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(54) SMOKE CONTROL DAMPER AND ITS SEALING

(57) The object of the invention is a smoke control damper incorporating a damper housing (body) made of permanently interconnected sections (1,2,3,4), and shut-off blades (9,10) of the damper, constituted by moving blades (10) and an external blade (9), the blades made of fire protection board, the damper incorporating a sealing of the blades, comprising a intumescent gasket (38) and an insulating gasket (27, 37) which are installed in grooves made along one longer edge of the moving blades (10) and a sealing installed on the body on each of the four sides, comprising an insulating gasket (27).

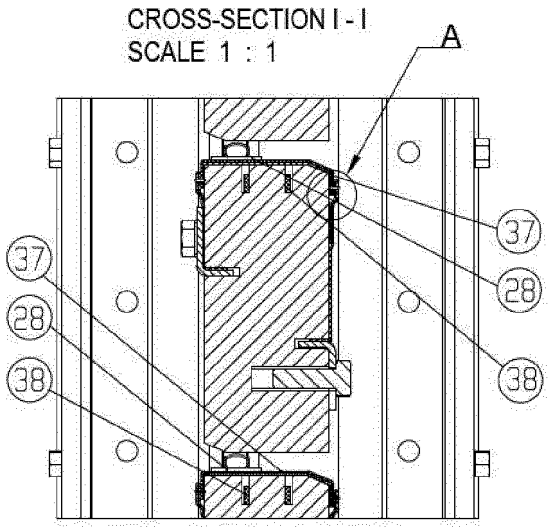

Fig. 4

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Description

[0001] The object of the invention is the sealing of a smoke control damper which is a multi-blade damper used in smoke control systems.

[0002] Various types of smoke control dampers for the above applications are known, including ones with moving blades installed, among other places, in walls or on smoke control system ducts for closing the vents. These dampers prevent fire and smoke from passing from rooms on fire to other rooms or to smoke control system ducts - in case they are closed during fire or let smoke and gases be removed from rooms on fire if they are open during fire. Actuation of dampers is performed using a drive mechanism controlled remotely with an electric signal.

[0003] These dampers should have definite fire resistance and smoke leakage class, which makes it possible to maintain the fire resistance of a wall or smoke control system ducts. These parameters are marked respectively EIS tt, where E -integrity, I-insulation, S - smoke leakage, tt - period during which all these parameters are maintained. In order to achieve E and I parameters, fireproof materials are used for construction of dampers. In order to achieve smoke leakage, rubber or silicone sealings are used, as well as intumescent sealings, which ensure the integrity of structure during fire, when normal sealings lose their properties.

[0004] The essential parameters of this damper type are defined in the harmonized product standard entitled: Smoke and heat control systems. Smoke control dampers EN 12101-8:2011. Classification of the mentioned dampers is according to the following pattern:

E	I		t	t		(	**v_{ed}	-	**h_{od}	-	i	***	o	)		S	*	****C_{yy}	HOT 400/30	AA lub MA	multi

[0005] The classes are expressed as follows:

- EI tt (...) tt expresses the classification time during which the criteria of integrity and fire insulation are satisfied;
- E tt (...) tt expresses the classification time during which the criterion of integrity is satisfied;
- EI tt (...) S tt expresses the classification time during which the criteria of integrity, insulation, and smoke leakage are satisfied;
- E tt (...) S tt expresses the classification time during which the criteria of integrity and smoke leakage are satisfied.

[0006] All times should be declared in minutes, using one of the times: 15, 20, 30, 45, 60, 90, 120, 180 or 240.

[0007] Resistance class is determined as follows:

- E - Integrity Integrity shall be assessed during the test, as the time during which the leakages through the smoke control damper after 5 minutes from starting the test exceed 360 m3/(m2h), cracks or openings exceed the specified dimensions, cotton pad ignites and flame is maintained on the unheated side around the dumper on the joint with the wall or ceiling. Ignition of the cotton pad should not be taken into consideration in the case of smoke control dampers classified exclusively in class E.
- I-Insulation

[0008] The performance level used to define insulation shall be the mean temperature rise on the unexposed face, limited to 140 °C above the initial mean temperature, with the maximum temperature rise at any point limited to 180 °C above the initial mean temperature.

