



(51) International Patent Classification:

*H05B 3/84* (2006.01)      *H05B 3/14* (2006.01)  
*H05B 3/86* (2006.01)      *E06B 7/12* (2006.01)  
*C03C 17/36* (2006.01)      *G05D 23/19* (2006.01)  
*E06B 3/663* (2006.01)

(21) International Application Number:

PCT/CZ2019/050055

(22) International Filing Date:

27 November 2019 (27.11.2019)

(25) Filing Language:

Czech

(26) Publication Language:

English

(30) Priority Data:

PV 2018-661      30 November 2018 (30.11.2018)      CZ

(71) Applicant: **THERMO GLASS.EU S.R.O.** [CZ/CZ]; Trojická 437/20, 12800 Praha 2 - Nové Město (CZ).

(72) Inventors; and

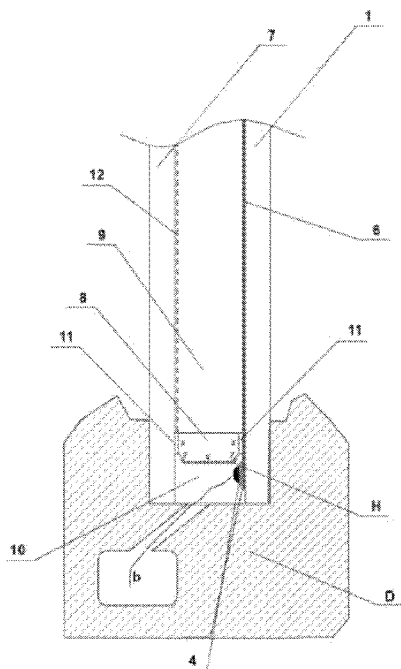
(71) Applicants (*for US only*): **CÍSAŘ, Zdeněk** [CZ/CZ]; Nad Turbovou 16, 15000 Praha 5 (CZ). **LOJÍK, Viktor** [CZ/CZ]; Saratovská 382/25, 10000 Praha 10 (CZ).

(74) Agent: **CHYTILOVÁ & SPOL., PATENTOVÁ KANCELÁŘ, S.R.O.**; Revoluční 725/11, 11000 Praha 1 - Staré Město (CZ).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,

(54) Title: HEATED SAFETY GLAZING

[Fig. 1]



(57) Abstract: The heated safety glazing is comprised of at least two flat glass substrates, of which at least one is hardened and equipped on its inner side with an electrically conductive heating mesh. Flat glass substrates that are separated by a chamber filled with some inert gas with low thermal conductivity are embedded in a common frame. All flat glass substrates are formed by monolithic soda-lime glass with a thickness of 3 to 8 mm comprising 70 to 72.5% by weight of SiO<sub>2</sub>, 13 to 14% by weight of Na<sub>2</sub>O, 9 to 10% by weight of CaO, 4 to 5% by weight of MgO, 0.60 to 0.75% by weight of Al<sub>2</sub>O<sub>3</sub>, 0.10 to 0.14% by weight of K<sub>2</sub>O, 0.25 to 0.27% by weight of SO<sub>3</sub>, and up to 1% by weight of other added substances. The electrically conductive heating mesh is made of SnO<sub>2</sub>:F with the thickness of 5 to 100 nm, with the transmissivity in the visible region of 79 to 84%, opacity for ultraviolet radiation of 84 to 86%, and reflectivity of infra-red radiation of 57 to 59%. It is designed in the form of mutually connected convex polygons allowing surface current density in the entire electrically conductive heating mesh to be constant and supplied by the first and second heating electrode. The first heating electrode is connected by a conductor via a relay switch to a phase conductor of a controllable thermostat connected to electric power supply. The second heating electrode is connected by a conductor to the neutral connector of the electric power supply that is connected via the relay winding and a conductor to the phase conductor via a safety electrode; the phase conductor that is led in the chamber inside the frame is connected via a magnetic contact to the electricity supply network by a conductor to the phase conductor of the controllable thermostat to which also a temperature sensor is connected by a

MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

- *as to the identity of the inventor (Rule 4.17(i))*
- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- *of inventorship (Rule 4.17(iv))*

**Published:**

- *with international search report (Art. 21(3))*

---

conductor; the temperature sensor is positioned at the edge of the glass substrate and the relay contact is connected to the digital input of the control system via the control unit in the electrical control panel transmitting random impulses to verify the closed position of the heating circuit. The neighbouring glass substrates have mutual distance of 9 to 30 mm depending on the width of the chamber filled with some inert gas with low thermal conductivity delimited by a plastic spacer frame with a rectangular cross-section with bevelled corners at the base. The base as well as the adjacent bevelled corners are fitted with a moisture-stop aluminium coat reaching up to a half of its length adjacent to the base. The plastic spacer frame is filled with a synthetic crystalline aluminosilicate-based molecular sieve with a three-dimensional system of pores with the diameter ranging from 0.29 to 0.31 nm, permanently attached along the vertical sides by flexible non-conducting polyisobutylene-based binding material and along the base and the bevelled corners by two-part polysulphide-based fixing sealant. The inert gas is selected from a group comprising argon and krypton.

