

**(12) PATENT**  
**(19) AUSTRALIAN PATENT OFFICE**

**(11)** Application No. **AU 199653997 B2**  
**(10)** Patent No. **700292**

(54) Title  
Housing structure for electrical and/or electronic devices for outdoor installation

(51)<sup>6</sup> International Patent Classification(s)  
**H05K** 007/20

(21) Application No: 199653997 (22) Application Date: 1996 .04 .15

(87) WIPO No: W096/34519

(30) Priority Data

| (31) Number | (32) Date    | (33) Country |
|-------------|--------------|--------------|
| 19515121    | 1995 .04 .25 | DE           |

(43) Publication Date : 1996 .11 .18

(43) Publication Journal Date : 1997 .01 .09

(44) Accepted Journal Date : 1998 .12 .24

(71) Applicant(s)  
Rittal-Werk Rudolf Loh GmbH Co. KG

(72) Inventor(s)  
Wolf Kurt W.

(74) Agent/Attorney  
GRIFFITH HACK

(56) Related Art  
FR 1085779

OPI DATE 18/11/96 APPLN. ID 53997/96  
AOJP DATE 09/01/97 PCT NUMBER PCT/EP96/01574



AU9653997

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                                                                                                                   |                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| <b>(51) Internationale Patentklassifikation <sup>6</sup> :</b><br><b>H05K 7/20</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | <b>A1</b>                                                                                                                                         | <b>(11) Internationale Veröffentlichungsnummer: WO 96/34519</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | <b>(43) Internationales Veröffentlichungsdatum:</b>                                                                                               | 31. Oktober 1996 (31.10.96)                                     |
| <b>(21) Internationales Aktenzeichen:</b> PCT/EP96/01574<br><b>(22) Internationales Anmeldedatum:</b> 15. April 1996 (15.04.96)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | <b>(81) Bestimmungsstaaten:</b> AU, CA, JP, RU, TR, US, europäisches Patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). |                                                                 |
| <b>(30) Prioritätsdaten:</b><br>195 15 121.6      25. April 1995 (25.04.95)      DE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  | <b>Veröffentlicht</b><br><i>Mit internationalem Recherchenbericht.</i>                                                                            |                                                                 |
| <b>(71) Anmelder (für alle Bestimmungsstaaten ausser US):</b> RITTAL-WERK RUDOLF LOH GMBH & CO. KG [DE/DE]; Auf dem Stützelberg, D-35745 Herborn (DE).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                                                                                                                                   |                                                                 |
| <b>(72) Erfinder; und</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |                                                                                                                                                   |                                                                 |
| <b>(75) Erfinder/Anmelder (nur für US):</b> WOLF, Kurt, W. [DE/DE]; Peter-Liebig-Weg 40, D-75323 Bad Wildbad (DE).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                                                                                   |                                                                 |
| <b>(74) Anwalt:</b> FLECK, Hermann-Josef, Markgröninger Strasse 47/1, D-71701 Schwieberdingen (DE).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |                                                                                                                                                   |                                                                 |
| <b>(54) Title:</b> HOUSING STRUCTURE FOR ELECTRICAL AND/OR ELECTRONIC DEVICES FOR OUTDOOR INSTALLATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                                                                                                                                   |                                                                 |
| <b>(54) Bezeichnung:</b> GEHÄUSEAUFBAU FÜR IM FREIEN AUFSTELLBARE, ELEKTRISCHE UND/ODER ELEKTRONISCHE GERÄTE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                                                                                                                                                   |                                                                 |
| <b>(57) Abstract</b><br><p>The invention relates to a housing structure for electrical and/or electronic devices for outdoor installation. Resistance to extreme weather conditions is achieved by the invention in that the electrical and/or electronic components of the device are fitted in a dust and sprayproof inner cubicle (IP66), itself fitted inside a sprayproof outer cubicle (IP44), with a space between all their faces, there is an air heat exchanger in the inner cubicle, to the input circuit of which the heated air generated in the inner cubicle can be fed via circulating fans and the output circuit of which is connected to the inner chamber of the outer cubicle, and, for the purposes of cooling the inner cubicle, a controlled cooling stream of air passes through the outer cubicle, a part of which passes the output circuit of the air heat exchanger.</p>                                                                  |  |                                                                                                                                                   |                                                                 |
| <b>(57) Zusammenfassung</b><br><p>Die Erfindung betrifft einen Gehäuseaufbau für im Freien aufstellbare elektrische und/oder elektronische Geräte. Eine Verwendung bei extremen Witterungsbedingungen wird nach der Erfindung dadurch erreicht, daß die elektrischen und/oder elektronischen Bauteile des Gerätes in einem staub- und spritzwasserdicht verschließbaren Innenschrank (IP66) untergebracht sind, das vorzugsweise allseitig beabstandet in einen spritzwasserdicht verschließbaren Außenschrank (IP44) eingebaut ist, daß im Innenschrank ein Luftwärmetauscher eingesetzt ist, dessen Eingangskreis über Umwälz-Ventilatoren die im Innenschrank auftretende Warmluft zuführbar ist und dessen Ausgangskreis mit dem Innenraum des Außenschrankes gekoppelt ist, und daß der Außenschrank zur Kühlung des Innenschrankes von einem gesteuerten Kühl-Luftstrom durchströmt ist, von dem ein Teil den Ausgangskreis des Luftwärmetauschers passiert.</p> |  |                                                                                                                                                   |                                                                 |