- S-Smoke leakage

[0009] For dampers for which the S class is relevant the leakage through the fire damper shall not exceed 200 $m^3/(m^2 \cdot h)$, corrected to 20 °C at ambient temperature prior to the fire test, and shall not exceed 200 $m^3/(m^2 \cdot h)$ corrected to 20 °C after the first 5 minutes of the fire test.

[0010] The classification should indicate whether the performance criteria are satisfied with fire impact on one side only or on both sides, and whether satisfying the performance criteria refers to horizontal or vertical position or to both positions. Additional symbols "i→o", "o→i" or "i↔o" should be used accordingly with "v_e" and/or "h_o" in order to indicate position:

- v_e - vertical - means damper installation in a wall,
- h_o - horizontal - means the possibility of damper installation in a ceiling,

- "v_{ed}", "v_{ew}" or "v_{edw}" and/or "h_{od}", "h_{ow}" or "h_{odw}" means suitability for application in horizontal and/or vertical position, together with installation in a ventilation conduit or in a wall or in both variants, respectively.
- The marking "i→o", "o→i" or "i↔o" indicates that the performance criteria are satisfied from the inside to the outside (fire from the inside), from the outside to the inside (fire from the outside), or in both situations, respectively,
- "500", "1,000" or "1,500" means that in case the damper has been subjected to the test with these negative pressure values, it is suitable for application in the scope from the test negative pressure value to the positive pressure of 500 Pa,
- "C_{300}", "C_{10000}" or "C_{mod}" means that the damper is suitable for application exclusively in smoke control systems, in mixed smoke control and general ventilation systems, and as a regulated damper in mixed smoke control and general ventilation systems, respectively. This means that the number of opening / closing cycles performed by the damper before the fire test is 300, 10200 and 20000, respectively,
- "HOT 400/30" (High Operational Temperature) means that the smoke control damper is capable of opening and closing for the period of 30 minutes in the conditions of temperature below 400°C,
- "AA" or "MA" means automatic actuation or manual intervention, and in the case of manual intervention (MA), which means the ability of the closed damper to open blades within 25 minutes from the start of a standard fire, which means in practice the ability to open blades when gases and smokes on the heated side have the temperature of approximately 815°C,
- The classification is supplemented with the suffix "multi" in order to indicate the suitability for multi-zone application.

[0011] A fire damper is known from the description of the European patent application EP2366435. A damper according to this invention incorporates a body comprising a steel frame and blades of fire protection material comprising gaskets. The damper is characterized in that in each blade there are two rotary axles mounted in two bearings located on opposite vertical sides of the body, and blades are connected with one another using a tie rod through sheet metal with opening, making it possible to transmit the drive between individual blades, and a spring is mounted to a spring bracket on one side and to a blade on the other side.

[0012] A smoke control fire damper is known from the American patent description US 6019679. The smoke control fire damper comprises a spring actuator rotating the blades (lamellas) between the "open" position and the "closed" position, when there is a condition of fire or smoke. The damper can incorporate one or more blades, opened and closed using a linkage connector in order to ensure simultaneous operation of them both. Flat coil springs remain under the tension of a realizer (such as a fusible one) and keep the blades in the "open" position. After a spring is released, a rotating system placed between the spring and the blades moves the blades to the closed position, thus blocking the flow of smoke and fire. The blades can have seals in order to ensure tightness.

[0013] The multi-plane damper by AEROPRODUKT ZRT company, of type BRK-J/EI90/M/HOT, is known on the basis of the information revealed on the web pagehttp://aeroprodukt.hu/product-details/bsk-jei90gmhot/. The sealings applied in this damper do not permit achieving the fire resistance as in the case of the damper known from the patent EP3061503. This damper has only been classified in the class S1000, which means in practice that this damper must not be used in systems of negative pressure greater than 1000 Pa and it guarantees smoke control in the conditions of fire at the pressure difference of 300 Pa - the fire resistance evaluation is performed at this pressure difference, and its duration is limited to 90 minutes, i.e.: EI 90 (v_{edw}-h_{odw}-i↔o) S1000 C_{10000} HOT400/30AAmulti. The sealings applied in this damper have a characteristic way of swelling - with increasing temperature they create short and soft "fibres" which do not restrict the operation of blades for a period of at least 30 minutes, when the temperature is equal or less than 400°C. However, such sealing has low resistance to high pressure differences, which results in limiting the fire resistance to the class S1000 and time 90 - i.e. the fire resistance evaluation has been performed at the pressure difference of 300 Pa and during the time of 90 minutes.

