FORM 8 COMMONWEALTH OF AUSTRALIA PATENTS ACT 1952-69

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

In support of the Convention Application made for a

patent ~~patent of addition~~ for an invention entitled

Installation for the Generation of an Outgoing or Incoming Heat Flow in a Body of Low Thermal Conductivity

Full name and address of Declarant.

I, Caspar O.H. Messner

of Gut Rosenberg, CH-8714 Feldbach, Switzerland

do solemnly and sincerely declare as follows:-

1. I am the applicant for the patent ~~patent of addition~~.

(or, in the case of an application by a body corporate)

~~1. I am authorised by~~

~~the applicant for the~~ patent ~~patent of addition to make this declaration on its behalf.~~

Insert country and date of basic application and name of foreign applicant.

2. The basic application as defined by Section 141 of the Act was made in Switzerland on the 18 day of March 1987 by Messner Caspar O.H.

3. I am the actual inventor of the invention referred to in the basic application.

(or where a person other than the inventor is the applicant)

Full name and address of Inventor(s)

~~3.~~

~~of~~

~~is the actual inventor of the invention and the facts upon which the applicant is/are entitled to make the application are as follows:~~

4. The basic application referred to in paragraph 2 of this Declaration was the first application made in a Convention country in respect of the invention the subject of the application.

Declared at Feldbach this nineteenth day of September 1988

Signature of Declarant

Caspar O.H. Messner

To:

The Commissioner of Patents,

SPRUSON & FERGUSON, SYDNEY.

(12) PATENT ABRIDGMENT (11) Document No. AU-B-13928/88
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 612634

(54) Title
INSTALLATION FOR THE GENERATION OF AN OUTGOING OR INCOMING HEAT FLOW IN A BODY OF LOW THERMAL CONDUCTIVITY

International Patent Classification(s)
(51)[4] F24J 002/34 F24J 002/04 F24J 003/06

(21) Application No. : 13928/88 (22) Application Date : 17.03.88

(87) PCT Publication Number : WO88/07160

(30) Priority Data

(31) Number (32) Date (33) Country
CH 8700035 18.03.87 WO WORLD INTELLECTUAL PROPERTY ORGANIS ATION (WIPO)

(43) Publication Date : 10.10.88

(44) Publication Date of Accepted Application : 18.07.91

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(56) Prior Art Documents
AU 500014 14104/76 F24H F24D

(57) Claim

1. Device for generation of incoming or outgoing heat flow in a body of low thermal conductivity less than 20 W/mK, suitable for absorption or storage of heat by means of at least one heat-transfer layer transversely disposed with respect to any natural or artificial heat-transfer field within the body, in order to supply heat to or withdraw heat from the body in one or more essentially parallel planes and to transfer the heat to, or from, a heat-transporting medium, wherein the layer comprises a material whose thermal conductivity coefficient is greater than that of the body and which is thermally connected to the body, and the layer is self-enclosed within individual transfer fields which are formed depending on the type of heat inflow or outflow produced by the heat-transfer medium, but is separated from any other heat-transfer layers.

33. A device suitable for storage and absorption or dispensing of heat comprising:

a body of low thermal conductivity of less than 20 W/mK suitable for storage and absorption of heat;

means for conveying heat from a heat transporting medium to the body, wherien the conveying means includes a plurality of tubes for the flow of heat therethrough in each heat transporting layer and heat flows in the opposite direction in each adjacent pair of tubes, and wherein each tube of each adjacent pair of tubes is separated from the other tube by a space that acts to interrupt a heat shunt therebetween;

at least one heat transporting layer thermally connected to the body for supplying heat to and for withdrawing heat from the body in one or more essentially parallel planes, the at least one heat transporting layer having a surface that is in direct thermal contact with the conveying means for transferring the heat to and from the heat transporting medium; and

wherein the at least one heat transporting layer consists of a material having a thermal conductivity coefficient greater than than of the body, and wherein the layer is positioned transverse to the direction in which heat flows from the heat transporting medium to the body.

AU-AI-13928/88

PCT WELTORGANISATION FÜR GEISTIGES EIGENTUM
Internationales Büro

INTERNATIONALE ANMELDUNG VERÖFFENTLICHT NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT)

612634

(51) Internationale Patentklassifikation 4 **:** F24J 2/34, 2/04, 3/06 — A1

(11) Internationale Veröffentlichungsnummer: WO 88/ 07160

(43) Internationales Veröffentlichungsdatum: 22. September 1988 (22.09.88)

(21) Internationales Aktenzeichen: PCT/CH88/00060

(22) Internationales Anmeldedatum: 17. März 1988 (17.03.88)

(31) Prioritätsaktenzeichen: PCT/CH87/00035

(32) Prioritätsdatum: 18. März 1987 (18.03.87)

(33) Prioritätslander: CH, usw.

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(81) Bestimmungsstaaten: AT (europäisches Patent), AU, BE (europäisches Patent), BR, CH (europäisches Patent), DE (europäisches Patent), DK, FI, FR (europäisches Patent), GB (europäisches Patent), IT (europäisches Patent), JP, KR, LU (europäisches Patent), MC, NL (europäisches Patent), NO, SE (europäisches Patent), US.

Veröffentlicht
Mit internationalem Recherchenbericht.
Mit geänderten Ansprüchen und Erklärung.

A. O. J. P. 17 NOV 1988

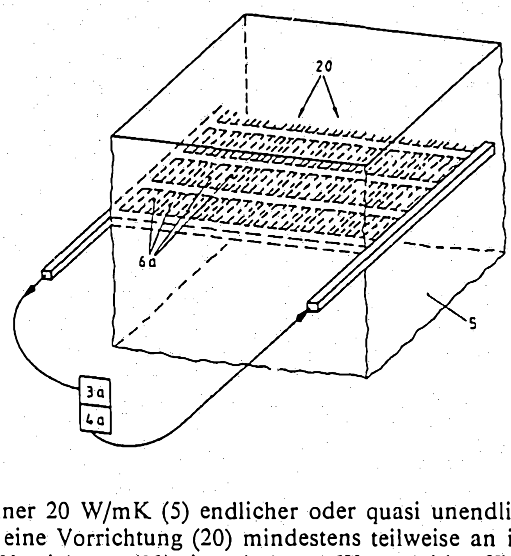
AUSTRALIAN
10 OCT 1988
PATENT OFFICE

(54) Title: INSTALLATION FOR THE GENERATION OF AN OUTGOING OR INCOMING HEAT FLOW IN A BODY OF LOW THERMAL CONDUCTIVITY

(54) Bezeichnung: ANLAGE FÜR DIE ERZEUGUNG EINES ZU- ODER ABFÜHRENDEN WÄRMEFLUSSES IN EINEM KÖRPER NIEDRIGER THERMISCHER LEITFÄHIGKEIT

(57) Abstract

To produce an outgoing or incoming heat flow in a body of low thermal conductivity less than 20 W/mK (5) and of finite or quasi infinite size, a device (20) is connected thermally on at least part of its surface to a monobloc (5) having a lower coefficient of thermal conductivity. The device (20) preferably includes one or more layers, for example sheets or tubes, manufactured from materials of high thermal conductivity, such as copper, aluminium, gold, silver, etc. These layers are connected in turn either to heat transport systems, such as the tubing (6) which carries the medium for the heat input or output, or to elements suitable for converting heat to electrical energy or vice versa. The device (20) is particularly suitable for installations for the extraction of atmospheric or terrestrial heat.



(57) Zusammenfassung

Um in einem Körper niedriger thermischer Leitfähigkeit kleiner 20 W/mK (5) endlicher oder quasi unendlicher Grösse einen zu- oder abführenden Wärmefluss zu erzeugen, wird eine Vorrichtung (20) mindestens teilweise an ihrer Oberfläche mit dem Monoblock (5) thermisch verbunden, wobei die Vorrichtung (20) einen höheren Wärmeleitkoeffizienten umfasst als der Monoblock (5). Die Vorrichtung (20) umfasst vorzugsweise eine oder mehrere Schichten, beispielsweise als Bleche oder Rohre ausgebildet, welche aus hochwärmeleitfähigen Werkstoffen, wie Kupfer, Aluminium, Gold, Silber usw., hergestellt sind. Diese Schichten sind weiter entweder mit Wärmetransportsystemen, wie medienführende Rohrleitungen (6) für die Zu- oder Abfuhr von Wärme verbunden, oder aber mit Elementen, welche zur Umwandlung der Wärme aus oder zu elektrischer Energie geeignet sind. Die Vorrichtung (20) eignet sich insbesondere für Anlagen zur Gewinnung atmosphärischer oder terrestrischer Wärme.

DEVICE SUITABLE FOR PRODUCING A THERMAL FLOW INSIDE A THERMAL INTEGRAL BLOCK

The present invention relates to a device capable of creating heat flow within an integral thermal block of finite or quasi finite dimensions. The invention relates further to a system incorporating a device suitable for employing or storing heat inside a thermal integral block, as well as to a system capable of exploiting atmospheric or terrestrial heat. Such a system moreover permits by regulating the surface temperature e.g. of a block constituting a floor, the heating or cooling of the atmosphere enveloping such a thermal integral block.

Heat is fed or removed by means of a system that by-passes the heat flow produced inside the integral block, such a system operating essentially at an angle to such block, wherefor the proposed device is also hereunder referred to as a heat shunt.

The problem of heat supply or removal with respect to the exploitation of heat issuing from atmospheric (solar and global radiation, latent heat, heat contained in the air, and in meteoric and waste water) and terrestrial (earth, ground and springs) sources -- entails the comtemporary requirement of the exploitation of energy that is renewable on a daily or yearly basis.

The deveopment of concepts and processes relating to such energy exploitation which have to some extent, been proctected by

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intellectual property laws, has increased greatly in recent years. Purely terrestrial underground heat extraction methods are technically feasible only if quasi-punctiform heat removal methods are employed at the lowest points of drilled holes. If terrestrial and atmospheric heat is to be captured, the latter can be captured only very near the earth's surface. Such methods necessarily interfere with local plant growth.

Numerous arrangements involving the bivalent use of parking areas or certain kinds of sports installations have been directed at exploiting terrestrial or atmospheric energy, whereby at the same time storage systems are utilized to an essentially large extent in storing daytime heat and releasing it at night. In order to load the storage system or to maintain the surface in an ice-free condition, heat is fed in general to systems that, designed for specific uses, are protected by numerous patents.

Also known is an arrangement suitable for heating and cooling a layer of bituminous material exposed to solar radiation, in particular the top layer of street pavement that features a plurality of heat exchange units disposed along the length of the material layer to be heated and/or cooled. Such units incorporate two fluid-flow systems, of which the first serves to transmit heat to and from the material layer to be heated and/or cooled, and the second serves to transfer heat to and from a heat

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storer.

The heat storer in this case may comprise the sub-structure of the street and may consist in whole or in part of the earth removed during construction of the street.

A heat transfer medium circulates through the fluid flow system in order to transport heat from the material layer into the heat storer and vice-versa, depending on whether the material layer e.g. is to be cooled in the summer or heated in the winter. Both fluid-flow systems are disposed in vertical planes (German Patent DE-OS 34 07 927) published on 5 September 1985 in the name of Hans Krinninger.