## Description

### Title of Invention: Heated Safety Glazing

#### Technical Field

[0001] The present invention discloses heated safety glazing units equipped with protection against overheating and security system.

#### Background Art

[0002] Various methods for the heating of glazing units have been employed for a long time in particular in vehicles. For example, the CZ 286724 B6 publication discloses an assembly of a pair of glass plate-like parts separated by a layer of polyvinyl butyral with an embedded heating circuit.

[0003] In addition, glass preventing condensation is disclosed, for example, in the EP 1626940 document. The glass is coated with a layer heated by electric current. The aforementioned glass is intended for freezers and its purpose is to make products clearly visible.

[0004] However, the design of heated windows known so far is not sufficiently resolved in terms of protection against overheating or protection against breaking and entering.

[0005] This is a serious disadvantage considering the fact that windows are the weakest link of a building security against breaking and entering. 85% of perpetrators enter buildings via windows and 80% of perpetrators are not afraid of being exposed by inhabitants in neighbouring buildings, however, they have difficulties in overcoming burglary monitoring systems, i.e. connection of buildings to security alarm receiving centres.

[0006] Nowadays, the safeguarding of windows against breaking and entering is performed by mechanical protection based on safety films. The window equipped with such film is not completely transparent and the mechanical protection created in this manner is not sufficient to withstand brute force. The situation may be partially improved by a shock sensor additionally stuck on the window. Such a solution does not look good and requires additional installation. Moreover, the glued-on sensor may not remain attached to the window.

[0007] In known heated windows, fire safety in the case of heated glass cracking, when electric arc occurs in the point of connection of the power supply conductor, has not been resolved satisfactorily yet. From the EP 1017254 A1 document, a heated window fitted with a heated layer connected via peripheral electrodes to a power supply unit with temperature control both by the sensor on the window and by a spatial thermostat is known. If the heated glass breaks, cracks spread over the entire surface, but the glass still may not disintegrate. However, electric arc can develop on the crack with a sig-

nificantly high temperature potentially lasting for a very long time. In such a case, the window frames get considerably damaged and could even catch fire.

[0008] With metal window frames, glass is separated from the frame by window seal, which means that if electric arc develops, electric circuit protection is not activated while insulation material is partly melted and can even catch on fire. In the case of a plastic window frame, the frame can be melted down or even ignite. With a wooden frame, ignition is the most likely as the temperature of electric arc exceeds the ignition temperature of wood many times.

### **Summary of Invention**

[0009] The heated safety glazing is comprised of at least two flat glass substrates, of which at least one is hardened and equipped on its inner side with an electrically conductive heating mesh. Flat glass substrates that are separated by a chamber filled with some inert gas with low thermal conductivity are embedded in a common frame. All flat glass substrates are formed by monolithic soda-lime glass with a thickness of 3 to 8 mm comprising 70 to 72.5% by weight of SiO<sub>2</sub>, 13 to 14% by weight of Na<sub>2</sub>O, 9 to 10% by weight of CaO, 4 to 5% by weight of MgO, 0.60 to 0.75% by weight of Al<sub>2</sub>O<sub>3</sub>, 0.10 to 0.14% by weight of K<sub>2</sub>O, 0.25 to 0.27% by weight of SO<sub>3</sub>, and up to 1% by weight of other added substances. The electrically conductive heating mesh is made of SnO<sub>2</sub>:F with the thickness of 5 to 100 nm, with the transmissivity in the visible region of 79 to 84%, opacity for ultraviolet radiation of 84 to 86%, and reflectivity of infra-red radiation of 57 to 59%. It is designed in the form of mutually connected convex polygons allowing surface current density in the entire electrically conductive heating mesh to be constant and supplied by the first and second heating electrode. The first heating electrode is connected by a conductor via a relay switch to a phase conductor of a controllable thermostat connected to electric power supply. The second heating electrode is connected by a conductor to the neutral connector of the electric power supply that is connected via the relay winding and a conductor to the phase conductor via a safety electrode; the phase conductor that is led in the chamber inside the frame is connected via a magnetic contact to the electricity supply network by a conductor to the phase conductor of the controllable thermostat to which also a temperature sensor is connected by a conductor; the temperature sensor is positioned at the edge of the glass substrate and the relay contact is connected to the digital input of the control system via the control unit in the electrical control panel transmitting random impulses to verify the closed position of the heating circuit.

[0010] The neighbouring glass substrates have mutual distance of 9 to 30 mm depending on the width of the chamber filled with some inert gas with low thermal conductivity delimited by a plastic spacer frame with a rectangular cross-section with bevelled

corners at the base. The base as well as the adjacent bevelled corners are fitted with a moisture-stop aluminium coat reaching up to a half of its length adjacent to the base. The plastic spacer frame is filled with a synthetic crystalline aluminosilicate-based molecular sieve with a three-dimensional system of pores with the diameter ranging from 0.29 to 0.31 nm, permanently attached along the vertical sides by flexible non-conducting polyisobutylene-based binding material and along the base and the bevelled corners by two-part polysulphide-based fixing sealant. The inert gas is selected from a group comprising argon and krypton.