[0014] The essence of the invention is a smoke control damper consisting of a damper housing and permanently interconnected sections, and a shut-off blades of the damper, constituted by moving blades and an external blades, made of fire protection board, characterized in that it comprises a sealing of the moving blades, comprising a intumescent gasket and an insulating gasket, installed in grooves made along one longer edge of the blades, except for the external blade, and a sealing installed on the body on each of the four sides, comprising an insulating gasket. Advantageously, the grooves are located beyond the axle of the blades. Advantageously, the insulating gasket consists of insulating fire protection materials and intumescent under the influence of temperature. Advantageously, the damper has a mounting for the insulating gasket with steel slats and aluminium rivets.

[0015] Another object of the invention is a smoke control damper consisting of a damper housing and permanently interconnected sections and a shut-off blades of the damper, constituted by moving blades and an external blade, made of fire protection board, characterized in that each of the blades comprises a sealing installed in grooves made along one longer edge and on each of the shorter sides, whereas the external blade comprises a sealing installed in grooves on each of the sides, where the sealing comprises a intumescent gasket and insulating gaskets.

[0016] Advantageously, the grooves are located beyond the axle of the blades.

[0017] Advantageously, the insulating gasket consists of insulating fire protection and intumescent materials. Advan-

tageously, the damper has a mounting for the insulating gasket with steel slats and aluminium rivets.

[0018] The solution of sealings of a multi-plane damper, being the object of this invention, permits to achieve fire resistance in the class S1500 for 120 minutes:

EI 120 (v_{edw}-h_{odw}-i↔o) S1500 C_{mod} HOT400/30AAmulti or
EI 120 (v_{edw}-h_{odw}-i↔o) S1500 C_{mod} MAmulti

[0019] A smoke control damper is known from the European patent description EP3061503, whose sealings in the case of a high temperature are intumescent and cause blocking of the blades, and as a result the damper cannot operate at the temperature of 400°C for 30 minutes - the damper cannot achieve the class HOT 400/30. For the same reason it is not possible to open a closed damper after subjecting it to a high temperature on the heated side (approximately 815°C), and thus it is not possible to open it after 25 minutes from starting the test, therefore the damper also cannot achieve the class MA.

[0020] The invention has been presented more closely in the following description and in the drawing where fig. 1 presents a front view of the damper with closed blades for the form of execution having the sealing installed on the body, fig. 1.1 presents a front view of the damper with closed blades having the sealing installed on the blades only, fig. 2 presents a side view of the smoke control damper, fig. 3 presents a front view of the damper with closed blades from the side opposite to fig. 1, fig. 4 presents the cross-section I-I, fig. 5 presents the cross-section K-K of the damper incorporating a sealing on the body, fig. 5.1 presents the cross-section K-K of the damper incorporating a sealing installed on the blades only, fig. 6 presents the cross-section J-J, fig. 7 presents the cross-section L-L of the damper incorporating a sealing on the body, fig. 7.1 presents the cross-section L-L of the damper incorporating a sealing installed on the blades only, fig. 8 presents the cross-section M-M, fig. 9 presents an enlarged view of element A, fig. 10 presents an enlarged view of element B, fig. 11 presents the insulating gasket 37, fig. 12 presents the insulating gasket 27, assembly H (used on vertical sections, includes holes for bearings, used on the housing on sections H), fig. 13 presents the insulating gasket 27, assembly L (used on sections L).

[0021] The elements comprised in the damper are analogous to the application EP3061503. It is a housing (body) of the damper, made of steel sheet and incorporating permanently interconnected sections 1, 2, 3, and 4 which can be reinforced in the corners with corner pieces 8. The shut-off blades of the damper are comprised by moving blades (guides) - one extreme (external) (9) and the remaining (10) made of fire protection board. The object of the invention is the sealing of a smoke control damper used in smoke control systems, i.e. the sealing between blades and the sealing between blades and the body, which is solved in such a way that the smoke control damper is capable of opening and closing for the period of 30 minutes in the conditions of temperature below 400°C - class "HOT 400/30" (High Operational Temperature) - making it possible for the position of the damper to be changed in these conditions by authorized persons and/or the possibility to open blades within 25 minutes from the start of a "standard" fire, when gases and smokes on the heated side have the temperature of approximately 815°C - class MA.