Another concept involving the use of a massive absorber as a new kind of heating system for prefabricated concrete components, has been dealt with exhaustively in SIA Bulletin "Industrial Construction", 4/82. In this arrangement, energy is drawn from the environment in the form of heat by absorbers that are actually large-surface heat exchangers.

Such heat energy is brought by means of a heat pump from a lower temperature level to a higher temperature level, so that the resulting heat energy can be used for heating purposes.

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In this paper, the temperatures at the surface and in various layers of a 30 cm steel-reinforced concrete wall exposed to the sun are plotted against time and the phase shift of the temperature curve in the fluid-filled absorber system is described. The output of the heat pump, relative to the outer air temperature, given the heating temperature as a system parameter, is illustrated.

In addition to a large area piping system, Swiss Patent CH-PS-661-340 published in the name of René Schärer on 15 July 1987 proposes that further metallic contact plates be laid on top of a heat storage layer, such contact layers being used today in surface heating technology.

Common to all such systems is a heat removal procedure that is effected through heat exchange pipes whose surface is, under certain circumstances, enlarged by the employment of conventional ribs or plates that serve to improve system performance. The quasi linear tubular system i.e. one providing only limited surface coverage produces, inside a thermal integral block or storage system, virtually cylindrical isotherms whose linear transport capacity expressed as W/m^2 K, does not correspond to an actual planar removal pattern having virtually parallel isotherms.

The plates proposed in CH-PS-601 340 moreover contain short-

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circuit elements since they redirect heat from the end of the tubing back to the tube entrance.

It is thus the objective of the present invention to create a device capable of producing inside a thermal integral block an incoming or outgoing flow of heat, whereby the isotherms produced inside the thermal integral block run virtually parallel to one another, and the heat conduits run preferably at an angle to the heat flow produced in the thermal integral block.

It is another object of the present invention to overcome or substantially ameliorate the above disadvantages.

There is disclosed herein a device for generation of incoming or outgoing heat flow in a body of low thermal conductivity less than 20 W/mK, suitable for absorption or storage of heat by means of at least one heat-transfer layer transversely disposed with respect to any natural or artificial heat-transfer field within the body, in order to supply heat to or withdraw heat from the body in one or more essentially parallel planes and to transfer the heat to, or from, a heat-transporting medium, wherein the layer comprises a material whose thermal conductivity coefficient is greater than that of the body and which is thermally connected to the body, and the layer is self-enclosed within individual transfer fields which are formed depending on the type of heat inflow or outflow produced by the heat-transfer medium, but is separated from any other heat-transfer layers.

There is further disclosed herein a device suitable for storage and absorption or dispensing of heat comprising:

a body of low thermal conductivity of less than 20 W/mK suitable for storage and absorption of heat;

means for conveying heat from a heat transporting medium to the body, wherien the conveying means includes a plurality of tubes for the flow of heat therethrough in each heat transporting layer and heat flows in the opposite direction in each adjacent pair of tubes, and wherein each tube of each adjacent pair of tubes is separated from the other tube by a space that acts to interrupt a heat shunt therebetween;

at least one heat transporting layer thermally connected to the body for supplying heat to and for withdrawing heat from the body in one or more essentially parallel planes, the at least one heat transporting layer having a surface that is in direct thermal contact with the conveying means for transferring the heat to and from the heat transporting medium; and

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wherein the at least one heat transporting layer consists of a material having a thermal conductivity coefficient greater than than of the body, and wherein the layer is positioned transverse to the direction in which heat flows from the heat transporting medium to the body.

The high-capacity heat transporting layer that transports heat in an integral block of low conductivity, may consist of copper, aluminum, silver or gold and its alloys and may be formed through the installation of semi-finished products such as sheet or piping, through the casting of the aforementioned metals into a composite structure, or by creating a sintered body in which the highly conductive layer is produced through sintering in situ.

The thermal integral block of finite or quasi finite dimensions having it its heat transporting portion heat transport capacities between 20 and 200 W/m^2, can be used

-- to capture and store atmospheric and terrestrial heat; to control the temperature of the surrounding area

- in thermal process control in nonmetallic thick-walled containers used in chemical and biochemical process technology

- in precise heating or cooling of the insides of mechanical components while precluding local temperature excesses e.g.

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maintenance of cooling or heating in electronic equipment.

The bidimensional effect of heat flow through the heat conduction layer permits the transfer of maximum specific heat outputs given certain K. In this respect, the invention differs essentially from the direct installation of a heat exchanger charged with a heat transport fluid, whereby the heat flow under ideal conditions occurs more or less linearly through heat exchange pipes, and very often, in the case of spherical containers, only in quasi-punctiform fashion.

The present invention ensures the maximum heat flow expressed in W/m^2 through a thermal integral block of any finite or quasi finite length through the optimal design of a heat flow occurring during either the feeding or the removal of heat.

Throughout the course of development of this system have arisen applications for capturing atmospheric and earth-bound energy, such as those of large systems used in chemical/biological process technologies and in machine construction. In such applications, the transport of heat using a transport fluid, whereby in special circumstances even steam heat can be directly used, has gained significance.

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In the case of industrial applications involving precision products or electronics, heat can be transported electrically by the Joules effect or removed by means of a Pelletier-element.

Should the heat exchange pipe registers installed to facilitate the forward and return flow of the heat transport medium and connected to the heat conducting surface acting as a shunt be arranged in parallel fashion, the heat transport medium is permitted to cool or heat during forward movement through the thermal integral block up to the point of return, in such a way that there ensues, over the entire width and in the corresponding direction, a uniform temperature gradient between the forward and return flows. The highly conductive feed or removal layer should under such circumstances cover the entire area to be affected.

Should, on the other hand, the heat exchange pipes be disposed over the heat shunt area in hairpin fashion, wherein forward and return flow occurs on the same side, or in meandering fashion, wherein forward and return flows fan out from one feed point, a heat field, produced as the heat transport medium changes temperature over its course, differs from that of the adjacent loop and dictates that the more highly conductive layer that acts as a heat shunt be discontinued by suitable means at the boundary separating it from the adjacent heat field. Otherwise, a heat bridge would be formed, which would create a short-circuit that

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would markedly diminish the heat removal ability of the system.

Should a thermal integral block be operated in bivalent mode so as to permit storage/loading or discharge, or, alternatively, the supply of surface heat or its removal (atmospheric collector), a compromise must be found respecting the geometrical layout of the highly heat-conductive heat shunt layer and the optional operating conditions for a collector or storer. Depending on local conditions, several heat shunts can be installed in positions that lend themselves to various kinds of applications.

The heat shunt connects the heat flow occuring inside the thermal integral block with the heat exchanger.

In order to permit removal of the entire quantity of heat brought to the block, the heat conduction capacity = $Q_{ww} \cdot \lambda_{ww}$ should correspond at least to the heat flow to be captured in the integral block $Q_{thMbl} \cdot \lambda_{thMbl}$ if higher temperature deviations and attendant lower effectiveness are, to be avoided. The layer cross-section, being thus defined, would then have merely to be connected to the heat exchanger, and could extend laterally away from such heat exchanger to the middle of the intermediate space separating the adjacent heat exchange pipe, to return to the point of origin. Such an embodiment of the heat

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shunt would however, present technical difficulties and be generally too expensive. The primary practical application for such a heat shunt would be to serve in the capture of atmospheric/terrestrial energy by means of storage/collectors. The optimal quantity that could be captured by the collector would be determined by local climatic conditions. Such a quantity ranges between 30 and 150 W/m^2 and fluctuates, according to weather conditions, between very wide limits. An important factor in the generally bivalent operation is the capacity of the underground storage system to release energy. In a continuous operation, such capacity lies between λ 4W/mK, which is the maximum conductivity of very dense rock and λ 0.3W/mK, which represents the conductivity of dry earth, and is subject to only very minor variations.

Should excess energy be withdrawn from underground storage, i.e. there be excessive ΔK between the heat transporting medium and the underground, there exists during increased heat removal from the surface the danger of ice formation, which can be countered by a reduction in the heat loss per unit of area or by increasing the coverage (heat shunts located deeper, the existence of possibly a greater number of heat shunts to accomodate seasonal loss).

In the winter semester heat loss from the surface of unused areas

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such as parks, etc. with attendant icing, can be avoided by the use of an insulating cover, in some cases, such surfaces can be iced for recreational purposes.

Another use for the proposed device consists in the storage and retrieval of energy in the form of heat, whereby in the event of an excess of heat, a thermal integral block can be very efficiently heated, and the warmth can be retrieved when required. The smallest temperature differences can serve the purpose of storage or retrieval and additionally the amount in storage, which can be increased through the inclusion of special storage bodies employing latent heat, is considerable, since such amounts can be utilized very effectively.

In the case of mobile thermal integral blocks e.g. such as those arranged on railway cars, a local thermal shift can be envisaged.

In general, the proposed device i.e. the heat shunt permits the feed or removal of heat in low-conductive media, which was in conventional processes and systems possible only at considerable expense or given extremely favourable conditions.

A preferred form of the present invention will now be described by way of example with reference to the accompanying drawings, wherein:

Accordingly a device is provided for the generation of an incoming or outgoing heat flow in a body of low thermal conductivity of less than 20 W/mK, suitable for absorption or storage of heat by means of at least one heat-transporting layer, in order to supply heat to or withdraw heat from the body in one or more essentially parallel planes and to transfer it to, or from, a heat-transporting medium, characterized in that the layer consists of a material whose thermal conductivity coefficient is greater than that of the body and which is thermally connected to the body and that the layer is self-enclosed within the individual transport fields which are formed depending on the type of heat inflow or outflow produced by the heat-transporting medium, but is separated from other heat-transporting layers.

The invention is described with reference to the examples depicted in the following drawing figures:

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~~Shown are:~~

Drawing 1. The schematically represented structure of a heat shunt with variations:

a) heat transfer by means of heat exchanger using heat transport fluid

b) electrical heat transport.

Drawing 2. The vertical section of a massive absorber -- heat exchange according to:

Drawing 2a: as a daily or annual storage system installed directly on a rock base.

Drawing 2b: an artificial daily storer on top of an earth or sediment base serving as an annual storage system.

Drawing 3 Top view of pipe layout

Drawing 3a: parallel-laid pipes, with flow in the same direction

Drawing 3b: hairpin pipes.

Drawing 3c: meandering pipes.

Drawing 4a-d Vertical sections through embodiment variations of the heat removal and heat exchange layers.

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Drawing 5 - Phase shift of the graph of the outside air temperature in the absorber circulation system.

Drawing 6 - Phase shift of the temperature graph inside a massive absorber/storer.

Drawing 7 - Schematic representation of the flow conditions in the heat removal system.

Drawing 8 - Annual cycle of the atmospheric energy supply.

Drawing 9 - Temperature curves as a function of depth below the earth's surface, in different seasons.

Schematically represented in drawing 1a is a device according to the invention, which essentially embraces heat conducting heat removal or feed layer 20, such device arranged inside and thermally connected to a thermal integral block 5. Layer 20 is thermally e.g. connected to tubular conduit 6a, in which a heat transport medium flows to/from a heat pump 3a (not shown) and to/from a heat source 4a or heat user 4a.