- [0011] In a preferred embodiment, the conductors are led together via a disconnectable connector. The convex polygons forming the electrically conductive heating mesh are preferably selected from a group comprising triangles, quadrangles, and hexagons. In a preferred embodiment the number of flat glass substrates is three and the substrate in the middle is preferably on its interior side fitted with a reflective layer.
- [0012] In a preferred embodiment, the exterior glass substrate is fitted on its inner side with the electrically conductive heating mesh. In another embodiment, the external exterior glass substrate is equipped on its inner side with a reflective layer.
- [0013] In a preferred embodiment, the convex polygons of the electrically conductive heating mesh have the width of the side (m) and the width of the side (n) ranging from 2.4 to 6.5 mm and the length of the side (k) and the length of the side (l) ranging from 11.41 to 51 mm.
- [0014] The heated safety glazing according to the invention prevents water vapour condensation on the window and thus formation of mildew. It has been ascertained that in winter season the temperature of the safety glazing prevents frost deposits formation. In a majority of applications, it is sufficient for space heating.
- [0015] If the heating glass breaks, cracks will spread over the entire glass and the circuit is interrupted on the safety electrode. No electric arc is formed as the current flowing through the electrode amounts to only a few mA. By interrupting the circuit on the safety electrode, the relay is disengaged and the contact, via which the first heating electrode is supplied with electric power, is disconnected and the heating glazing is disconnected from the electric power supply.

## **Brief Description of Drawings**

### **Fig.1**

- [0016] [Fig.1] illustrates the section of the heating safety glass in various variants,

### **Fig.2**

- [0017] [Fig.2] illustrates the section of the heating safety glass in various variants,

### **Fig.3**

- [0018] [Fig.3] illustrates the section of the heating safety glass in various variants,

**Fig.4**

[0019] [Fig.4] illustrates the connection of the heating mesh in various variants,

**Fig.5**

[0020] [Fig.5] illustrates the connection of the heating mesh in various variants,

**Fig.6**

[0021] [Fig.6] illustrates various embodiments of the heating mesh,

**Fig.7**

[0022] [Fig.7] illustrates various embodiments of the heating mesh,

**Fig.8**

[0023] [Fig.8] illustrates various embodiments of the heating mesh,

**Fig.9**

[0024] [Fig.9] illustrates various embodiments of the heating mesh.

**Examples**

[0025] Example 1

[0026] An example of embodiments of the heating safety window is provided in Fig. 1, Fig. 4, and Fig. 6.

[0027] A heating safety window with an openable wooden frame D with the size of  $h = 1,100$  mm and  $s = 800$  mm, connected with a fixed wooden frame D on the side h using three hinge plates was manufactured. The frame D was fitted with two flat glass substrates 1, 7 with the size of  $h = 1,000$  mm and  $s = 700$  mm manufactured from monolithic soda-lime glass with the thickness of 3 mm, comprising 72.5% by weight of SiO<sub>2</sub>, 13% by weight of Na<sub>2</sub>O, 9.0% by weight of CaO, 4% by weight of MgO, 0.60% by weight of Al<sub>2</sub>O<sub>3</sub>, 0.10% by weight of K<sub>2</sub>O, 0.25% by weight of SO<sub>3</sub>, and 0.55% by weight of other added substances. The glasses were separated by the chamber 9 filled with argon. The flat glass substrate 7 was fitted with a reflective layer 12 with the emissivity of 0.03. The flat glass substrate 1 was hardened and on its inner side fitted with an electrically conductive heating mesh 6 with the thickness of 5 nm, made of SnO<sub>2</sub>:F, the transmissivity of which in the visible region was 84%, ultraviolet radiation opacity was 84%, and the infra-red radiation reflectivity was 57%. The electrically conductive heating mesh 6 was manufactured in the form of mutually connected convex hexagons with the dimensions of  $l = 12.47$  mm,  $k = 13.62$  mm,  $n = 4.63$  mm, and  $m = 2.4$  mm. Surface current density was constant throughout the entire electrically conductive heating mesh. The electrically conductive heating mesh 6 was powered by the first heating electrode 2 and the second heating electrode 4. The first heating electrode 2 was connected by a conductor a via the NO switch of a relay 5 to a phase conductor L of a controllable thermostat R connected to electric power supply. The second heating electrode 4 was connected by a conductor b to the neutral