[0022] In one example of execution, two grooves 12 and 13 have been made in the upper part of blades, and the intumescent gaskets 38 under the influence of a high temperature, e.g. graphite ones, have been placed in them. The intumescent gaskets have been shielded with the composite insulating gasket 37 ensuring protection of the swelling gaskets 38 against heating and swelling too quickly.

[0023] In the advantageous example of execution shown in fig. 1 the external blade 9 is free of the sealing which comprises the intumescent gasket 38 and the insulating gasket 37 which are installed in the grooves 12 and 13. This external blade is sealed "on the bottom" with the preceding blade and "on the top" with the insulating gasket 27 placed on the body, consisting of fire protection insulating and intumescent materials.

[0024] In another advantageous example of execution shown in fig. 1.1 the body does not comprise the insulating gasket 27, it is only present on the blades, i.e. the blade 10 comprises the intumescent gasket 38 and the insulating gasket 37 and the insulating gasket 37' which are installed in the grooves 12 and 13 made along one longer edge and along both shorter sides, whereas the external blade 9 comprises sealing on each of the sides.

[0025] In an advantageous example of execution, the composite insulating gaskets 37 consist of layers of metalized glass fabric 37A - one, two or more (depending on the available basis weight and weave) interconnected, advantageously using seams with the fireproof thread 37C - advantageously resistant to the temperature of 400°C, possibly with additional insulating layer e.g. of ceramic paper 37B.

[0026] Due to the above protection of the intumescent gaskets 38, the blades can move at the temperature of 400°C for at least 30 minutes. In the case of further growth of temperature above 400°C the thermally activated intumescent gaskets 38 are swelling, and thus, in case blades are in the closed position, sealing of the closed blades occurs and it is possible to achieve the required fire resistance expressed with class EI 120 (v_{ew}-h_{ow}-i↔o) S1500C_{mod}HOT400/30 AAmulti.

[0027] A sealing according to the invention makes it also possible to open a damper after 25 minutes from the start of testing according to the standard EN 12101-8:2011, which means that it is possible to open the damper when gases

and smokes on the heated side have the temperature of approximately 815°C. This ability makes it possible to achieve the fire resistance expressed with class EI 120 (v_{ew}-h_{ow}-i↔o) S1500C_{mod}HOT400/30 MAmulti.

[0028] Additionally, sealings in the form of the gasket with "O" section 28, empty inside, of plastic, e.g. silicone, are glued on the insulating gaskets 37 installed on blades, with the purpose to ensure tightness at low temperatures. In the closed position of blades, the edges of the gasket with "O" section 28 contact the "O" section of the gaskets with "O" section 28 glued on the side H of the damper, which ensures damper tightness in normal conditions.

[0029] The insulating gaskets 37 consist of 3 parts interconnected with e.g. a seam made using the fireproof thread 37C - advantageously resistant to the temperature of at least 400°C. Extreme parts of the gaskets 37 are constricted under the reinforcements of blades 11, which makes it possible to stretch the gaskets 37, limiting the possibility of increasing the volume of the gaskets for a certain period making it possible for blades to rotate despite the increased ambient temperature.

[0030] The body of a damper according to the invention has also been covered by gluing from the inside with the composite insulating gaskets 27, which have been made of layers of metalized glass fabric 27A, ceramic paper 27B, sewn with the fireproof thread 27C and the intumescent gasket e.g. graphite one 27D, with the gaskets with "O" profile 28 of plastic e.g. silicone also glued on them. Along the body, the gaskets 27 are additionally fastened using known means, for example the steel slats 34 and the aluminium rivets 39.

[0031] In the initial phase of temperature growth and for at least 30 minutes, when the ambient temperature is below 400°C, the steel slats 34 fastening the insulting gaskets 27 effectively restrict the swelling of the thermally activated gaskets 27D, which makes it possible to open and close blades for at least 30 minutes, if the ambient temperature is equal or less than 400°C (class HOT 400/30) and which makes it possible to open blades of a closed damper after 25 minutes from the start of a standard fire (class MA) even at the temperature of 820°C.

Claims

1. A smoke control damper consisting of a damper housing and the permanently interconnected sections (1), (2), (3), and (4) and a shut-off blades of the damper, constituted by the moving blades (10) and the external blade (9), made of fire protection board, **characterized in that** it comprises a sealing of the blades (10), comprising the intumescent gasket (38) and the insulating gasket (37), installed in the grooves (12) and (13) made along one longer edge of the blades (10), and a sealing installed on the body, on each of the four sides, comprising the insulating gasket (27).