Analogously, drawing 1b shows layer 20, attached to which at the ends of an edge 6b has been a voltage line, e.g. connected

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through power source 4b.

The heat produced by the electricity running along the edge strip of layer 20 is conducted through this layer to the integral block. Similarly, heat may, through the use of a Pelletier-Element (not shown), be drawn from the integral block by means of an electric current.

Drawing 2 depicts in vertical section the basic structure of a massive absorber/storer in alternative a, on top of a rock that acts as a rock storage system 15 (λ = 1.75 - 4.65 W/mK) or b, on top of earth or sediment 16 (λ <0.8 W/mK).

The bare rock is covered with a flat layer 17 of dense cement (λ >1.16 - 1.4 W/mK) in order to form a suitable pipe-laying surface 20.

Earth or sediment is consolidated by stamping in loose rocks and by being covered with lean concrete 18 ($\lambda \sim$ 0.8 W/mK) and developed into an optional second pipe-bearing surface 20. The daily storer 19 having a thermal conductivity λ =1.16 - 1.4 Wm/K is embodied as a massive reinforced concrete plate of highly compressed concrete whose thickness corresponds to the daily storage requirement but is any case at least 15 cm.
The heat removal and heat exchange layer having a heat

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conductivity at least 100 times that of the massive absorber/storage block is formed by heat transport fluid conduits 6 and the heat conducting layer 22 that covers as fully as possible the removal plane and is connected to the former in such a way as to facilitate heat conduction, both of which being constructed preferably of copper having a thermal conductivity of $\lambda \sim$ 400 W/mK.

Thus, a structure is created that can be considered a heat shunt. Warmth from the outside enters through the material of storer 19 into the heat conducting material layer, whose is $\lambda \sim 200 - 400$ W/mK. The layer, e.g. in the form of connected plates 22, is very thin, e.g. 0.1 - 1mm, and permits the transfer of the arriving heat batches into small cross sections that are designed to take into account the values λ for the storer and λ for the metal, which is preferably Cu, in any direction. Such heat is transferred to the heat absorbing water by means of forced convection. Thus is provided an elegant means of shunting heat in any direction.

The heat conducting layer should be joined to the underlying layer as well as to the overlying concrete layer so as to preclude pore formation and to conduct heat. The removal of heat and the transfer of the latter from the transport medium can take place either in a single plane suitable for conducting

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atmospheric or terrestrial heat in accordance with Drawing 2a or in two phases in accordance with Drawing 2b which, separately, serve to capture absorbed or stored heat.

The absorbing top layer 21 on the surface whose conductivity is $\lambda \sim 1.2$ W/mK should, together with the underlying layers that serve as a bed, be constructed given respect to the primary function, e.g. that of road surface, etc. The thickness of layer 21 should be such that surface temperature differences, i.e. the temperature differences occuring on the surface, are not detected in the pipes or the thermal shunt (e.g.< 2K). The absorbing area can itself be constructed so as to better absorb solar radiation if tar, paint, dark additives or possibly a layer 24 of asphalt or dark natural rock, is applied.

The massive storage block should be insulated against heat loss to the outside or against drawing heat from adjacent buildings by means of a heat stop 23 ($\lambda < 0.6$ W/mK) composed of expanded clay aggregate or other weather-resistant material and sunk to a suitable depth, so as to permit the heat to flow essentially only at right angles to the absorbing top surface.

If, due to low outside temperatures, heat is drawn from the

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storer through the absorbing surface, such an undesirable heat flow can be reduced by the employment of an insulating cover 25 ($\lambda < 0.1$ W/mK) that can be controlled by temperature or radiation-sensitive devices and be capable of being rolled away.

Drawings 3a, b and c give the outlines of three different embodiments of a quasi two-dimentional removal layer inside a heat exchanger that constitutes a massive absorber/storer 5. The pipe diameter depends upon the hourly flow requirement, whereby the cross-sections should, in order to avoid pump energy losses and flow rates >1 m/s, be of adequate size.

In order to ensure the optimal use of latent and convectional heat in condensate and meteoric water congregating at top layer 21, or its optional covering 24, the surface should be as water-repellant as possible and sufficiently sloped.

Drawing 3a shows a heat exchanger having parallel, unidirectional flow, i.e. prefeed at 26 on one side and return/delivery/27 on the other.

Even flow through the register is ensured by directing the flow forward or backward according to Tichelmann or by the use of bilateral connected blocks of large cross-section that serve to equalize pressure. In the removal plane, the temperature rises steadily up to the exit side. Heat removal sheets 22 can hence completely cover the entire area.

In the hairpin register showns in drawing 3b, which features flow paths of equal length and which is thus able to ensure, without additional expense, the flow of equal quantities of fluid, fields of differing temperature occur in the forward flow and return flow legs. Heat conducting layer 22 must, in consequence, be separated at 28 medially between the pipes by a space of 5 - 10 mm. The width of the plate field can be changed by alternating the arrangement of hairpin pairs.

The meandering arrangement according to Drawing 3c facilitates the coverage of complex areas. The fields of differing temperature, however, increase in complexity, and the disposition of the uncircumventable zones 28 separating the plates for the purpose of discouraging the mutual influence of the individual heat fields, becomes less predictable.

In the case of the quasi three dimensional removal of heat from the spatially practically unbounded rock storer 15, such temperature fields are, compared to the withdrawal of heat from the atmosphere, of subsidiary importance.

Drawings 4a-d show in section embodiments of the heat exchanger.

The most cost-effective and adaptable systems are basically those using commercially availble copper pipes and sheets, examples of which are shown in drawings 4a and b.

The space between the pipes, or rather, the effective width of the heat absorbing plates 22 that direct flow to the heat exchanging pipes 6a, i.e.

effective width x $\frac{1.16}{400}$ (Conductivity = 1.16 of the cover plate 21/plates 22 - conductivity λ =400) i.e.

for the extreme pipe separating spaces	1000mm or	200 mm
or pipe axis half distances	500 mm	100 mm
minus effective pipe zone	40 mm	30 mm
= effective plate area	460 mm	70 mm
the plate thickness becomes approx	> 1.2mm	> 0.2mm.

The heat conduction-connection to fluid conduits embodied as pipes 6 can be ensured through adequate coverage with longtitudinally or cross-crimped sheeting embodied as "continuous" heat-conducting layers 22 0.15 to 0.4 mm thick. Flat sheets can also be attached, by means of welding or soldering to pipes 6a as prefabricated sections. The space separating the pipes and thickness of the plates should be optimized for varying applications in accordance with local material and construction costs, whereby small pipe-separating spaces are especially suitable for parallel, unidirectional pipe registers.

Drawing 4c shows a rectangular box 29, stiffened on the inside by struts or spacers and that produces an ideal flow pattern, the rigidity of such rectangular box 29 first being ensured when the concrete sets.

In drawing 4d, dual layered, welded sheets, or so-called rollbond-elements which are not welded together, are widened to form through flow cross-sections 30 of adequate dimensions. In such heat exchangers, conduction pipes 6a are combined with sheets 22 and are primarily suited for fluid-conveying unidirectional parallel registers according to drawing 3a.

The heat flowing to the absorbing surface is dependent upon solar radiation and, with regard to global radiation and latent heat as well as conventional heat, upon the temperature of the surface. The quantities of such heat forms are determined largely by local climatic conditions and by the supercooling capacity of the collector.

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Although daily highs and mid-week values for solar and global radiation throughout the course of a year are known to have held true for a great number of geographical localities, such as e.g. appear in the handbook "Climatic Data for Energy Engineering- July 1981 to Jun 1985", of the SMA, these give only an approximation of the practical energy capture capacity of a system.

Hence, in a climatically ideal location, (regular maturing of corn to the cob state) an energy capture based on the data given of 100 W/m^{-2} should be appropriate.
The supply of latent heat of convectively transported meteoric water and heat being subject to dew conditions, fluctuating frequently over time and the quantity of which varying within broad limits renders impossible the estimation of the total atmospheric energy supply.

The daily cycle of the external heat supply is shifted, timewise, due to the inherent inertia of the absorber system according to Drawing 5 and in far greater measure to the speed at which the massive storer according to Drawing 6, is loaded.

The optimal 10 - 12 hour shift of the maximum extraction rate to the external air minimum is possible in the case of limited heat withdrawal given a rock storer 15, and is ensured by the use of

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an artificial daily storer 19 having sufficient storage capacity.

The bivalent function of the system is revealed in the five operating modes shown in Drawings 7a-e. In Drawing 7a, no heat is withdrawn. System 1 is not operational. The total absorbed atmospheric energy flows into rock storer 15 in Drawing 2a or into daily storer 19 and to a lesser extent into the earth or sediment 18 (Drawing 2b). Should the extraction system be operating, then either (as in Drawing 7b) only part of the absorbed energy or (as in Drawing 7c) the entire quantity of energy can be withdrawn, whereby in case b) the excess flows into the storer.

Complete extraction with insufficient absorption and partial voiding of the storer is represented by Fig. 7d. If, as a consequence of seasonal change, as in Drawing 8, the atmospheric energy becomes unuseably small, then only the terrestrial heat according to Drawing 7e can be utilised. Heat loss through the absorbing surface should be minimized through an insulating layer 25. If further withdrawal layers are present underneath the daily storer according to Drawing 2b, the heat can be withdrawn.

A precondition to the amount of terrestrial heat that can be retrieved per unit area from rock storer 15 or from sediment 16 is that of the homogeniety and isotropism of the storage mass.

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Such conditions are present only under certain circumstances; as a rule, rock is integumentary, anisotropic, may contain water-bearing veins, is of uneven depth, may contain soil and sediment and, unless the soil undergoes expensive testing for thermophysical characteristics, hardly admits of assessment. Only the heat exchanger employed to extract atmospheric energy can be utilized to the greatest extent possible. The extraction rate of 100 Wm^{-2} chosen as the ideal rate should be adequate in the case of hard rock having greater thermal conductivity and high heat content.

Massive absorber/heat exchanger 5 can be embodied as canal beds or load bearing surfaces for the purpose of extracting heat from flowing water, preferably hot waste water. The prefabrication of high-load bearing e.g. prestressed concrete elements permits the installation of special heat exchange-extraction layers that incorporate poorly deformable conduit systems 6a whose deformability increases during setting of the surrounding concrete. In such prefabricated elements, the heat exchangers are, together with forward and return flow (connection distribution) boxes, especially well protected and the heat conducting connection with the concrete is assured.

If sufficient open areas without intensive plant growth are available, the installation of an extraction layer of limited

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output (30-80 W/m^2) in soil of low conductivity (λ= 0.3 - 0.7) can be economical.

The bare extraction layer is laid at a depth of 20-50 cm and is covered with standard copper sheets suitable for vertical construction (2 X 1 m, 0.55 mm thick) that are crimped in the center in the longditudinal direction so as to be able to clip onto the pipe register. Such sheets serve as a heat shunt. The extraction layer is next covered over with fill and then with topsoil, and planted.