conductor N of the electric power supply, which was, via a winding C of the relay 5, connected by a conductor c via a safety electrode 3 with the phase conductor L, led in the chamber inside the frame via a magnetic contact M connected to the electricity supply network by a conductor d to the phase conductor L, which was led via the controllable thermostat R. The safety electrode 3 had the width of 1 mm. A temperature sensor T was connected to the thermostat R by a conductor e; the temperature sensor T was positioned at the edge of the glass substrate 1; the controllable thermostat R was further connected to the control unit in the electrical control panel. The conductors a, b, c, d, and e were led between the movable and fixed frame by an armoured grommet 13. In addition, the NC contact of the relay 5 was connected to the DIx digital input of the control system. The glass substrates 1, 7 were installed at a mutual distance of 9 mm, depending on the width of the chamber 9, delimited by a plastic spacer frame 8 with the cross-section in the shape of rectangle with bevelled corners. The base V of the rectangle was fitted with a moisture-stop aluminium coat H. The bevel Z of the rectangle was up to a half of its length adjacent to the base V fitted with the same moisture-stop aluminium coat H. The plastic spacer frame 8 was filled with a synthetic crystalline aluminosilicate-based molecular sieve with a three-dimensional system of pores with the diameter of 0.29 nm. The plastic spacer frame 8 was along the vertical sides X of the rectangle attached to the substrates 1, 7 by permanently flexible non-conducting polyisobutylene-based binding material 11. On the side of the base V and bevel Z, the plastic spacer frame was attached to the substrates 1, 7 by two-part polysulphide-based fixing sealant 10.

[0028] In addition, a variant of this heating safety window with a chamber 9 filled with krypton was manufactured.

[0029] Example 2

[0030] An example of embodiments of the heating safety window is provided in Fig. 1, Fig. 5, and Fig. 7.

[0031] A heating safety window with a sliding wooden frame D with the size of  $h = 2,200$  mm and  $s = 1,100$  mm, positioned on the side s on guide rails of a fixed wooden frame was manufactured. The frame D was fitted with two flat glass substrates 1, 7 with the size of  $h = 2,100$  mm and  $s = 1,000$  mm manufactured from monolithic soda-lime glass with the thickness of 8 mm, comprising 70% by weight of SiO<sub>2</sub>, 13% by weight of Na<sub>2</sub>O, 10.0% by weight of CaO, 5% by weight of MgO, 0.75% by weight of Al<sub>2</sub>O<sub>3</sub>, 0.14% by weight of K<sub>2</sub>O, 0.27% by weight of SO<sub>3</sub>, and 0.84% by weight of other added substances. The glasses were separated by the chamber 9 filled with argon. The flat glass substrate 7 was fitted with a reflective layer 12 with the emissivity of 0.03. The flat glass substrate 1 was hardened and on its inner side fitted with an electrically conductive heating mesh 6 with the thickness of 100 nm, made of SnO<sub>2</sub>:F, the trans-

missivity of which in the visible region was 79%, ultraviolet radiation opacity was 86%, and the infra-red radiation reflectivity was 59%. The electrically conductive heating mesh 6 was manufactured in the form of mutually connected equilateral triangles with the dimensions of  $l = 51$  mm,  $n = 3.5$  mm, and  $m = 3.5$  mm. Surface current density was constant throughout the entire electrically conductive heating mesh 6. The electrically conductive heating mesh 6 was powered by the first heating electrode 2 and the second heating electrode 4. The first heating electrode 2 was connected by a conductor a via the NO switch of a relay 5 to a phase conductor L of a thermostat R connected to electric power supply. The second heating electrode 4 was connected by a conductor b to the neutral conductor N of electric power supply, which was via the winding C of the relay 5 connected to a conductor c via a safety electrode 3 with a phase conductor led in the chamber in the frame via a magnetic contact M connected to the electricity supply network by a conductor d to the phase conductor L, which was led via a controllable thermostat R. The controllable thermostat R was fitted with, by a conductor e, a temperature sensor T which was positioned at the edge of the substrate 1, and the controllable thermostat R was also connected to the control unit in the electrical control panel. The conductors a, b, c, d, and e were between the moving and fixed frames connected via a connector K. In addition, the NC contact of the relay 5 was connected to the digital input DIx of the control system. The glass substrates 1, 7 were installed at a mutual distance of 30 mm, depending on the width of the chamber 9, delimited by a plastic spacer frame 8 with the cross-section in the shape of rectangle with bevelled corners. The base V of the rectangle was fitted with a moisture-stop aluminium coat H. The bevel Z of the rectangle was up to a half of its length adjacent to the base V fitted with the same moisture-stop aluminium coat H. The plastic spacer frame 8 was filled with a synthetic crystalline aluminosilicate-based molecular sieve with a three-dimensional system of pores with the diameter of 0.31 nm. The plastic spacer frame 8 was along the vertical sides X of the rectangle attached to the substrates 1, 7 by permanently flexible non-conducting polyisobutylene-based binding material 11. On the side of the base V and bevel Z, the plastic spacer frame was attached to the substrates 1, 7 by two-part polysulphide-based fixing sealant 10.

