope element 20 at the same time.

When the plastic foil 8 is to be pulled up over the  
10 greenhouse 1, the plastic foil 8 is moved by means of said components in the opposite direction.

In another embodiment, not shown, the plastic foil 8 is tight at its first end portion 16, the fluid flowing through the channels 14 discharging into one or more channels 14 with  
15 collecting openings near the first end portion 16.

It is also possible to utilize the heat in the water, which is in the water tank 30, by means of a heat pump, not shown, giving off heat into the greenhouse 1.

The channels 14 can be flowed through by, for example, water  
20 from a different source, for example from a river or sea, not shown, when there is a need for cooling the greenhouse 1.

## C l a i m s

1. A climate control device for a greenhouse (1) comprising a double plastic foil (8) provided with channels (14), the foil (8) being placed, in its  
5 active position, on the greenhouse (1), c h a r a c -  
t e r i z e d i n that the channels (14) of the plastic foil (8), which are arranged to be flowed through by fluid, extend in a direction between different height levels, the plastic foil (8) being  
10 windable.
2. The climate control device in accordance with claim 1, c h a r a c t e r i z e d i n that the channels (14) of the plastic foil (8) are selectively connected to a water supply (30, 32).
- 15 3. The climate control device in accordance with claim 1, c h a r a c t e r i z e d i n that the channels (14) of the plastic foil (8) are selectively connected to an air supply (38).
4. The climate control device in accordance with claim 1,  
20 c h a r a c t e r i z e d i n that the channels (14) of the plastic foil (8) are provided with a flow controller (42) at their outlets (24).
5. The climate control device in accordance with claim 1,  
25 c h a r a c t e r i z e d i n that the plastic foil (8) is connected, at its first end portion (16), to a wind-up roller (2).
6. The climate control device in accordance with claim 5,  
30 c h a r a c t e r i z e d i n that the plastic foil (8) is connected, at its second end portion (18), to a winch (6).

7. The climate control device in accordance with claim 6, characterized in that the winch (6) is arranged to move the plastic foil (8) relative to at least the wall (4) or roof (10) of the greenhouse (1).

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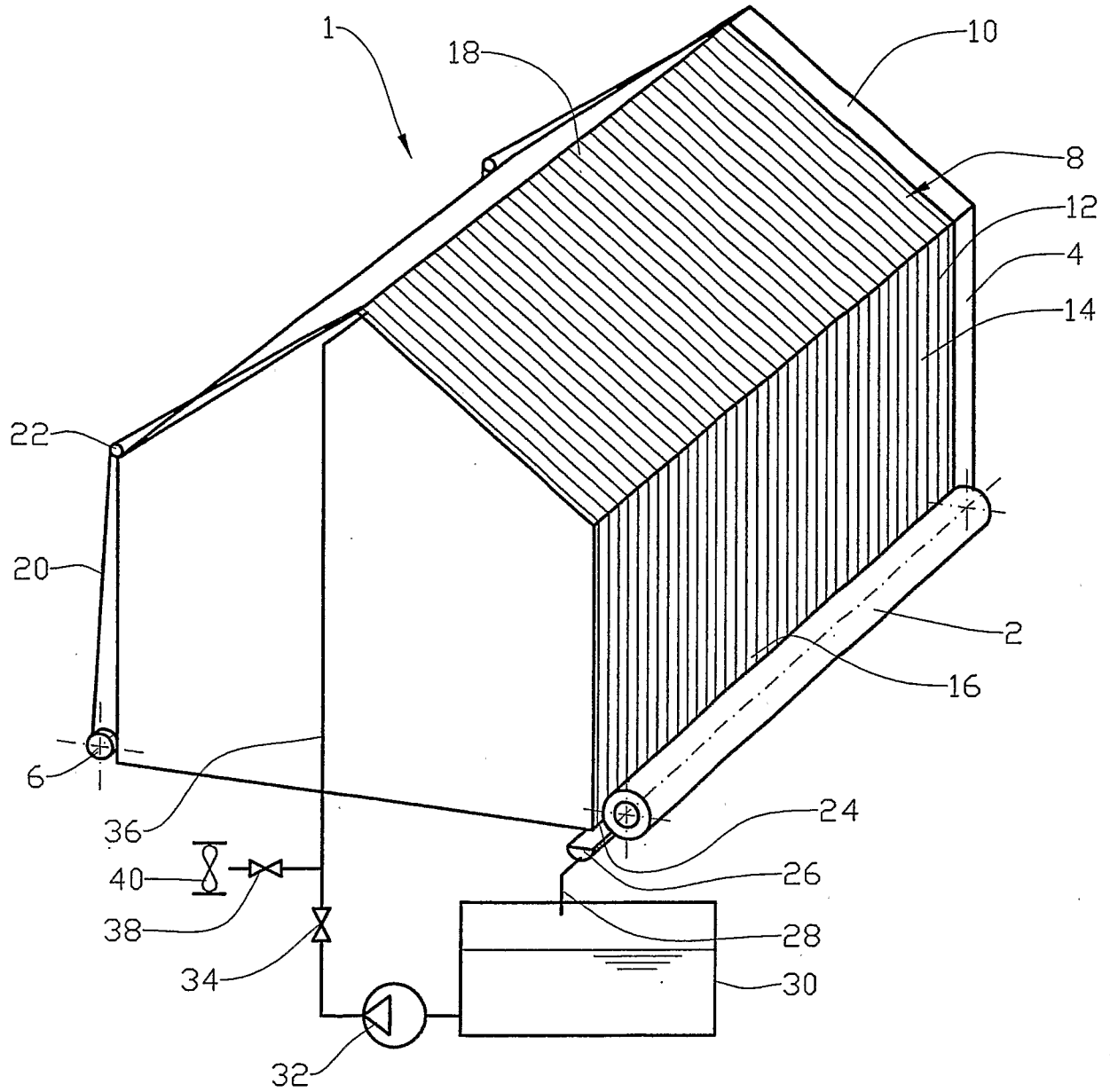