From these considerations, one can derive the following quantitative principles to govern the construction of the described system:

1. The temperature curves and thus the temperature fluctuations occuring at a depth X which is the distance measured from the open absorbing surface, are given by the envelopes according to Drawing 9.
2. In order for the daily periodicity (Daily cycle) of the energy absorbed by the open absorber surface to be utilised, the fluid conduction system such as e.g. are represented in Drawings 5 and 6, must be set out at depths that are measured in decimeters.

When installing such a system the desired phase shift (Drawing 5)

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must be taken into account, that is dependent upon the frequency of the excitation temperature oscillation as well as the temperature conductivity coefficient of the absorber/storage material. If n is the oscillation coefficient, t time, x depth and a the temperature conductivity coefficient, such a phase shift can be expressed by the relationship

$$\cos\left(n\cdot t - \frac{\sqrt{n}}{a\cdot\sqrt{2}}\cdot x\right)$$

The phase shift increases as depth x increases oscillation coefficient n and as the thermal conductivity coefficient λ of the absorber storage material decreases.

The heat energy to be extracted becomes, given a selected installation depth x, a question of the size of the open absorbing surface and of that of the fluid transport system, its construction and constitution.

A further secondary condition that should be taken into account is that of the selection of the installation depth x, when the temperature boundaries at such depth x are known. The envelopes of the daily temperature curves -- which are analogous to the yearly temperature curves in Drawing 9 define the installation zone, in which such limits are to be anticipated. On the

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ordinate indicating the temperature in °C, are given for the data 31.1, 30.4, 31.7 and 31.10 temperature curves dependent upon the distance from the surface of the earth.

3. The optimal exploitation of the annual cycle of the energy absorbed by the open absorbing surface is subject to analogous principles relating to the choice of installation depth, as formulated in point 2.

   It is obvious that, given such conditions, the factor of storage capacity should be accorded far greater importance.

   In this case, however, the choice of installation depth x is, as opposed to point 2, subject to construction-related expense and, if need be, an increased amount of displaced soil.

4. Such considerations would indicate that from a purely technical viewpoint, it would be desirable to install at least a number of fluid transport systems at various depths to correspond to the periodicity number relating to the absorption of heat from the open atmosphere.

There would be two such numbers - one for the daily cycle and another for the yearly cycle. Whether it will serve any purpose

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in the future to add to such cycles, remains to be seen. The factors that effectively influence the entire problem and contribute to the choice of solution are technical or constant, but are purely economic ones, such as material costs, wages, construction specifications, environment, etc. Since these factors are subject to constant change, optimalisation will always necessitate further embodiments.

All of the individual components and individual distinguishing features described in the disclosure and/or drawings, as well as permutations, combinations and variations thereof, are inventive. The same holds true for n components and individual distinguishing features having the values n=1 to $n \to \infty$.

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The claims defining the invention are as follows:

1. Device for generation of incoming or outgoing heat flow in a body of low thermal conductivity less than 20 W/mK, suitable for absorption or storage of heat by means of at least one heat-transfer layer transversely disposed with respect to any natural or artificial heat-transfer field within the body, in order to supply heat to or withdraw heat from the body in one or more essentially parallel planes and to transfer the heat to, or from, a heat-transporting medium, wherein the layer comprises a material whose thermal conductivity coefficient is greater than that of the body and which is thermally connected to the body, and the layer is self-enclosed within individual transfer fields which are formed depending on the type of heat inflow or outflow produced by the heat-transfer medium, but is separated from any other heat-transfer layers.

2. Device according to claim 1, wherein the thermal conductivity of the at least one layer is at least fifty times as great as that of the body of low thermal conductivity.

3. Device according to claim 1, being connected to a solid-fluid heat exchanger with heat-transfer preferably taking place through a pipe conduit circulation system comprising a circulating pump and an energy consumer or generator, such as a processing plant or a heat pump, a heat exchanger/vaporizer of which is either connected to said heat-transfer medium conduit or is formed directly by the heat exchanger installed in the body of low thermal conductivity.

4. Device according to claim 1, being connected, in a manner permitting heat-transfer, to a Pelletier element or Joule resistance element, and the heat-transfer results at least partially in generation of electrical energy.

5. Device according to claim 1, wherein a cross section Q_{ww} of the at least one heat-transfer layer, corresponds to a higher conductivity λ_{ww} according to the equation

$$Q_{ww} \geq Q_{th\ Mbl} \cdot \frac{\lambda\ th\ Mbl}{\lambda\ ww}$$

where $Q_{th\ Mbl}$ is the cross section of the heat flow to be affected in the body having the lower specific conductivity λ

6. Device according to claim 1 wherein at least one heat-transfer layer being connected in such a way as to conduct heat with the surrounding body of low thermal conductivity, is made of highly conductive material such as copper, aluminum, silver, gold and/or an alloy of these metals, an aluminide, a silicide, a modification of carbon and/or a plastic with high heat conductivity.

7. Device according to claim 1, wherein the heat-transfer layer is made of cast-in metals with high thermal conductivity, such as copper, aluminum, silver, gold and their alloys.

8. Device according to claim 1, wherein the heat-transfer layer is formed by the addition, in layer form, of powdered or granulated materials such as copper, aluminum, silver, gold, modified plastics, aluminides and/or silicides and by subsequent after-treatment such as, for example, sintering, reactive cross-linking.

9. Device according to claim 1, wherein a heat absorption or storing body used to exchange heat at a thermal boundary surfaces of the body has in its interior, almost parallel to said surfaces, highly conductive layers and preferably connected with heat exchangers in such a way as to conduct heat.

10. Device according to claim 1, wherein the body of low thermal conductivity which is used bivalently for heat exchange at a thermal boundary surfaces of the body and for heat storage has, for the purpose of capturing the heat flow alternatively for collection or storage operation, several layers with higher heat conductivity which lie one behind the other in the direction of heat flow.

11. Device according to claim 10, wherein pipes which carry the heat-transfer medium are laid out in the heat-transfer layer in the pattern of a register at intervals of 5 to 120 cm.

12. Method for operating a device according to claim 1, wherein the body of low thermal conductivity, as a storage device, is, bivalently, charged by adding heat or discharged by withdrawing heat through the layer with high thermal conductivity.

13. Method for operating a device according to claim 1, wherein the body of low thermal conductivity can, bivalently, release heat to the environment or absorb heat in the form of radiation, contact heat or latent heat, through regulation of the boundary surface temperature.

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14. A device according to any one of claims 1 to 11 for the generation of an incoming or outgoing heat flow in an earth bounded absorption or storage body which is used for obtaining atmospheric or terrestrial heat, with a duct system for the transport of a heat-transfer fluid which is placed in the absorption or storage body, wherein:

the absorption or storage body includes at least one removal layer made from a heat conductive material which extends perpendicular to the natural heat flow and over a surface defined by the duct system, and which is heat connected with the duct system and the absorption or storage body.

15. Device according to claim 14, having a thermal energy storage device encompassed by naturally occurring soil and with a liquid-carrying conduit system installed in concrete and/or in soil which system is connected with the concrete and/or soil in such a way as to permit exchange of heat, wherein the conduit system consists of a material whose thermal conductivity coefficient is $\lambda > 200$ W/mK and this conduit system is connected in such a way as to conduct heat with at least one removal layer which is self-enclosed or network-like, with this removal layer having a thermal coefficient which is at least 80 or 100 times greater than that of the concrete or soil material surrounding said layer.

16. Device according to claim 14, wherein the storage capacity of the thermal energy storage device corresponds to the fluctuations in heat supply and demand during the day, i.e. permits a natural charging of the storage device by the higher heat supply during daytime and a postponed heat removal, corresponding to the demand at the lower nighttime temperatures or to the lower rates for electric power, for direct heating or refilling a hot-water heater.

17. Device according to claim 14, wherein transportation surfaces such as streets, paths, ramps, steps and parking areas are constructed as the thermal energy storage device which, in addition to the load-bearing capacity suitable for the transportation surfaces, also has the capturing capacity and thermal conductivity to function as an optimal atmospheric heat collector/storage device and to permit removal or return of the stored heat to compensate for the fluctuations of the heat supply during the day and the demand for heat for home heating or the preheating of water for general use.

18. Device according to claim 17, wherein an absorbing layer exposed to the open atmosphere is designed as a radiation absorber, in particular a

black surface obtained e.g. by blacking, paint, asphalt coating, dark concrete additives, a covering of dark artificial or natural stone, with a heat conductivity of $\lambda > 0.8$ W/mK and with a thickness of 2 - 20 cm, preferably 6 - 8 cm, good water wettability and an inclination of 1° - 5°.

19. Device according to claim 17, wherein a flow of air over the open surface is ensured by artificial ventilation, preferably by the existing exhaust air from a building or buildings, or by the design of the air supply system.

20. Device according to claim 15, wherein the absorbing layer covering the heat removal layer consists of concrete with a thermal conductivity of $\lambda = 1.0 - 1.4$ W/mK.

21. Device according to claim 15, wherein the thickness of the absorbing layer covering the pipes carrying the heat-transfer medium is between 2 cm and 40 cm, in order to reduce surface temperature differences in the area directly affected by the heat exchangers through which the heat-transporting fluid flows.

22. Device according to claim 15, wherein a covering layer beneath a heat removal plane is connected, in such a way as to conduct heat, with underlying rock by means of a concrete filling with a thermal conductivity of $\lambda > 1$ W/mK.

23. Device according to claim 15, wherein an artifical daytime storage device, preferably of concrete or massive masonry with a thickness of at least 15 cm, is constructed on a foundation of soil or sediments with a thermal conductivity of $\lambda > 0.8$ W/mK, in order to satisfy a thermal capacity which corresponds to storage requirements.

24. Device according to claim 15, wherein an insulating cover is provided to cover the soil.

25. Device according to claim 14, wherein the storage device comprises side walls at least some of which include partially insulated removal planes.

26. Device according to claim 14, wherein the removal layer comprises two metal sheets which are welded together in such a manner that, by mechanical, pneumatic and/or hydraulic dilation of the surfaces which are not welded together, channels are created which serve to carry the heat exchanger fluid and have openings at the ends which can be connected to the inlet and return lines.

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27. Device according to claim 14, wherein the removal layer is connected with one or more flat, essentially rectangular pipes for carrying the heat exchanger medium which are preferably stiffened by spacers or internal supports dividing them into sections.

28. Device according to claim 14, wherein the thickness of the storage layer is 15 to 80 cm, for example 18 - 50 cm, if required 30 cm, preferably 20 cm, and that the storage layer comprises concrete.

29. Device according to claim 14, comprising a solid body with a thermal conductivity coefficient of 0.5 - 5.0 W/mK, and an end surface which is, for example, essentially flat, in particular masonry, concrete or rock, and a layer of material which has a thermal conductivity coefficient of 200 to 400 W/mK connected with the end surface of said solid body in such a way as to conduct heat, in order to draw off heat flowing into this end surface through the layer of material and to do this essentially parallel to said surface.

30. Method for operating a device according to claim 14, for the purpose of obtaining atmospheric heat, wherein the surface temperature is adjusted, for outputs between 20 and 200 W/m^2 to a temperature which, in the case of solar and global radiation, contact or latent heat transfer, is 2° to 7° K lower than the prevailing air temperature, the dew point or the temperature of meteorological water.