[0032] Example 3

[0033] An example of embodiments of the heating safety window is provided in Fig. 2, Fig. 5, and Fig. 8..

[0034] A heating safety window with a sliding wooden frame D with the size of  $h = 2,200$  mm and  $s = 1,900$  mm, positioned on the side s on guide rails of a fixed wooden frame was manufactured. The frame D was fitted with three flat glass substrates 1, 14, and 7 with the size of  $h = 2,100$  mm and  $s = 1,800$  mm manufactured from monolithic soda-lime glass with the thickness of 4 mm, comprising 70% by weight of SiO<sub>2</sub>, 14% by



weight of Na<sub>2</sub>O, 10.0% by weight of CaO, 4% by weight of MgO, 0.75% by weight of Al<sub>2</sub>O<sub>3</sub>, 0.1% by weight of K<sub>2</sub>O, 0.25% by weight of SO<sub>3</sub>, and 0.9% by weight of other added substances. The glasses were separated by chambers 9 filled with argon. The flat glass substrates 7 14 were fitted with a reflective layer 12 with the emissivity of 0.03. The flat glass substrate 1 was hardened and on its inner side fitted with an electrically conductive heating mesh 6 with the thickness of 25 nm, made of SnO<sub>2</sub>:F, the transmissivity of which in the visible region was 82%, ultraviolet radiation opacity was 85%, and the infra-red radiation reflectivity was 58%. The electrically conductive heating mesh 6 was manufactured in the form of regular equilateral quadrangle with the dimensions of l = 105 mm, k = 105 mm, n = 5.6 mm, and m = 5.6 mm. Surface current density was constant throughout the entire electrically conductive heating mesh 6. The electrically conductive heating mesh 6 was powered by the first heating electrode 2 and the second heating electrode 4. The first heating electrode 2 was connected by a conductor a via the NO switch of a relay 5 to a phase conductor L of a controllable thermostat R connected to electric power supply. The second heating electrode 4 was connected by a conductor b to the neutral conductor N of electric power supply, which was via the winding C of the relay 5 connected to a conductor c via a safety electrode 3 with a phase conductor L led in the chamber in the frame via a magnetic contact M connected to the electricity supply network by a conductor d to the phase conductor L, which was led via a controllable thermostat R. The controllable thermostat R was fitted with, by a conductor e, a temperature sensor T which was positioned at the edge of the substrate 1, and the controllable thermostat R was also connected to the control unit in the electrical control panel. The conductors a, b, c, d, and e were between the moving and fixed frames connected via a connector K. In addition, the NC contact of the relay 5 was connected to the digital input DI<sub>x</sub> of the control system. The glass substrates 1, 14 and 14, 7 were installed at a mutual distance of 16 mm, depending on the width of the chambers 9, delimited by plastic spacer frames 8 with the cross-section in the shape of rectangle with bevelled corners. The base V of the rectangle was fitted with a moisture-stop aluminium coat H. The bevel Z of the rectangle was up to a half of its length adjacent to the base V fitted with the same moisture-stop aluminium coat H. The plastic spacer frames 8 were filled with a synthetic crystalline aluminosilicate-based molecular sieve with a three-dimensional system of pores with the diameter of 0.31 nm. The plastic spacer frames 8 were along the vertical sides X of the rectangle attached to the substrates 1, 14 and 14, 7 by permanently flexible non-conducting polyisobutylene-based binding material 11. On the side of the base V and bevel Z, the plastic spacer frames were attached to the substrates 1, 14 and 14, 7 by two-part polysulphide-based fixing sealant 10.