The invention concerns a housing structure for electrical and/or electronic equipment for outdoor installation.

In the case of electrical and/or electronic equipment which is to be installed outdoors it is important to consider the atmospheric conditions, like maximum temperature, sand storms, rain or sun radiation and the like. one needs to point out only the use of TV transmitters and TV receivers in desert-like regions, where high ambient temperatures may arise, while the operation of the equipment has to be ensured. since power semiconductors are often used, their cooling and the operational reliability connected with it is a basic criterion for the operational reliability of the equipment.

It is therefore desirable to produce a housing structure for electrical and/or electronic equipment for outdoor installation which can be used under extreme environmental conditions as far as temperature and protection against dust and water are concerned.

SUMMARY OF THE INVENTION

The present invention provides a housing structure for electrical and/or electronic components wherein the electrical and/or electrical components are accommodated in a dustproof and spraywater-proof lockable inner cubicle, which is installed in a spraywater-proof lockable outer cubicle preferably in such a manner that the inner and outer containers are separated, an air heat exchanger being installed in the inner cubicle, to the input of which the warm air occurring in the inner cubicle is supplied via circulation fans and the output of which is connected with an inner chamber of the outer cubicle, and for the purpose of cooling of the inner cubicle, a directed cool air stream passes through the outer cubicle, part of which stream passes the output of the air heat exchanger.

By this construction the electrical and/or electronic components are accommodated in a dustproof and spraywater-proof manner, wherein the heat generated in the inner cubicle is removed from the inner cubicle via the air

S: 16384AM/704

heat exchanger as a result of internal circulation of the inner cubicle and it reaches the atmosphere via the directed cool air stream of the outer cubicle. The dust contained in the cool air stream does not reach the inner  
5 cubicle, as it is enclosed in a dustproof and spraywater-proof manner, and the output of the air heat exchanger is delimited from the interior of the inner cubicle in a dustproof manner.

10 As inner cubicle and the outer cubicle are dustproofed and spraywater-proofed, and spraywater-proofed respectively, wherein corresponding switch cabinets can have co-ordinated dimensions.

15 According to one preferred embodiment the air heat exchanger is constructed as a bundle of tubes, wherein the inlets and outlets of the tubes are aligned or can be aligned with corresponding openings in the bottom and top lateral walls of the inner cubicle. The external surface of the tubes in the bundle of tubes forms the inlet side of the air heat exchanger, which can be very large if several  
20 thin-walled tubes are used in the bundle. The internal cross-section enclosed by the tubes form the outlet of the air heat exchanger, which is clearly delimited from the inlet circuit.

25 According to a further preferred embodiment the air heat exchanger is inserted into the inner cubicle as a separate unit. Such an air heat exchanger can be manufactured as a separate unit and inserted into the inner cubicle as required.

30 According to a further preferred embodiment, the action of the air heat exchanger in the inner cubicle can be improved by use of first and second circulation fans, the hot air of the inner cubicle being conveyed to that region of the air heat exchanger which is facing a bottom lateral wall by means of the first circulation fan and by means of  
35 the second circulation fan the air can be sucked out from the air heat exchanger from that region which faces a top lateral wall of the inner cubicle, while for the purpose of

S: 16384AM/704

circulation the bottom and top regions of the air heat exchanger are separated by a separating plate.

The manufacture and the use of circulation fans may be simplified by fastening of the circulation fans onto a carrier plate which can be inserted into the inner cubicle parallel to the air heat exchanger.