31. Method according to claim 30, wherein heat is removed in open areas - for instance, lawns - which are used insignificantly or not at all for growing plants, and the underlying ground, such as soil, sediment or rock, is used as a terrestrial storage device, with the removal layer being at a depth of 5 - 50 cm, in order to ensure that if removal takes place only from the underlying ground, the covering layer prevents any loss on the surface, even if the outside temperatures are low.

32. Method according to claim 30, wherein the heat of groundwater or waste water flows is utilized by placement of the energy storage device above, in, or below such flows.

33. A device suitable for storage and absorption or dispensing of heat comprising:

a body of low thermal conductivity of less than 20 W/mK suitable for storage and absorption of heat;

means for conveying heat from a heat transporting medium to the body, wherien the conveying means includes a plurality of tubes for the flow of heat therethrough in each heat transporting layer and heat flows in the opposite direction in each adjacent pair of tubes, and wherein each tube of each adjacent pair of tubes is separated from the other tube by a space that acts to interrupt a heat shunt therebetween;

at least one heat transporting layer thermally connected to the body for supplying heat to and for withdrawing heat from the body in one or more essentially parallel planes, the at least one heat transporting layer having a surface that is in direct thermal contact with the conveying means for transferring the heat to and from the heat transporting medium; and

wherein the at least one heat transporting layer consists of a material having a thermal conductivity coefficient greater than than of the body, and wherein the layer is positioned transverse to the direction in which heat flows from the heat transporting medium to the body.

34. The device of claim 33, wherein the at least one heat transporting layer covers entirely each of said plurality of tubes.

35. A heat transfer device substantially as hereinbefore described with reference to the drawings.

DATED this TWENTY-NINTH day of APRIL 1991

Caspar O.H. Messner

Patent Attorneys for the Applicant
SPRUSON & FERGUSON

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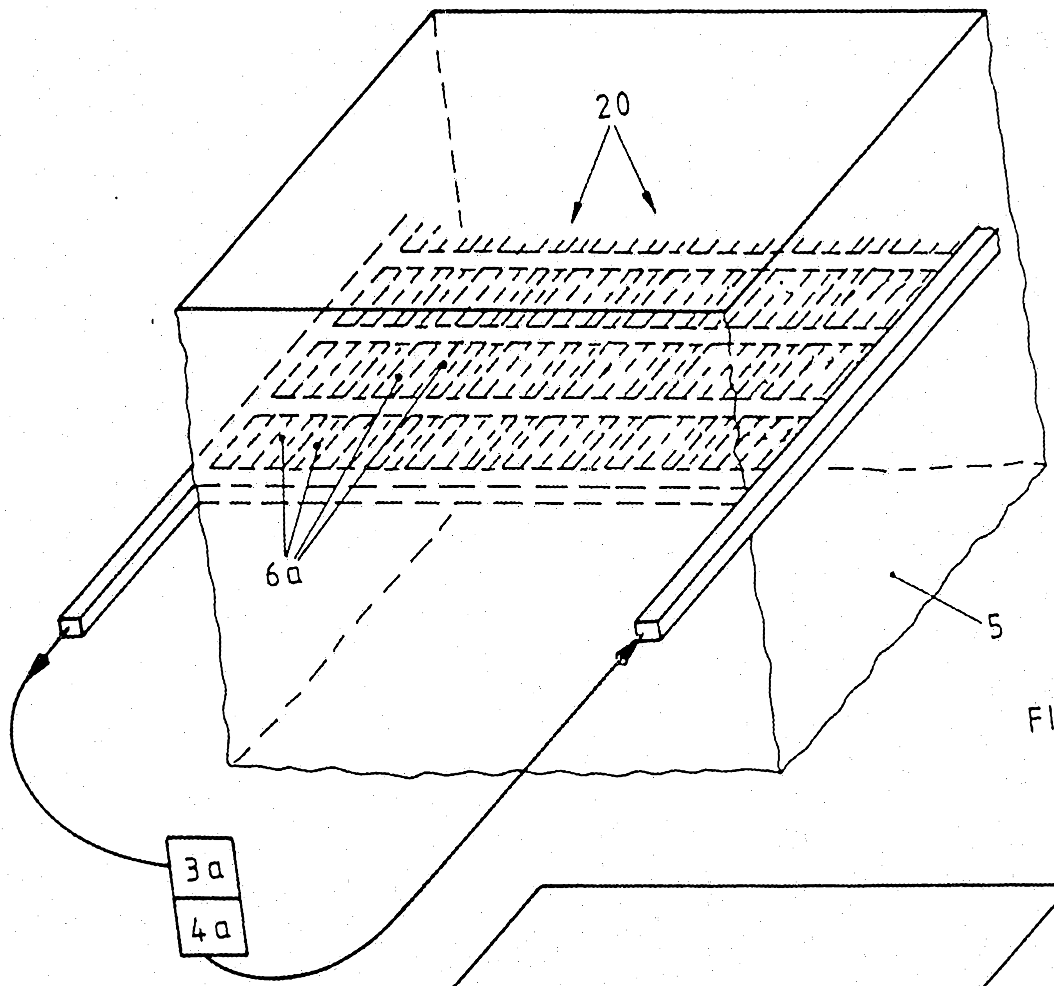


FIG.1a

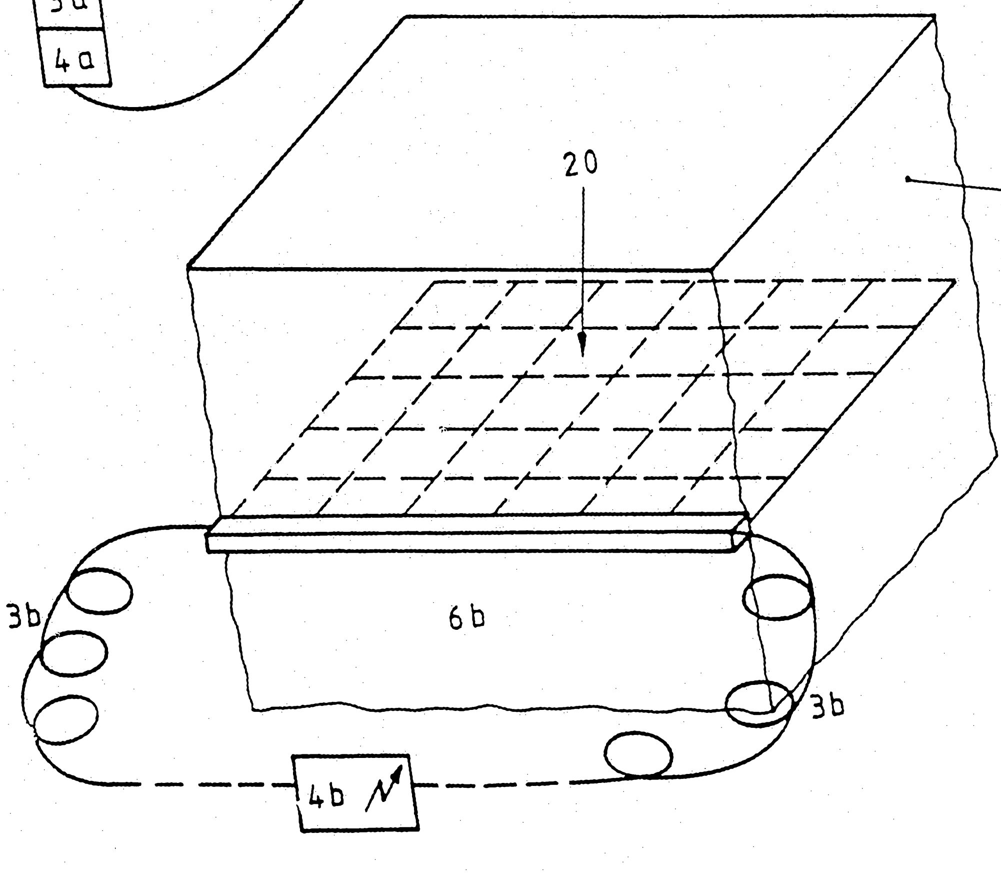


FIG.1b

FIG. 2a

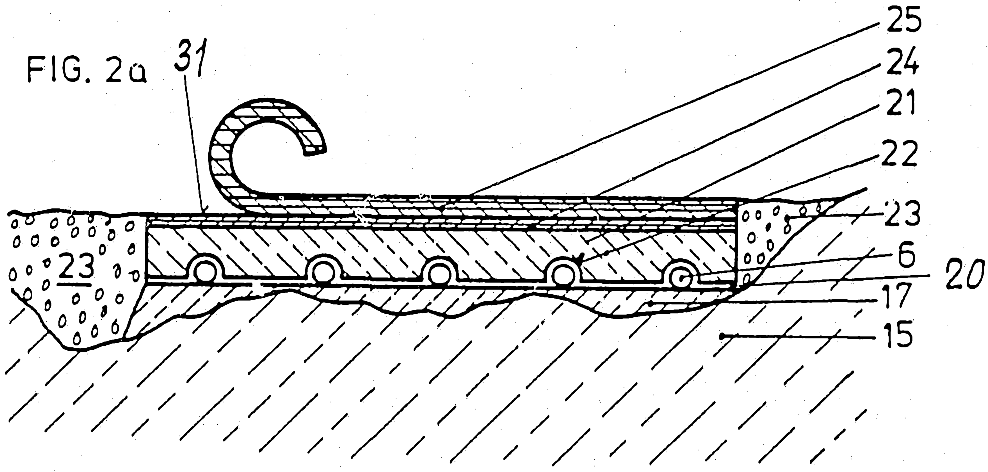
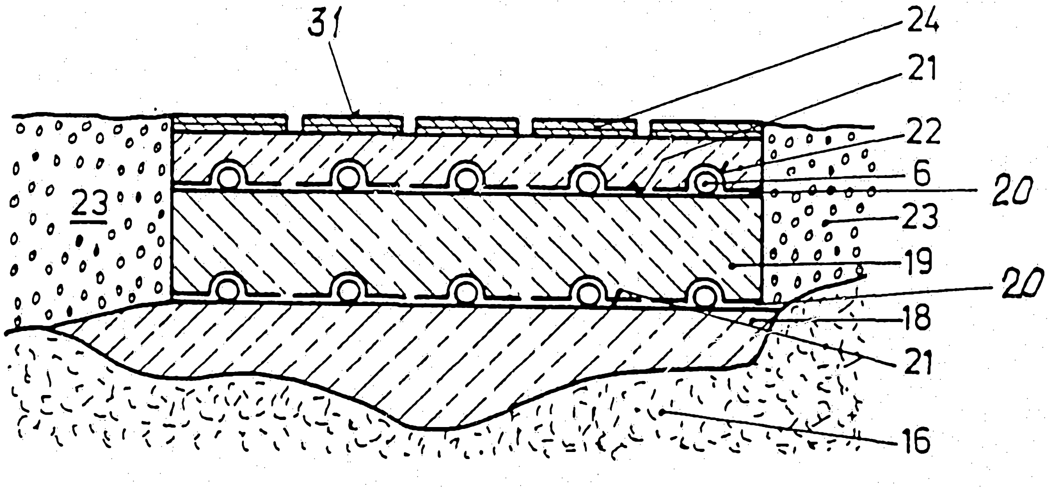