- [0036] An example of embodiments of the heating safety window is provided in Fig. 3, Fig. 4, and Fig. 9.
- [0037] A heating safety studio window with a swivel-mounted wooden frame D with the size of  $h = 1,200$  mm and  $s = 900$  mm, connected with a fixed wooden frame on the side  $s$  using two hinge plates was manufactured. The frame D was fitted with three flat glass substrates 1, 14, and 7 with the size of  $h = 1,100$  mm and  $s = 800$  mm manufactured from monolithic soda-lime glass with the thickness of 4 mm, comprising 71% by weight of  $\text{SiO}_2$ , 13% by weight of  $\text{Na}_2\text{O}$ , 9.5% by weight of  $\text{CaO}$ , 5% by weight of  $\text{MgO}$ , 0.7% by weight of  $\text{Al}_2\text{O}_3$ , 0.14% by weight of  $\text{K}_2\text{O}$ , 0.27% by weight of  $\text{SO}_3$ , and 0.39% by weight of other added substances. The glasses were separated by chambers 9 filled with argon. The flat glass substrate 14 was fitted with a reflective layer 12 with the emissivity of 0.03. The flat glass substrate 1 was hardened and on its inner side fitted with an electrically conductive heating mesh 6 with the thickness of 20 nm, made of  $\text{SnO}_2:\text{F}$ , the transmissivity of which in the visible region was 83%, ultraviolet radiation opacity was 85%, and the infra-red radiation reflectivity was 58%. The electrically conductive heating mesh 6 was manufactured in the form of mutually connected convex hexagons with the dimensions of  $l = 12.47$  mm,  $k = 13.62$  mm,  $n = 4.63$  mm, and  $m = 2.4$  mm. Surface current density was constant throughout the entire electrically conductive heating mesh. This electrically conductive heating mesh was powered by the first heating electrode 2 and the second heating electrode 4. The first heating electrode 2 was connected by a conductor a via the NO switch of a relay 5 to a phase conductor L of a thermostat R connected to electric power supply. The second heating electrode 4 was connected by a conductor b to the neutral conductor N of electric power supply, which was via the winding C of the relay 5 connected to a conductor c via a safety electrode 3 with the phase conductor L led in the chamber in the frame via a magnetic contact M connected to the electricity supply network by a conductor d to the phase conductor L, which was led via a controllable thermostat R. The thermostat R was fitted with, by a conductor e, a temperature sensor T which was positioned at the edge of the substrate 1, and the controllable thermostat R was also connected to the control unit in the electrical control panel. The conductors a, b, c, d, and e were led between the movable and fixed frame by an armoured grommet 13. In addition, the NC contact of the relay 5 was connected to the DIx digital input of the control system.
- [0038] The glass substrates 1, 14 and 14, 7 were installed at a mutual distance of 16 mm, depending on the width of the chambers 9, delimited by plastic spacer frames 8 with the cross-section in the shape of rectangle with bevelled corners. The base V of the rectangle was fitted with a moisture-stop aluminium coat H. The bevel Z of the rectangle was up to a half of its length adjacent to the base V fitted with the same

moisture-stop aluminium coat H. The plastic spacer frames 8 were filled with a synthetic crystalline aluminosilicate-based molecular sieve with a three-dimensional system of pores with the diameter of 0.31 nm. The plastic spacer frames 8 were along the vertical sides X of the rectangle attached to the substrates 1, 14 and 14, 7 by permanently flexible non-conducting polyisobutylene-based binding material 11. On the side of the base V and bevel Z, the plastic spacer frames were attached to the substrates 1, 14 and 14, 7 by two-part polysulphide-based fixing sealant 10.

[0039] In addition to heating, the heating glass also fulfils the security function as a sensor of unauthorized breaking and entering. When the glass is broken, electric current flowing in the inner glass substrate of the insulation glass is interrupted. The heating control system detects the interruption of electric current flow and may raise an alarm. No additional installation of shock window sensors is required. Such sensors do not look good anyway and in addition to power supply cables they require other signal cables.

### **Industrial Applicability**

[0040] The heated safety glazing has a wide applicability in all types of structures. It can be implemented for example as standard and roof window, glazing for winter gardens, swimming pool or terrace.

## Claims

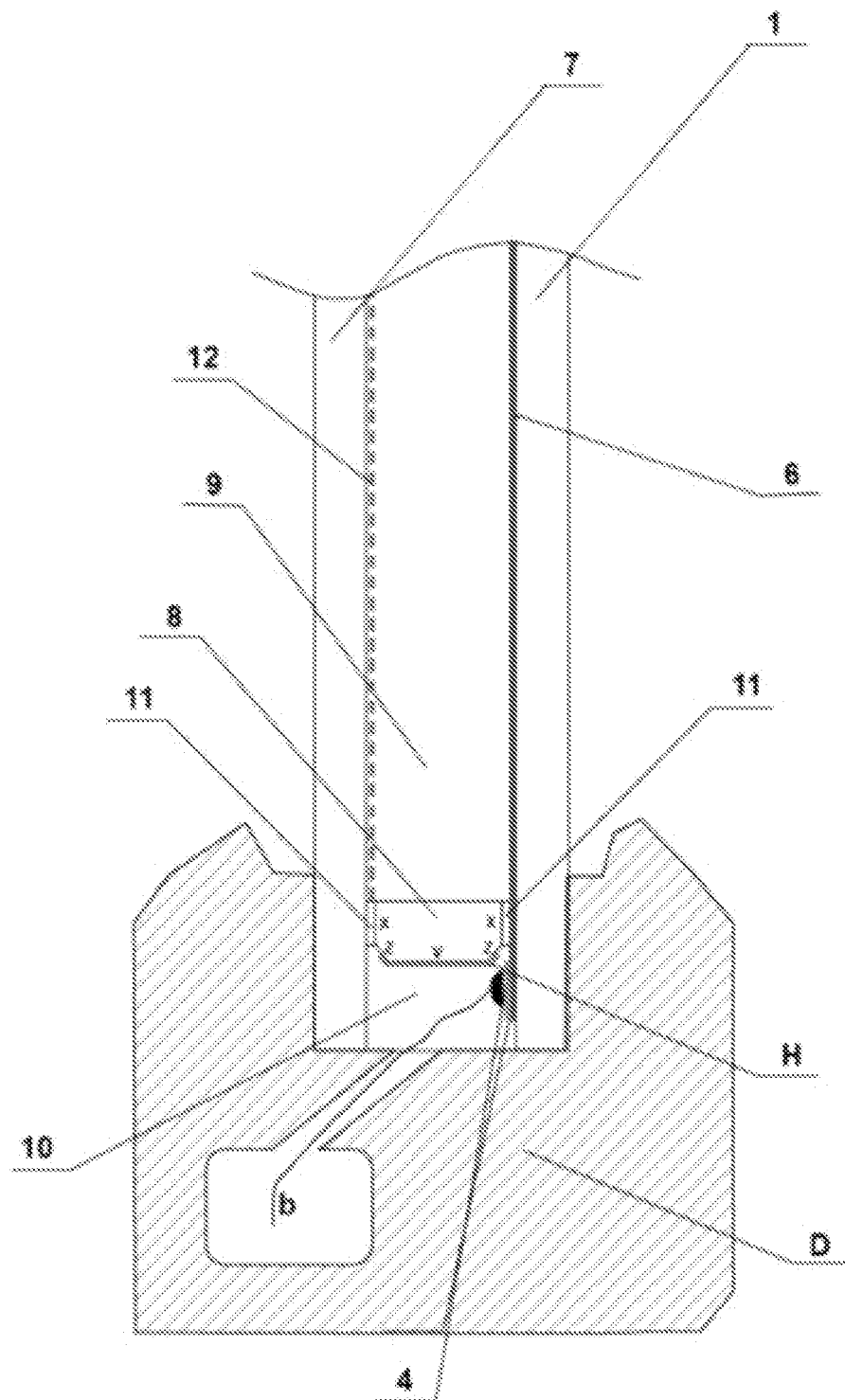
[Claim 1]