For a better utilisation of the cooling effect of the heat sinks or the like provision may be made that when electronic components are mounted on heat sinks or the like, the heat sinks are fastened on the outside of the lateral walls of the inner cubicle and communicate with the interior of the inner cubicle via cut-outs. The mounting surface of the heat sinks or the like for mounting of the electronic components remains accessible in the inner cubicle. Such an arrangement enables heat from the electronic components to reach, via the heat sink or the like, the cooled intermediate space between the outer and inner cubicles to as full an extent as possible. The electronic components which in the interior of the inner cubicle are in contact with the heat sinks or the like may be covered with a heat-insulating cover towards the interior of the inner cubicle. This should enable the heat radiation in the interior of the inner cubicle to be strongly reduced, if not fully prevented. The air is expelled from the inner cubicle via the air heat exchanger and the internal circulation.

In order to stabilise the temperature in the inner cubicle at the lowest possible temperature the external and internal surfaces of the inner cubicle may be provided with a lagging or coating having good heat emitting properties, e.g. are painted black.

The cool air stream may be produced by a cooling air fan mounted on a bottom lateral wall of the outer cubicle in a dustproof and spraywater-proof manner, which fan sucks in the air from the atmosphere and conveys it to the interior of the outer cubicle, and that the heated up cool

S: 16384AM/704

air stream exits from the outer cubicle through outlet openings in a top lateral wall.

So that the suction opening of the cooling air fan is not obstructed by leaves and the like, the direction of rotation of the cooling air fan, as a function of time or temperature, can be reversed for a short period reversing the air stream through the outer cubicle (reverse operation).

By reversing the air stream the inlet of the cooling fan can be blown free and the dust which reached the intermediate space between the outer cubicle and the inner cubicle can be expelled and returned to the atmosphere.

To improve the spraywater-proofing a roof structure can be provided on the outer cubicle, which partially overlaps the lateral walls, the rear wall and the door of the cubicle.

There is preferably sufficient separation between the the roof structure and the door to enable opening of the door.

The rear wall of the outer cubicle may have fastening elements protruding into its own interior and the rear wall of the inner cubicle may have corresponding fastening fixtures for installation of the inner and outer cubicle, while the fastening elements and the fastening fixtures assure dustproof and spraywater-proof joints.

The electrical connecting cables for the equipment installed in the inner cubicle may be guided through the inner cubicle by means of cable conduits in a dustproof and spraywater-proof manner.

#### 30 BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig.1 shows a front view of the inner cubicle with installed electrical and/or electronic components, with the cubicle door open,

S: 16384AM/704

Fig.2 is a perspective view of an embodiment for an air heat exchanger which can be installed as a separate unit and

Fig.3 shows a front view, with the cubicle door open, of the outer cubicle for the inner cubicle according to Fig.1 to be installed and

Fig.4 shows a front view of the housing structure, comprising the inner cubicle and the outer cubicle with the inner cubicle fitted and closed and the outer cubicle open.

10 BEST MODE FOR CARRYING OUT THE INVENTION

As Fig.1 shows, the electrical and/or electronic components 21, 22 and 23 are installed in a dustproof and spraywater-proof (IP66) lockable switch cabinet, used as an inner cubicle 10. Thus 21 may be designed as a TV transmitter or TV receiver device having heat-generating semi-conductors, while the components 22 and 23 may be power units. These components are fastened on the lateral walls 11 and 12 of the inner cubicle 10. These lateral walls 11 and 12 have cut-outs 17, in which the heat sinks 20 and 28 are fastened on the outside, so that their mounting surfaces for the semi-conductors to be cooled are accessible from the interior of the inner cubicle 10. So that the heat occurring in the components 21, 22 and 23 would be radiated as fully as possible to the heat sinks 20 and 28, the components 21, 22 and 23 are heat insulated towards the interior of the inner cubicle 10.

To dissipate the heat occurring in the interior of the inner cubicle 10, be it due to heating up from the outside or the residual heat of the installed components, a circulation is produced in the interior of the inner cubicle 10 by virtue of the circulation fans 25 and 26 and an air heat exchanger 30. The first circulation fan 25 sucks the air in and conveys it to that region of the air heat exchanger 30 which is adjacent to

the bottom lateral wall 13, whereas the second circulation fan 26 in the upper region of the air heat exchanger 30, which is facing the upper lateral wall 14 of the inner cubicle 10, expels the air through the heat exchanger and returns it to the interior.