FIG. 2b



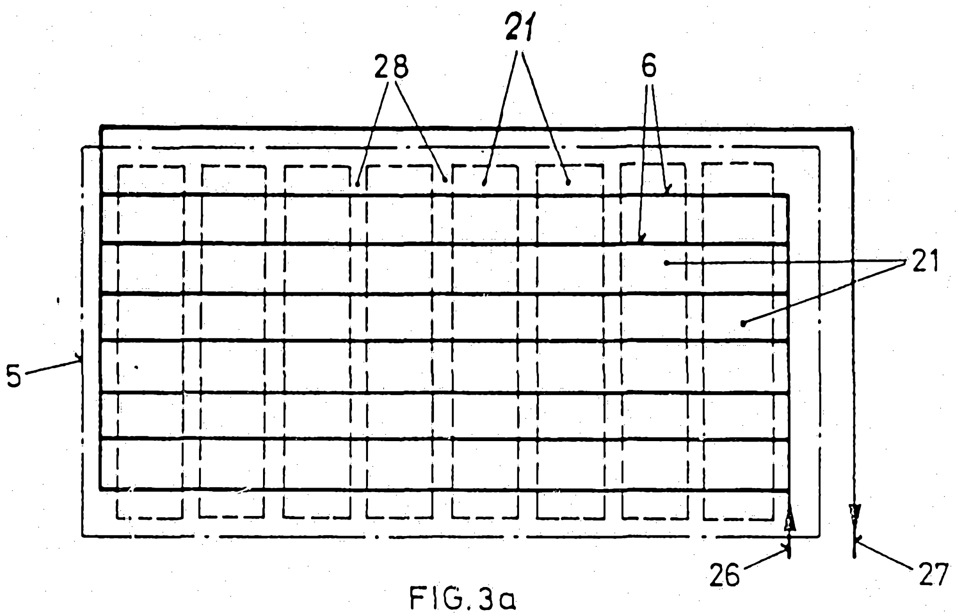


FIG.3a

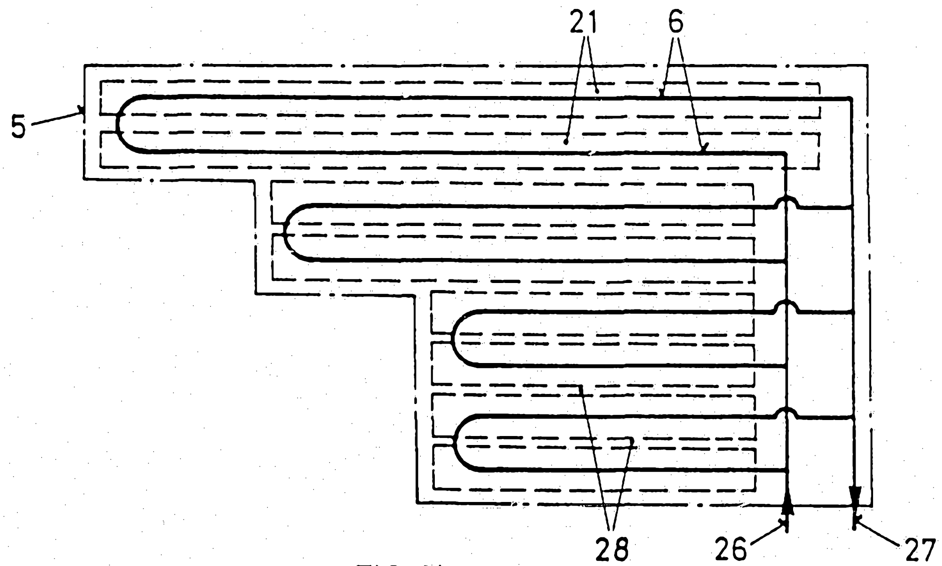


FIG.3b

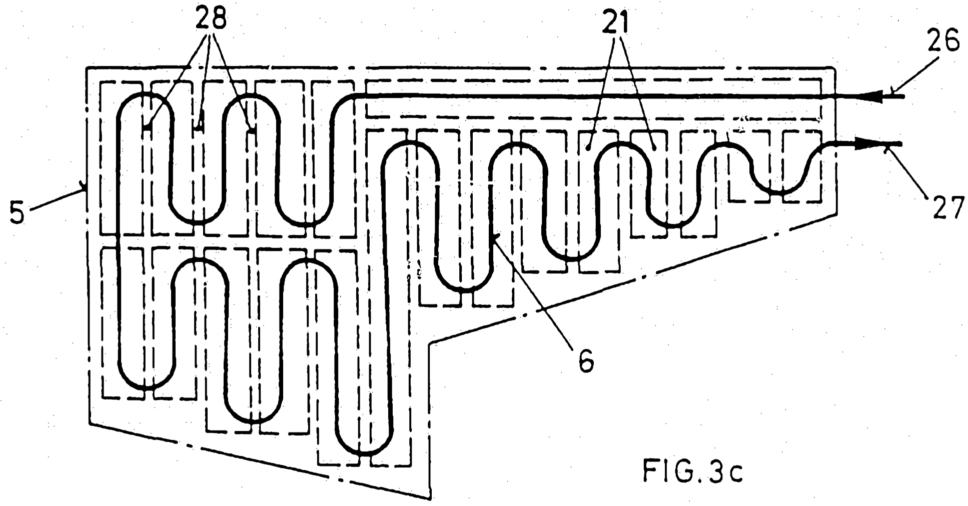


FIG.3c

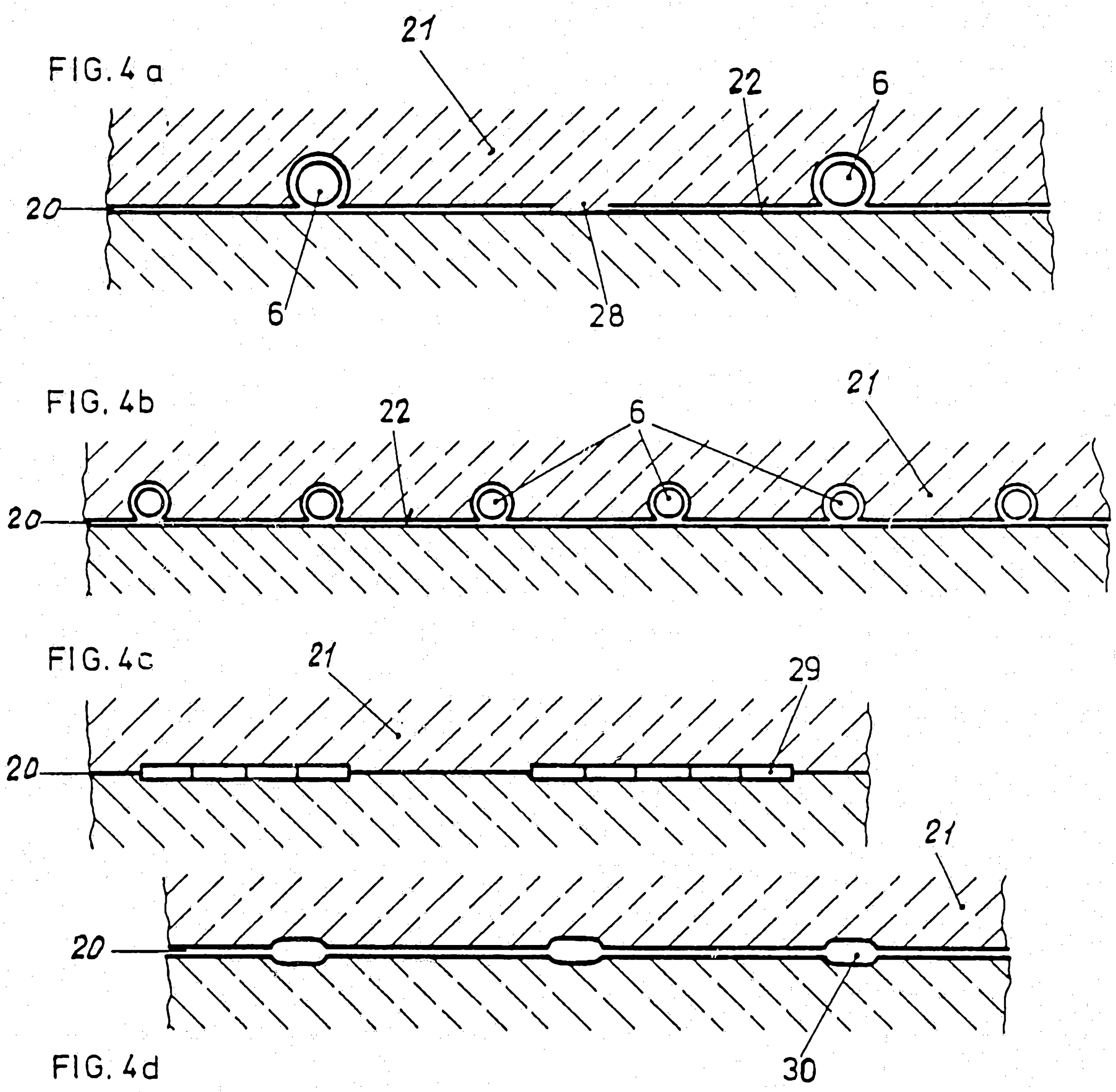


FIG. 4a
FIG. 4b
FIG. 4c
FIG. 4d

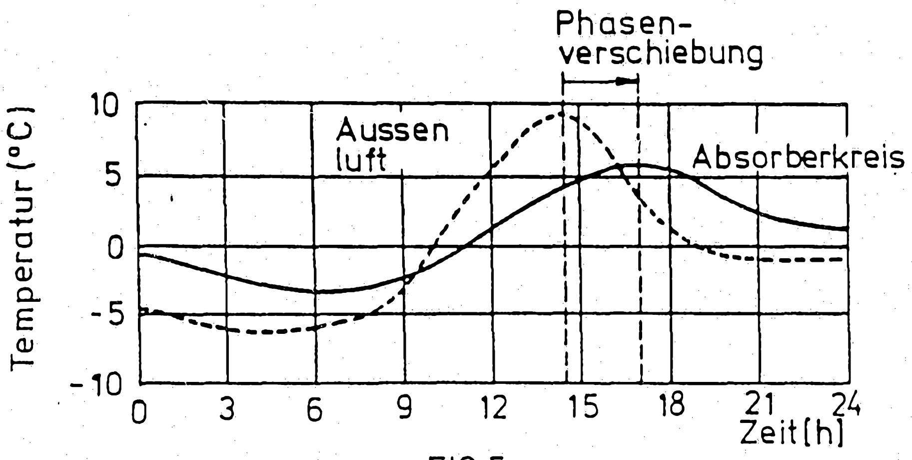

Phasen-
verschiebung
Aussen
luft
Absorberkreis
Temperatur (°C)
10
5
0
-5
-10
0
3
6
9
12
15
18
21
24
Zeit [h]