Heated safety glazing comprising at least two flat glass substrates (1, 7), of which at least one is fitted with electrically conductive heating mesh powered by heating electrodes separated from each other by a chamber (9) filled with some rare gas with low thermal conductivity and installed in a common frame (D), **characterized in that** all flat glass substrates (1, 7) are created from monolithic soda-lime glass with the thickness of 3 to 8 mm comprising 70 to 72.5% by weight of SiO<sub>2</sub>, 13 to 14% by weight of Na<sub>2</sub>O, 9 to 10% by weight of CaO, 4 to 5% by weight of MgO, 0.60 to 0.75% by weight of Al<sub>2</sub>O<sub>3</sub>, 0.10 to 0.14% by weight of K<sub>2</sub>O, 0.25 to 0.27% by weight of SO<sub>3</sub> and up to 1% by weight of other added substances and at least one of the external flat glass substrates (1, 7) is hardened and fitted, on its inner side, by the electrically conductive heating mesh (6) with the thickness ranging from 5 to 100 nm, made of SnO<sub>2</sub>:F, the transmissivity of which in the visible region ranges from 79 to 84%, ultraviolet radiation opacity ranges from 84 to 86%, and infra-red radiation reflectivity ranges from 57 to 59%, performed in the form of mutually connected convex polygons to keep surface current density constant throughout the entire electrically conductive heating mesh (6), powered by the first heating electrode (2) and the second heating electrode (4), where the first heating electrode (2) is connected by the conductor (a) by the switch (NO) of the relay (5) to the phase conductor (L) of the controllable thermostat R, connected to the electric power supply and the second heating electrode (4) is connected by the conductor (b) to the neutral conductor (N) of the electric power supply, which is, via the winding (C) of the relay (5) connected by the conductor (c) via the safety electrode (3) with the phase conductor (L), led in the chamber inside the frame via the magnetic contact (M) connected to the electricity supply network by the conductor (d) to the phase conductor (L) of the controllable thermostat (R), to which, also the temperature sensor (T) is connected by the conductor (e) where the temperature sensor is positioned at the edge of the glass substrate (1) and the contact (NC) of the relay (5) is connected to the digital input (DIx) of the control system via the control unit in the electrical control panel, transmitting and analysing random impulses to verify the closed state of the heating circuit and the neighbouring glass substrates have a mutual distance