As Fig.2 shows, as a heat exchanger 30 a bundle of tubes can be used, wherein the ends of the tubes 31 are fastened in holding plates 32 and 33 and the bottom and top region of the tubes 31 are divided by a separating plate 24. These tubes 31 have a thin wall and with their external surfaces form on the entry side a large area as the inlet, while the internal surfaces of the tubes 31 form the outlet with an equally large area. This outlet circuit is delimited from the inlet circuit in a dustproof manner.

If the air heat exchanger 30 is constructed and manufactured as a separate unit, then it can be positioned in the inner cubicle 10, while the inlet and outlet openings of the tubes 31 are aligned with the corresponding openings 18 and 19 in the bottom and top lateral wall 19 of the inner cubicle 10.

The circulation fans 25 and 26 are fastened on a carrier plate 24 and are positioned in the inner cubicle 10 parallel to the tubes 31 of the air heat exchanger 30. The lateral walls 13 and 14 carry on their internal sides corresponding mountings and guides to fasten the carrier plate 24 and the mounting plates 32 and 33 of the air heat exchanger 30. A separating plate 27 on the carrier plate 24 forms with the separating plate 34 of the air heat exchanger 30 a barrier for both streams of the circulated air in the region of the circulation fans 25 and 26 too.

As this will be shown later, cool air is conveyed through the tubes 31 of the air heat exchanger 30.

The inner cubicle 10 according to Fig.1 is built into a spraywater-proof outer cubicle 40 (IP44) according to Fig.3.

This outer cubicle 40 has fastening elements 46 on the rear wall 45, while the rear wall 15 of the inner cubicle 10 is provided with correspondingly distributed and matched fastening fixtures for these fastening elements 46. The connections are dustproof and spraywater-proof and are constructed in such a manner that all lateral walls 11, 12, 13 and 14, the rear wall 15 and the cubicle door 16 are at a distance to the facing lateral walls 41, 43, 48 and 49, the rear wall 45 and the cubicle door 47 of the outer cubicle 40. A powerful cooling air fan 42 is mounted in a dustproof and spraywater-proof manner (IP66) in the bottom lateral wall 41 of the outer cubicle 40, which sucks in the air from the outside and conveys it to the interior of the outer cubicle 40. Outlet openings 44 are provided for the cool air stream in the top lateral wall 43 of the outer cubicle 40.

As this can be seen from Fig.4, the directed cool air stream passes through from below to above along all sides of the inner cubicle installed in the outer cubicle 40, while a proportion passes through the tubes 31 of the air heat exchanger 30 and thus takes care of the removal of the heat from the interior of the inner cubicle 10. The cool air stream is conveyed also through the heat sinks 20 and 28 fastened on the outside of the inner cubicle 10 and accordingly improves their cooling effect due to the good heat removal.

The connecting cables 51, 54 and 55 are introduced into the inner cubicle 10 through dustproof and spraywater-proof cable conduits 53 and they exit in the same manner. At the same time the connecting cable 55 can serve as an antenna lead-in wire. The cable conduits 52 in the outer cubicle 40 need to have protection against sprayed water only.

On the outer cubicle 40 a cover structure 50 is fastened, which partially overlaps the lateral walls 48 and 49, the rear wall 45 and the cubicle door 47 at a distance and thus clearly assures a protection against rain for the upper horizontal edges of the outer cubicle 40.

The inlet side of the cooling air fan 42 is covered with a protective screen, which prevents the access by larger foreign bodies, like leaves and the like. To prevent an unintentional blocking of the protective screen, at certain time intervals or  
5 when the temperature rises in the interior of the inner and/or outer cubicle, the direction of rotation of the cooling air fans 42 is reversed for a short period, so that the air stream reverses its direction. In this manner the protective screen of the cooling air fan 42 is blown clear and the dust, which would  
10 have reached the outer cubicle 40, is expelled and returned to the atmosphere.

The outer cubicle 40 prevents a heating up of the inner cubicle 10 by the sun's radiation.

15 The cooling air fan 42 mounted on the bottom 41 of the outer cubicle 40 is preferably switched on continuously, so that its bearings cannot seize.