2. A damper according to claim 1 **characterized in that** the grooves (12) and (13) are located outside the axle of the blades (10).

3. A damper according to claim 1 **characterized in that** the insulating gasket (27) consists of insulating fire protection materials, swelling under the influence of temperature.

4. A damper according to claim 1 or 2 **characterized in that** it has a mounting for the insulating gasket (27) with the steel slats (34) and the aluminium rivets (39).

5. A smoke control damper consisting of a damper housing and the permanently interconnected sections (1), (2), (3), and (4) and a shut-off blades of the damper, constituted by the moving blades (10) and the external blade (9), made of fire protection board, **characterized in that** each of the blades (10) comprises a sealing installed in the grooves (12) and (13) made along one longer edge and on each of the shorter sides, whereas the external blade (9) comprises a sealing installed in the grooves (12) and (13) on each of the sides, where the sealing comprises the intumescent gasket (38) and the insulating gasket (37) and the insulating gasket (37').

6. A damper according to claim 5 **characterized in that** the grooves (12) and (13) are located outside the axle of the blades (9) and (10).

7. A damper according to claim 5 **characterized in that** the insulating gasket (27) consists of insulating fire protection and intumescent materials.

8. A damper according to claim 5 or 6 **characterized in that** it has a mounting for the insulating gasket (27) with the steel slats (34) and the aluminium rivets (39).