Fig. 1

2/2

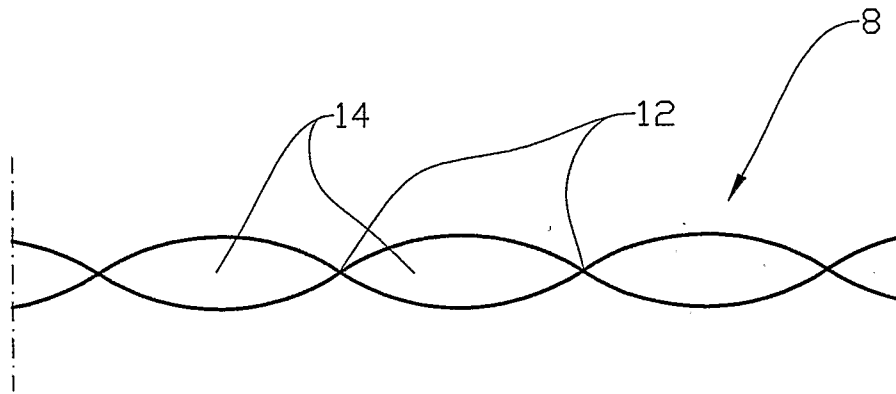


Fig. 2

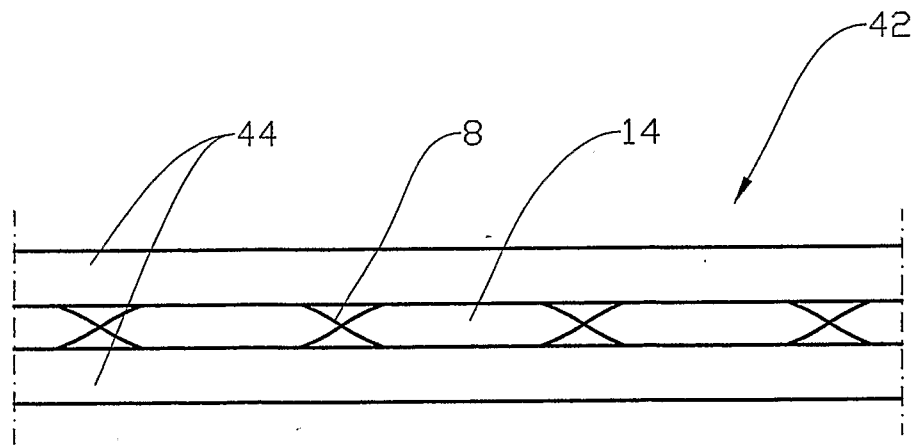


Fig. 3

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO2007/000193

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
<b>IPC: see extra sheet</b> According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols)		
<b>IPC: A01G</b>		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
<b>SE,DK,FI,NO classes as above</b>		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
<b>EPO-INTERNAL, WPI DATA, PAJ</b>		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4108373 A (J.-P. CHIAPALE ET AL), 22 August 1978 (22.08.1978), figure 5, claim 1, abstract --	1,2,4
A	US 6282834 B1 (C.L. MOSSEY), 4 Sept 2001 (04.09.2001), figure 4, claim 1, abstract --	1,3,5-7
A	jp 2004161394 A, SEIWA CO LTD, 2004-06-10: (abstract) Retrieved from: EPODOC database Original document: figur 2 --	1,5-7
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 application or patent 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
18 Sept 2007		19-09-2007
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86		Authorized officer  Hans Nordström / MRo Telephone No. +46 8 782 25 00

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO2007/000193

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 4012867 A (D. LAINCHBURY ET AL), 22 March 1977 (22.03.1977), column 4, line 10 - line 30, figures 1,2  -- -----	1,3

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**E04D 13/18** (2006.01)  
**F24J 2/36** (2006.01)

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Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.

## INTERNATIONAL SEARCH REPORT

Information on patent family members

31/07/2007

International application No.

PCT/NO2007/000193

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