20 If the housing structure is used in areas where cold temperatures may be prevalent, then a heating device is installed in the inner cubicle. When reaching a certain minus temperature, this heating device is switched on and after heating up to a predetermined higher temperature, it is  
25 switched off again.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A housing structure for electrical and/or electronic equipment for outdoor installation, wherein the electrical and/or electronic components of the equipment are accommodated in a dustproof and spraywater-proof lockable inner cubicle, which is installed in a spraywater-proof lockable outer cubicle, an air heat exchanger being installed in the inner cubicle, to the input of which the warm air occurring in the inner cubicle is supplied via circulation fans and the output of which is connected with an inner chamber of the outer cubicle, and for the purpose of cooling of the inner cubicle, a directed cool air stream passes through the outer cubicle, part of which stream passes the output of the air heat exchanger.
2. A housing structure as claimed in claim 1, wherein the air heat exchanger is constructed as a bundle of tubes, the inlets and outlets of the tubes being aligned with corresponding openings in bottom and top lateral walls of the inner cubicle.
3. A housing structure as claimed in claim 1 or claim 2, wherein the air heat exchanger is a separate unit in the inner cubicle.
4. A housing structure as claimed in claim 2 or claim 3, wherein the hot air of the inner cubicle is conveyed to that region of the air heat exchanger which is facing the bottom lateral wall by means of a first circulation fan and by means of a second circulation fan the air is sucked out from the air heat exchanger from that region which faces the top lateral wall of the inner cubicle.
5. A housing structure as claimed in claim 4, wherein the bottom and top regions of the air heat exchanger are separated by a separating plate.
6. A housing structure as claimed in claim 4 or claim 5, wherein the circulation fans are fastened on a carrier plate which can be inserted into the inner cubicle parallel to a longitudinal axis of the air heat exchanger.
7. A housing structure as claimed in any one of the preceding claims, wherein when electronic components are

S: 16384AM/704

mounted on heat sinks or the like, the heat sinks are fastened on the outside of the lateral walls of the inner cubicle and communicate with the interior of the inner cubicle via cut-outs.

5        8. A housing structure as claimed in claim 7, wherein the electronic components which in the interior of the inner cubicle are in contact with the heat sinks or the like are covered with a heatinsulating cover towards the interior of the inner cubicle.

10       9. A housing structure as claimed in any one of the preceding claims wherein the external and internal surfaces of the inner cubicle are provided with a lagging or coating having good heat emitting properties.

15       10. A housing structure as claimed in claim 9 wherein the lagging or coating includes black paint.

20       11. A housing structure as claimed in any one of the preceding claims, wherein the cool air stream is produced by a cooling air fan mounted on a bottom lateral wall of the outer cubicle in a dustproof and spraywater-proof manner, which fan sucks in the air from the atmosphere and conveys it to the interior of the outer cubicle, and the heated up cool air stream exits from the outer cubicle through outlet openings in a top lateral wall.

25       12. A housing structure as claimed in claim 11, wherein the direction of rotation of the cooling air fan, as a function of time or temperature, can be reversed for a short period reversing the air stream through the outer cubicle.

30       13. A housing structure as claimed in any one of the preceding claims, wherein a roof structure is provided on the outer cubicle, which partially overlaps the lateral walls, a rear wall and door of the cubicle.

35       14. A housing structure as claimed in claim 13 wherein separation between the roof structure and the door is sufficient to enable opening of the door.

15. A housing structure as claimed in any one of the preceding claims, wherein the rear wall of the outer cubicle has fastening elements protruding into its own

S: 16384AM/704

interior and the rear wall of the inner cubicle has fastening fixtures matching the fastening elements, while the fastening elements and the fastening fixtures assure dustproof and spraywater-proof joints.

5        16. A housing structure as claimed in any one of the preceding claims, wherein the connecting cables for the equipment installed in the inner cubicle are guided through the inner cubicle by means of cable conduits in a dustproof and spraywater-proof manner.

10       17. A housing structure as claimed in any one of the preceding claims, wherein in the inner cubicle a heating device is installed, which, when reaching a certain minus temperature can be switched on and when a predetermined temperature increase is achieved, can be switched off.

15       18. A housing structure as claimed in any one of the preceding claims, wherein the cooling air fan is switched on continuously or is operated in the switch-on phases with full rotational speed.

20       19. A housing structure for electrical and/or electronic equipment for outdoor installation as herein described with reference to the accompanying drawings.