FIG.5

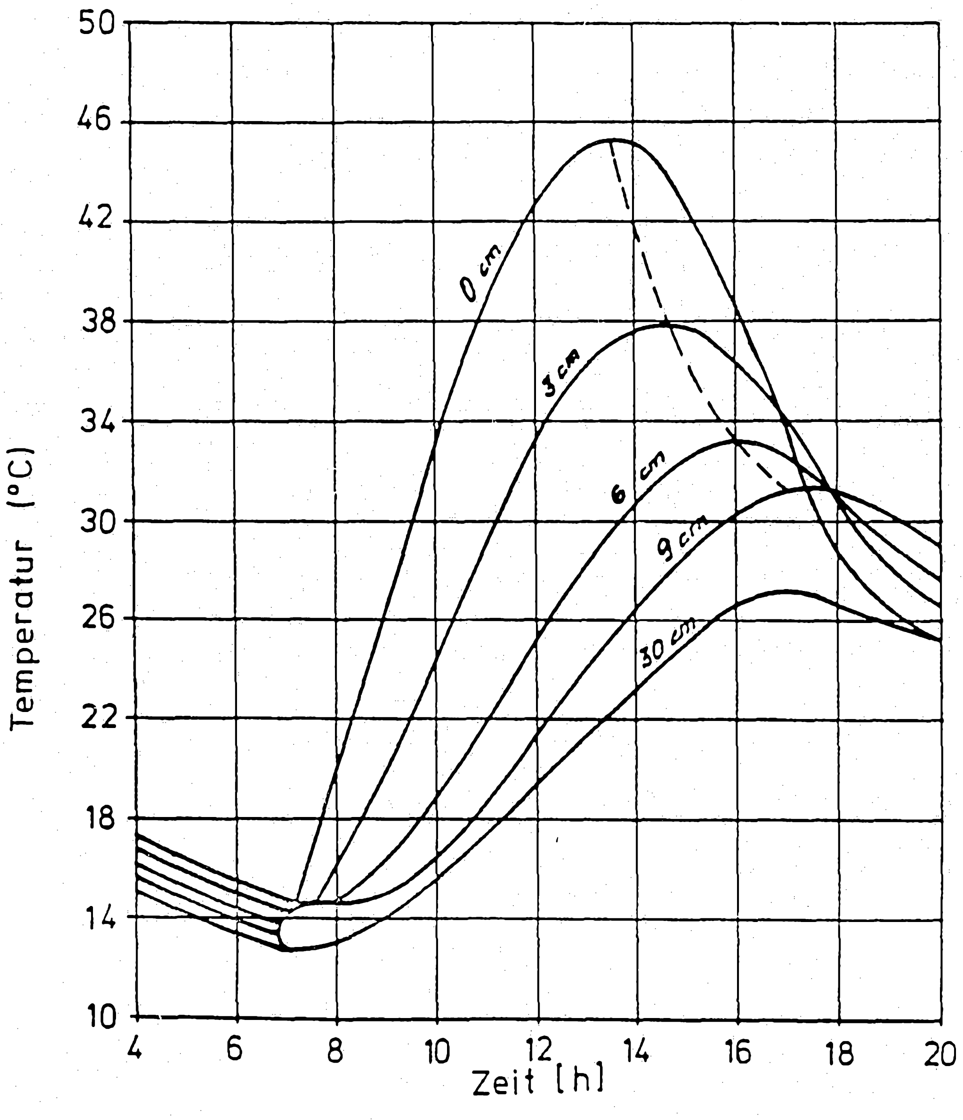

0 cm
3 cm
6 cm
9 cm
30 cm
Temperatur (°C)
50
46
42
38
34
30
26
22
18
14
10
4
6
8
10
12
14
16
18
20
Zeit [h]