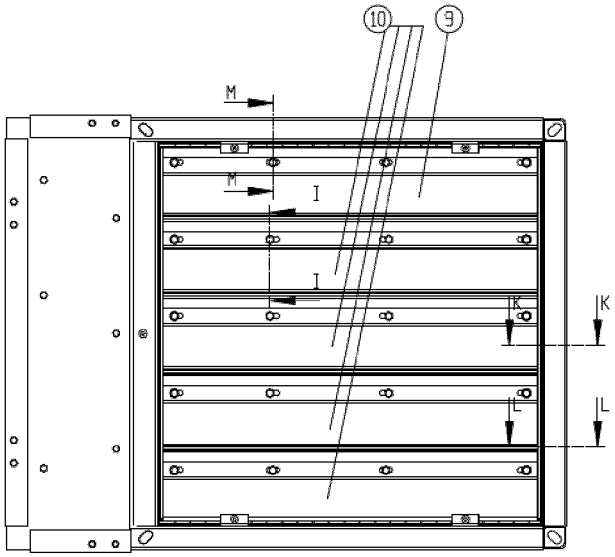


Fig. 1

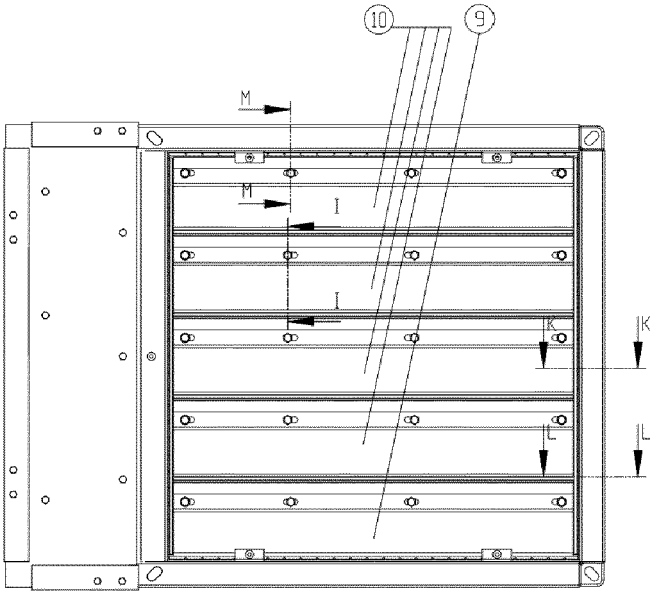


Fig. 1.1

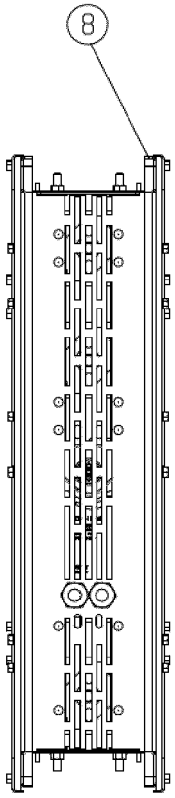


Fig. 2

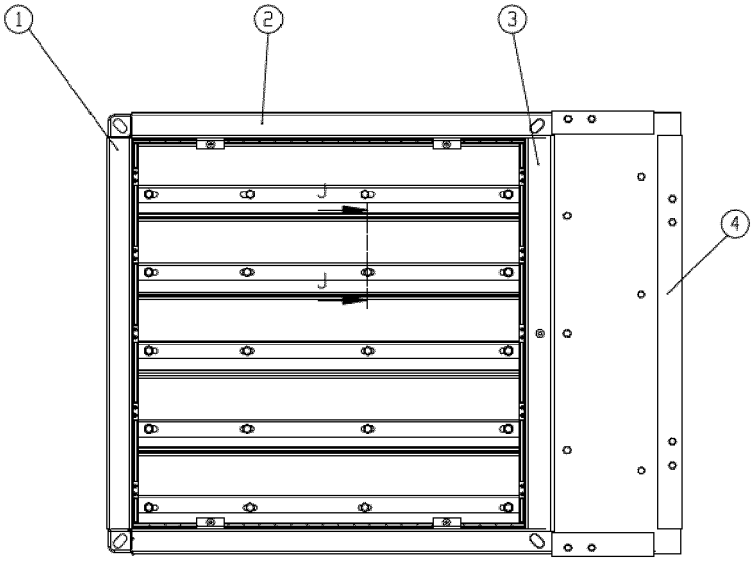


Fig. 3

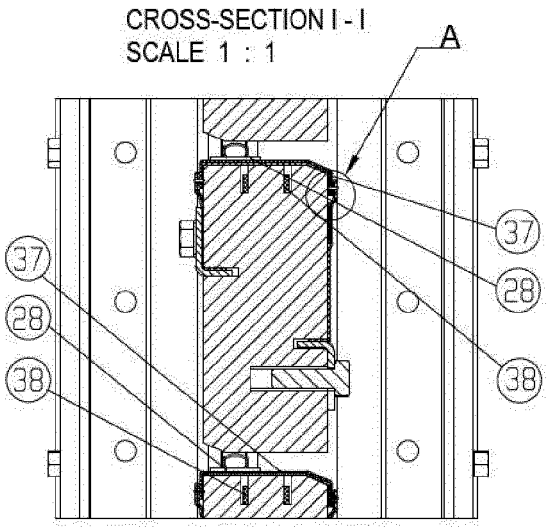

CROSS-SECTION I - I
SCALE 1 : 1
A
37
28
38
37
28
38

Fig. 4

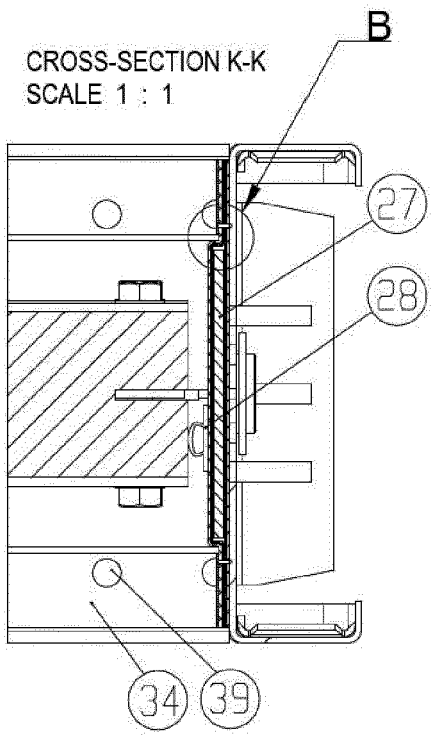

B
CROSS-SECTION K-K