Dated this 27th day of October 1998

RITTAL-WERK Rudolf Loh GmbH & Co. KG

By their Patent Attorney

25       GRIFFITH HACK

S: 16384AM/704

1/4

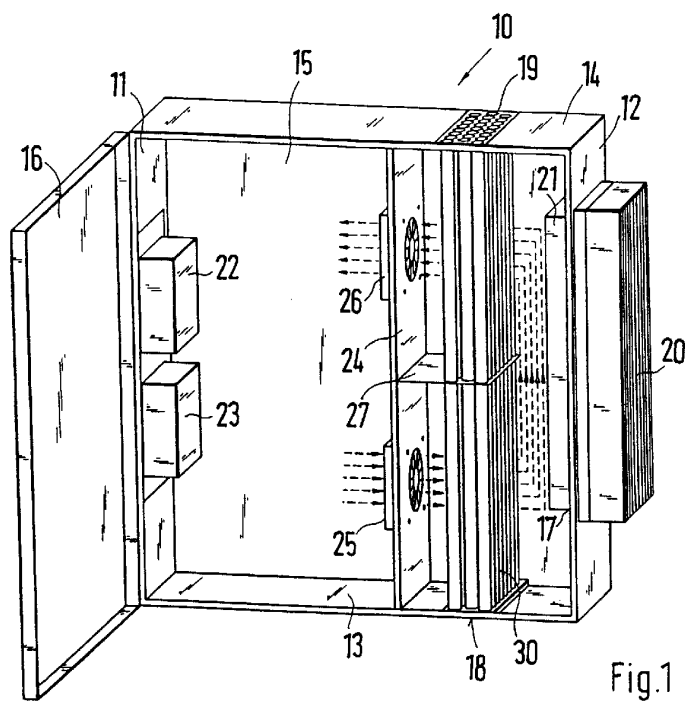
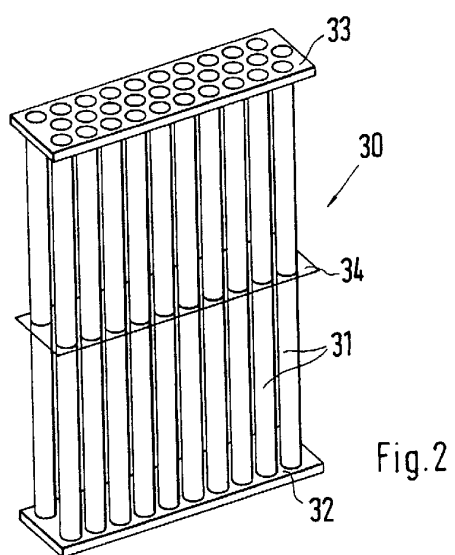


Fig.1

2/4



3/4

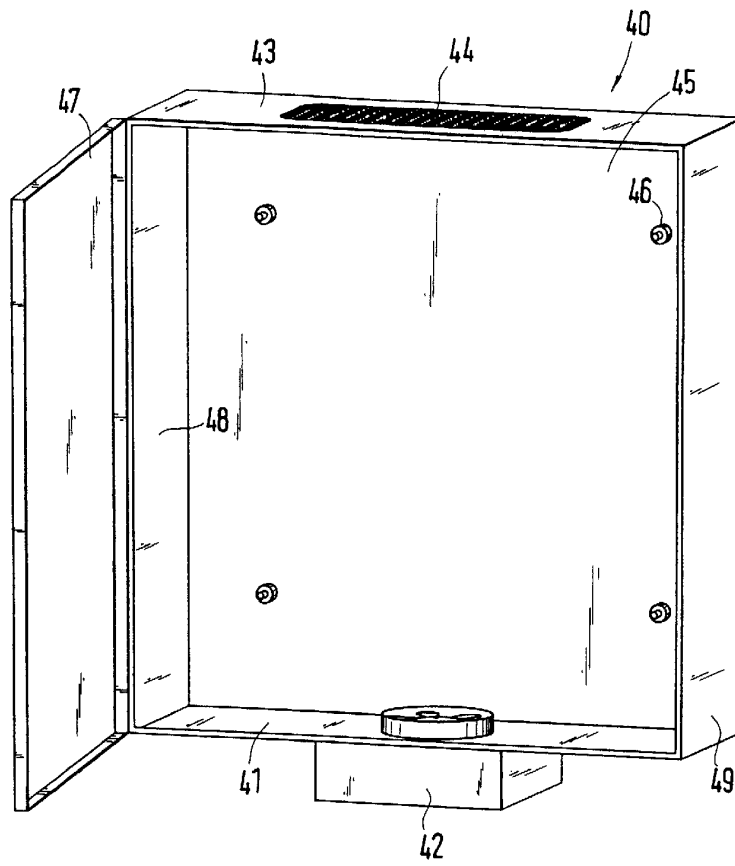


Fig.3