FIG.6

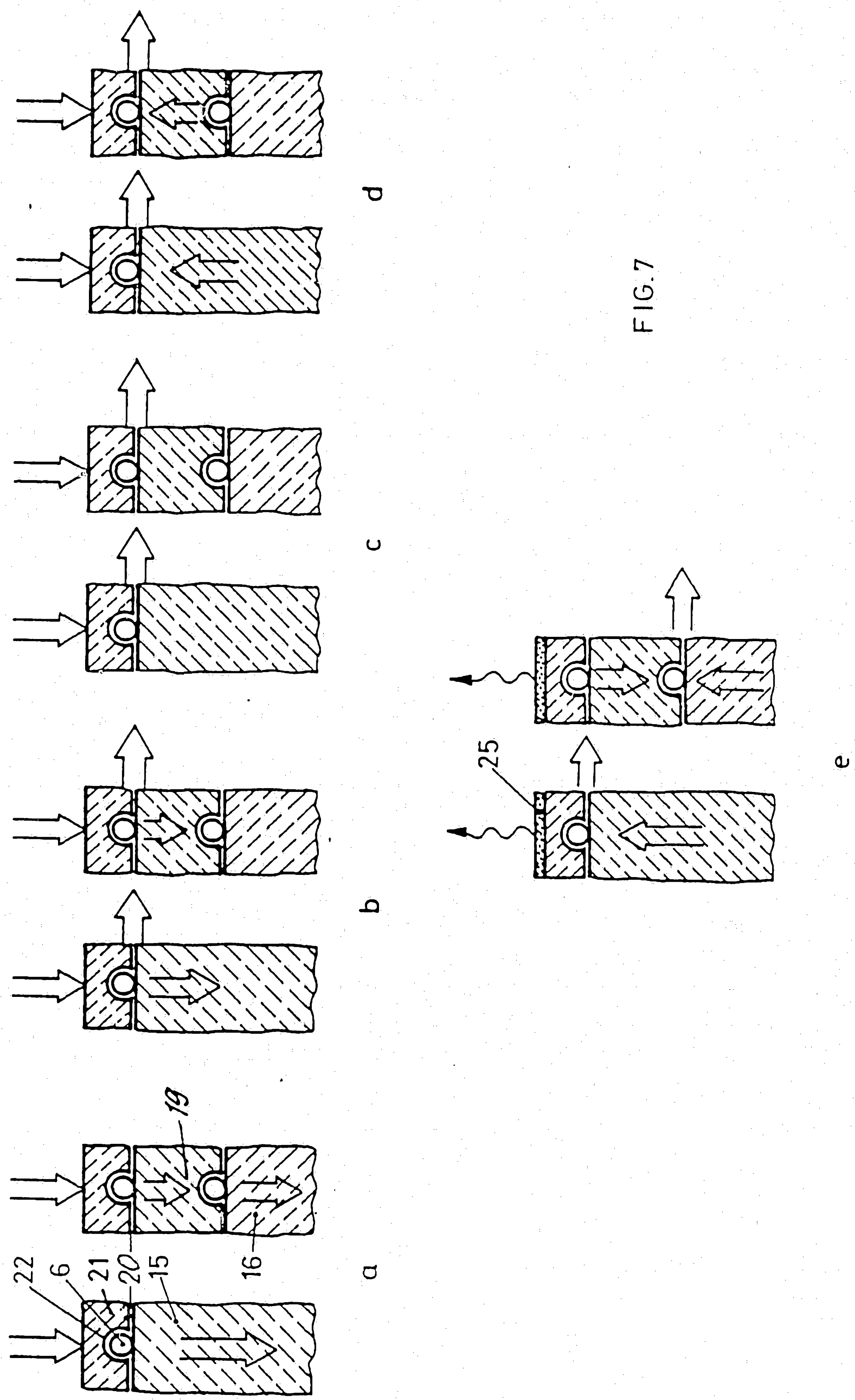


FIG.7

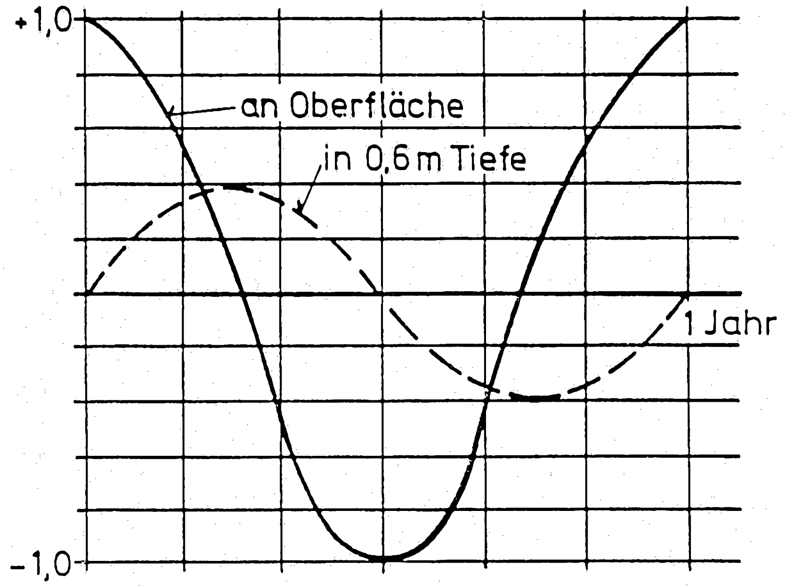


FIG. 8

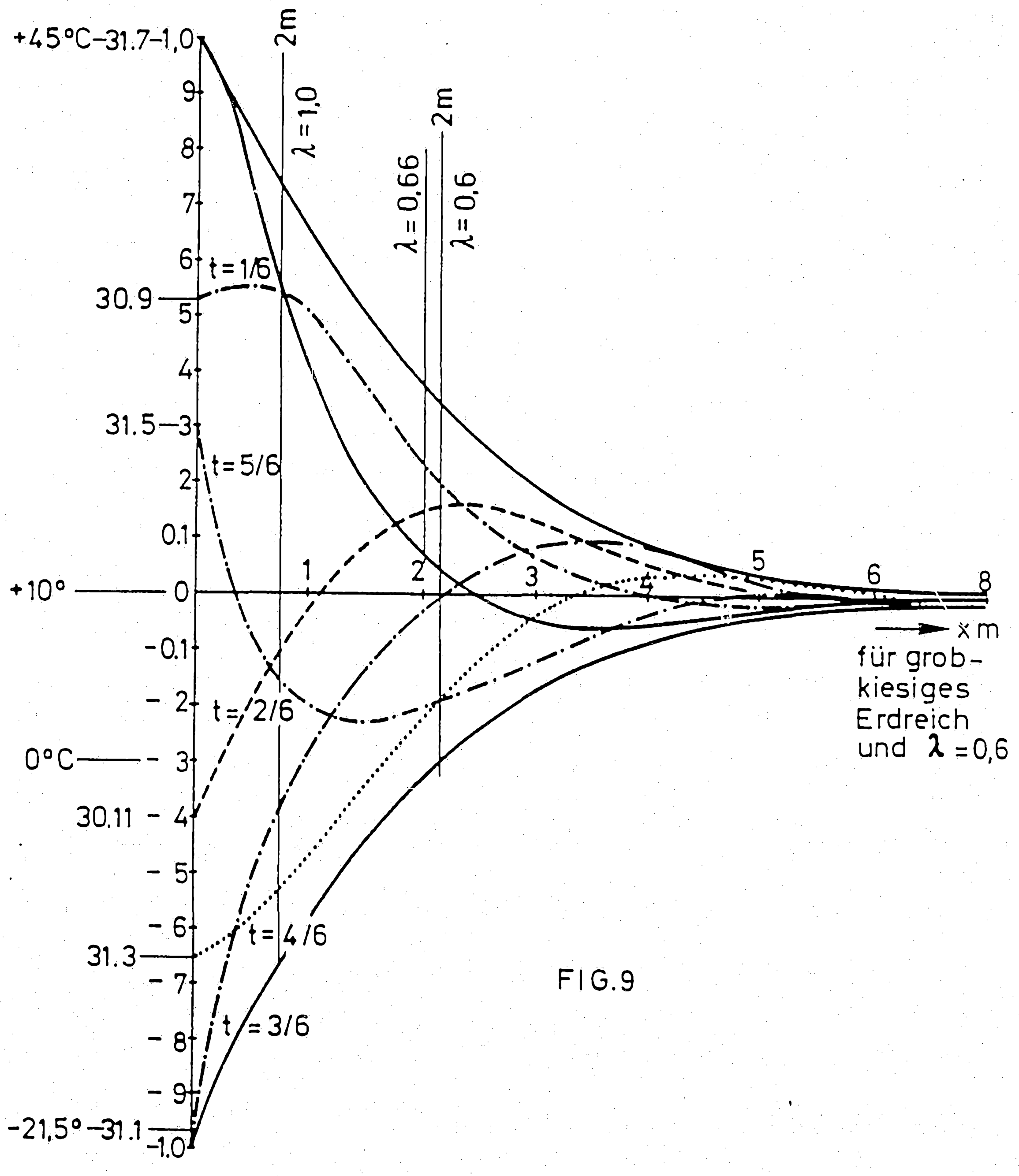

+45°C-31.7-1,0
30.9
31.5-3
+10°
0°C
30.11
31.3
-21,5°-31.1
-1.0
2m
λ=1,0
λ=0,66
λ=0,6
t=1/6
t=5/6
t=2/6
t=4/6
t=3/6
x m
für grob-
kiesiges
Erdreich
und λ=0,6

FIG.9

INTERNATIONAL SEARCH REPORT

International Application No PCT/CH 88/00060

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] F 24 J 2/34; 2/04; 3/06

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
Int. Cl.[4]	F 24 J; E 01 C; F 24 D; F 28 D

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	DE, A, 3407927 (KRINNINGER) 5 September 1985, see abstract; claims 1-3,6,11; page 13, lines 16-28; page 14, lines 29-31; pages 18,19; fig. 1 (cited in the application) --	1,2,5-7,14,26, 28,32
Y	M. Bäckström et al.: "Kältetechnik", 3rd. changed and extended edition, published in 1965 by publisher G. Braun (Karslruhe, DE) page 343, see table 9.08a "Kupfer", Aluminium", "Beton", "Granit" and "Bitumen" --	1,2,5-7,14,26, 28,32
A	US, A, 2584573 (GAY) 31 January 1950, see column 3, lines 22-36; figs. 1,3 --	3,9-11,13,17
A	US, A, 4117305 (COLTEN) 26 September 1978, see abstract; fig. 1 --	4
A	F. Weber: "Messen, Regeln und Steuern in der Lüftungs- und Klimatechnik", published in 1965 by VDI-publisher (Düsseldorf, DE) page 18, see lines 6 to 12 --	12
A	DE, A, 2825684 (A. SEEGER) 20 December 1979, see page 7, line 23 - page 8, line 6; fig. 1 --	3,15,16,23

./.

* Special categories of cited documents: [10]

"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

"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

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
7 June 1988 (07.06.88)	7 July 1988 (07.07.88)
International Searching Authority	Signature of Authorized Officer
EUROPEAN PATENT OFFICE	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	CH, A, 656451 (STEINER SILIDUR) 30 June 1986, see abstract, figs. 1-4 --	18,34
A	FR, A, 2310539 (SVENSKA FLÄKTFABRIKEN) 3 December 1976, see figs. 1,4 --	20
A	FR, A, 2479957 (LAMARQUE) 9 October 1981, see page 4, lines 9-11; fig. 1 --	25
A	DE, A, 2840389 (FELDKAMP GEB. MÖHLENKAMP) 27 March 1980, see page 9, line 22 - page 10, line 3; page 12, line 18 - page 13, line 3; fig. 3 --	36
A	FR, A, 2270442 (TECHNIP) 5 December 1975, see claims 1,3; figs. 1,2 --	37
A	WO, A, 81/00445 (ALOSI) 19 February 1981, see abstract; fig. 1 --	38,39
E	CH, A, 661340 (SCHÄRER) 15 July 1987 (cited in the application) --	
A	DE, A, 2919855 (KOHLER) 20 November 1980	
A	DE, A, 2003394 (THERMO-BAUELEMENT) 6 August 1970	
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A	FR, A, 2574911 (AMIAND) 20 June 1986	
A	US, A, 4314772 (LESTRADEN) 9 February 1982	
A	DE, A, 3024201 (EMMERICH) 21 January 1982	
A	DE, A, 3214102 (ARIZONA-POOL) 20 October 1983	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. CH 8800060

SA 21007

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 24/06/88
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A- 3407927	05-09-85	Keine	
US-A- 2584573		Keine	
US-A- 4117305	26-09-78	CA-A- 1081752	15-07-80
DE-A- 2825684	20-12-79	Keine	
CH-A- 656451	30-06-86	Keine	
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		DE-A- 2520101	20-11-75
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FR-A- 2531192	03-02-84	Keine	
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. CH 8800060

SA 21007

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 24/06/88
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INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen PCT/CH 88/00060

I. KLASSIFIKATION DES ANMELDUNGSGEGENSTANDS (bei mehreren Klassifikationssymbolen sind alle anzugeben)[6]

Nach der Internationalen Patentklassifikation (IPC) oder nach der nationalen Klassifikation und der IPC

Int Cl 4 F 24 J 2/34; 2/04; 3/06

II. RECHERCHIERTE SACHGEBIETE

Recherchierter Mindestprüfstoff[7]

Klassifikationssystem	Klassifikationssymbole
Int. Cl 4	F 24 J; E 01 C; F 24 D; F 28 D

Recherchierte nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Sachgebiete fallen[8]

III. EINSCHLÄGIGE VERÖFFENTLICHUNGEN[9]

Art*	Kennzeichnung der Veröffentlichung[11], soweit erforderlich unter Angabe der maßgeblichen Teile[12]	Betr. Anspruch Nr.[13]
Y	DE, A, 3407927 (KRINNINGER) 5. September 1985, siehe Zusammenfassung; Ansprüche 1-3,6,11; Seite 13, Zeilen 16-28; Seite 14, Zeilen 29-31; Seiten 18,19; Figur 1 (in der Anmeldung erwähnt) --	1,2,5-7, 14,26, 28,32
Y	M. Bäckström et al.: "Kältetechnik", 3. umgearbeitete und erweiterte Auflage, herausgegeben 1965 von Verlag G. Braun (Karslruhe, DE) Seite 343, siehe Tabelle 9.08a "Kupfer, "Aluminium", "Beton", "Granit" und "Bitumen" --	1,2,5-7, 14,26,28, 32
A	US, A, 2584573 (GAY) 31. Januar 1950, siehe Spalte 3, Zeilen 22-36; Figuren 1,3 --	3,9-11, 13,17
A	US, A, 4117305 (COLTEN) 26. September 1978, siehe Zusammenfassung; Figur 1 --	4
A	F. Weber: "Messen, Regeln und Steuern in der Lüftungs - und Klimatechnik",	12

* Besondere Kategorien von angegebenen Veröffentlichungen[10]:

"A" Veröffentlichung, die den allgemeinen Stand der Technik definiert, aber nicht als besonders bedeutsam anzusehen ist

"E" älteres Dokument, das jedoch erst am oder nach dem internationalen Anmeldedatum veröffentlicht worden ist

"L" Veröffentlichung, die geeignet ist, einen Prioritätsanspruch zweifelhaft erscheinen zu lassen, oder durch die das Veröffentlichungsdatum einer anderen im Recherchenbericht genannten Veröffentlichung belegt werden soll oder die aus einem anderen besonderen Grund angegeben ist (wie ausgeführt)

"O" Veröffentlichung, die sich auf eine mündliche Offenbarung, eine Benutzung, eine Ausstellung oder andere Maßnahmen bezieht

"P" Veröffentlichung, die vor dem internationalen Anmeldedatum, aber nach dem beanspruchten Prioritätsdatum veröffentlicht worden ist

"T" Spätere Veröffentlichung, die nach dem internationalen Anmeldedatum oder dem Prioritätsdatum veröffentlicht worden ist und mit der Anmeldung nicht kollidiert, sondern nur zum Verständnis des der Erfindung zugrundeliegenden Prinzips oder der ihr zugrundeliegenden Theorie angegeben ist

"X" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung kann nicht als neu oder auf erfinderischer Tätigkeit beruhend betrachtet werden

"Y" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung kann nicht als auf erfinderischer Tätigkeit beruhend betrachtet werden, wenn die Veröffentlichung mit einer oder mehreren anderen Veröffentlichungen dieser Kategorie in Verbindung gebracht wird und diese Verbindung für einen Fachmann naheliegend ist

"&" Veröffentlichung, die Mitglied derselben Patentfamilie ist

IV. BESCHEINIGUNG

Datum des Abschlusses der internationalen Recherche	Absendedatum des internationalen Recherchenberichts
7. Juni 1988	07 JUL 1988
Internationale Recherchenbehörde	Unterschrift des bevollmächtigten Bediensteten
Europäisches Patentamt	P.C.G. VAN DER PUTTEN

III. EINSCHLÄGIGE VERÖFFENTLICHUNGEN (Fortsetzung von Blatt 2)

Art *	Kennzeichnung der Veröffentlichung, soweit erforderlich unter Angabe der maßgeblichen Teile	Betr. Anspruch Nr.
	herausgegeben 1965 von VDI-Verlag (Düsseldorf, DE) seite 18, siehe Zeilen 6 bis 12 --	
A	DE, A, 2825684 (A. SEEGER) 20. Dezember 1979, siehe Seite 7, Zeile 23 - Seite 8, Zeile 6; Figur 1 --	3,15,16,23
A	CH, A, 656451 (STEINER SILIDUR) 30. Juni 1986, siehe Zusammenfassung, Figuren 1-4 --	18,34
A	FR, A, 2310539 (SVENSKA FLÄKTFABRIKEN) 3. Dezember 1976, siehe Figuren 1,4 --	20
A	FR, A, 2479957 (LAMARQUE) 9. Oktober 1981, siehe Seite 4, Zeilen 9-11; Figur 1 --	25
A	DE, A, 2840389 (FELDKAMP GEB. MÖHLENKAMP) 27. März 1980, siehe Seite 9, Zeile 22 - Seite 10, Zeile 3; Seite 12, Zeile 18 - Seite 13, Zeile 3; Figur 3 --	36
A	FR, A, 2270442 (TECHNIP) 5. Dezember 1975, siehe Ansprüche 1,3; Figuren 1,2 --	37
A	WO, A, 81/00445 (ALOSI) 19. Februar 1981, siehe Zusammenfassung; Figur 1 --	38,39
E	CH, A, 661340 (SCHÄRER) 15. Juli 1987 (in der Anmeldung erwähnt) --	
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In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentdokumente angegeben.
Die Angaben über die Familienmitglieder entsprechen dem Stand der Datei des Europäischen Patentamts am 24/06/88
Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

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