SCALE 1 : 1
27
28
34
39

Fig. 5

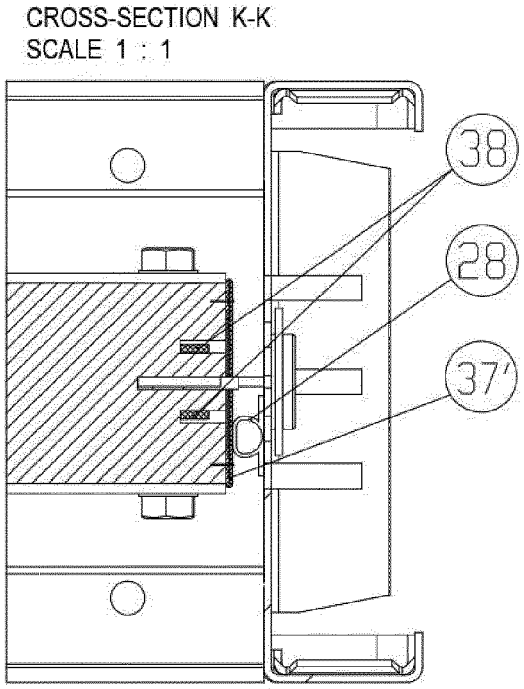

CROSS-SECTION K-K
SCALE 1 : 1
38
28
37'

Fig. 5.1

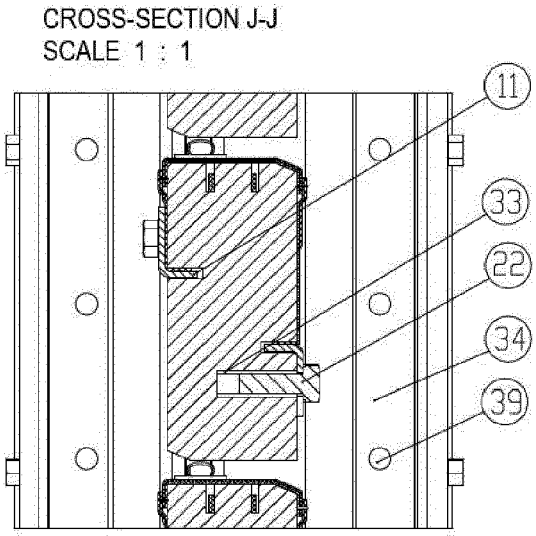
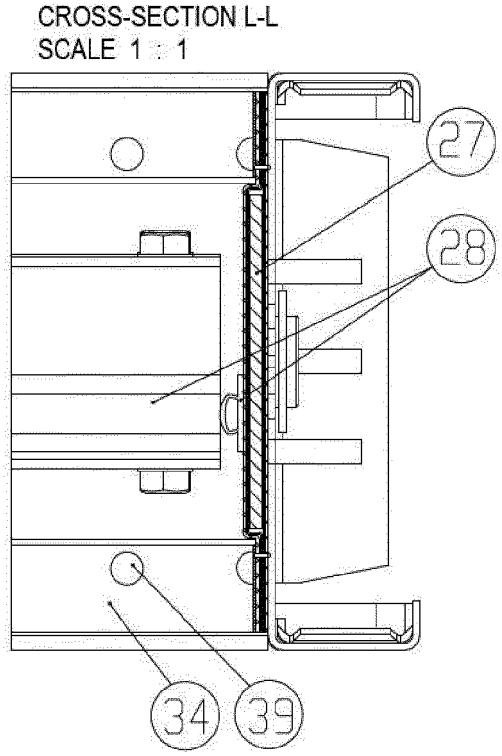

CROSS-SECTION J-J
SCALE 1 : 1
11
33
22
34
39

Fig. 6


CROSS-SECTION L-L
SCALE 1 : 1
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34
39

Fig. 7

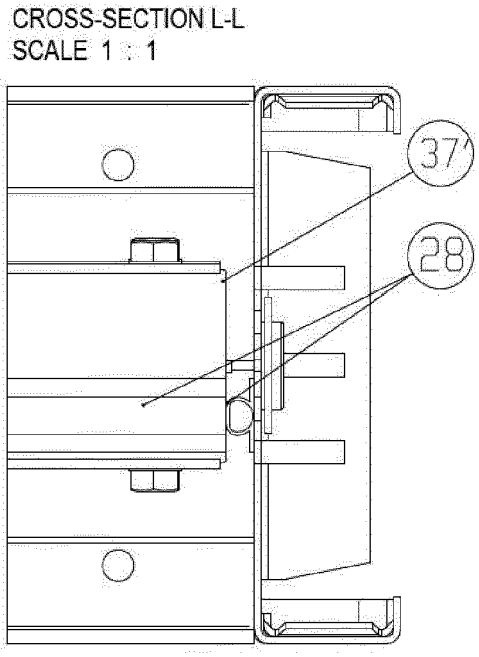
CROSS-SECTION L-L
SCALE 1 : 1
37'
28

Fig. 7.1

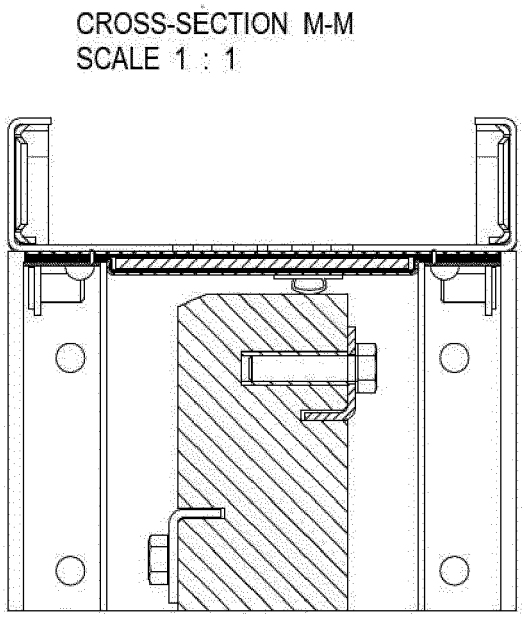

Fig. 8

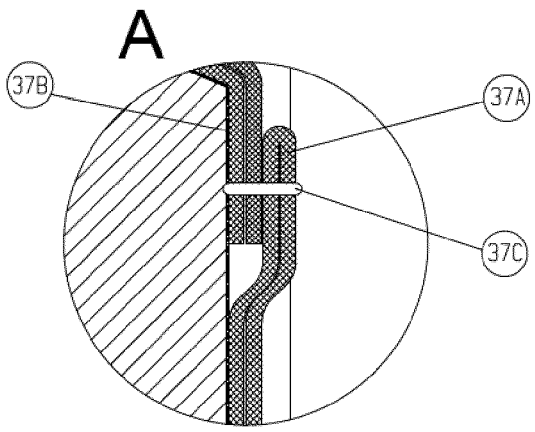

Fig. 9

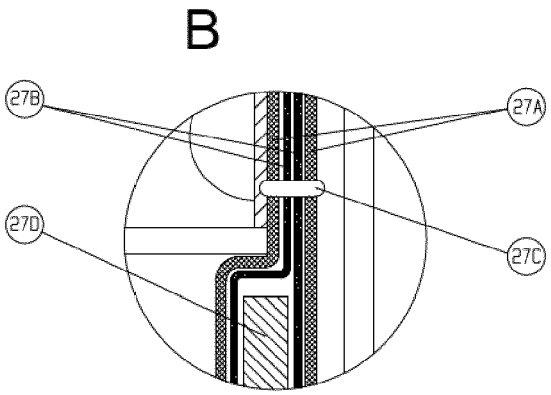

Fig. 10

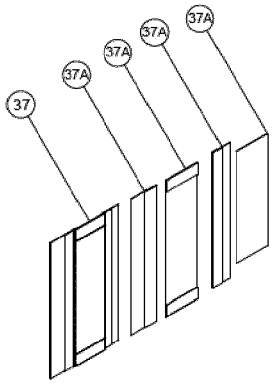

Fig. 11

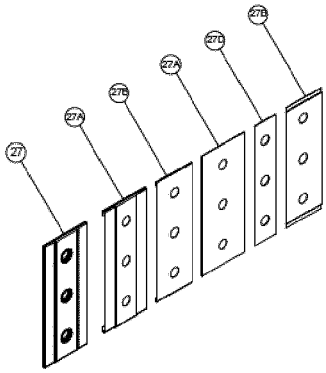

Fig. 12

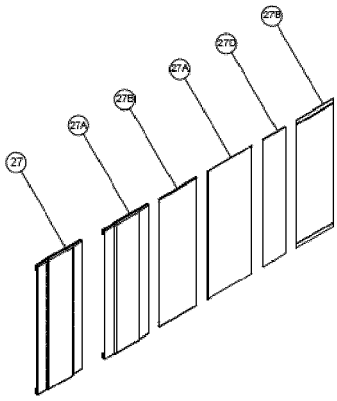

Fig. 13

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 18 6661

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D	EP 2 366 435 A1 (GREMPCO S A [PL]) 21 September 2011 (2011-09-21) * paragraph [0002] - paragraph [0016] * * paragraph [0030] - paragraph [0039] * * figures *	1-8	INV. A62C2/14 F24F13/15
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