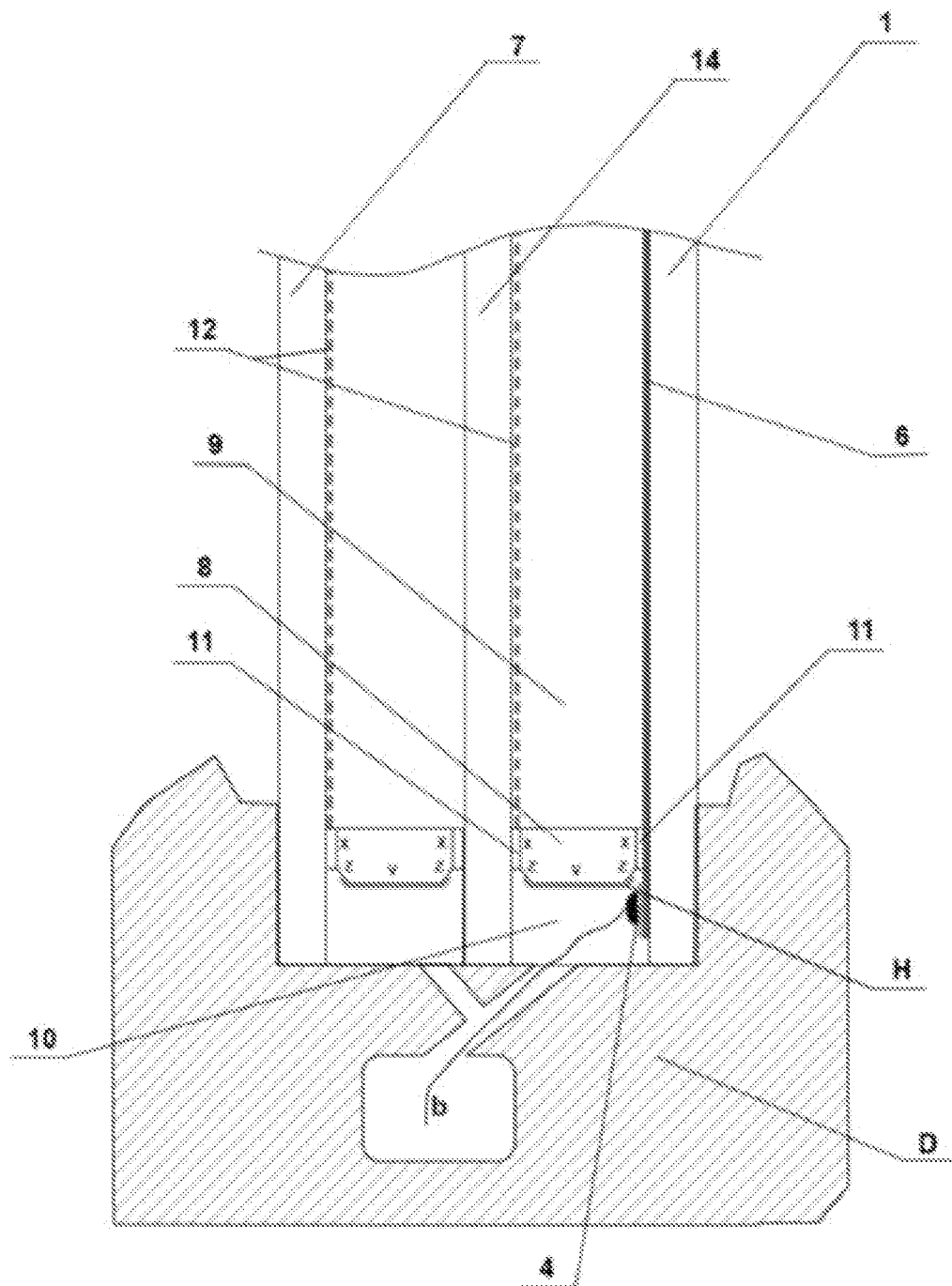
ranging from 9 to 30 mm depending on the width of the chamber (9), filled with some inert gas with low thermal conductivity, delimited by a plastic spacer frame (8) with the cross-section in the shape of rectangular with bevelled corners where the base (V) of the rectangle as well as the adjacent bevels (Z) are fitted with a moisture-stop aluminium coat (H) up to a half of its length adjacent to the base (V), the plastic spacer frame (8) is filled with a synthetic crystalline aluminosilicate-based molecular sieve with a three-dimensional system of pores with the diameter ranging from 0.29 to 0.31 nm, and along the vertical sides (X) it is attached by permanently flexible non-conducting polyisobutylene-based binding material (11) and on the side of the base (V) and bevels (Z) by two-part polysulphide-based fixing sealant (10) and that the inert gas is selected from a group comprising argon and krypton.

- [Claim 2] The heating safety glazing according to claim 1, characterized in that the conductors (a), (b), (c), and (d) are led together via a disconnectable connector (K).
- [Claim 3] The heating safety glazing according to claim 1 or 2, characterized in that the convex polygons are selected from a group comprising triangles, quadrangles, and hexagons.
- [Claim 4] The heating safety glazing according to claim 1 through 3, characterized in that there are three flat glass substrates (1, 7, 14) and the glass substrate in the middle (14) is on its interior side fitted with the reflective layer (12).
- [Claim 5] The heating safety glazing according to claim 1 through 4, characterized in that the external exterior glass substrate (7) is on its inner side fitted with the heating mesh (6).
- [Claim 6] The heating safety glazing according to claim 1 through 4, characterized in that the external exterior glass substrate (7) is on its inner side fitted with a reflective layer (12).
- [Claim 7] The heating safety glazing according to claim 1 through 6, characterized in that the polygons have the width (m) and the width (n) of the side ranging from 2.4 to 6.5 mm and the length (k) and the length (l) of the side ranging from 11.41 to 51 mm

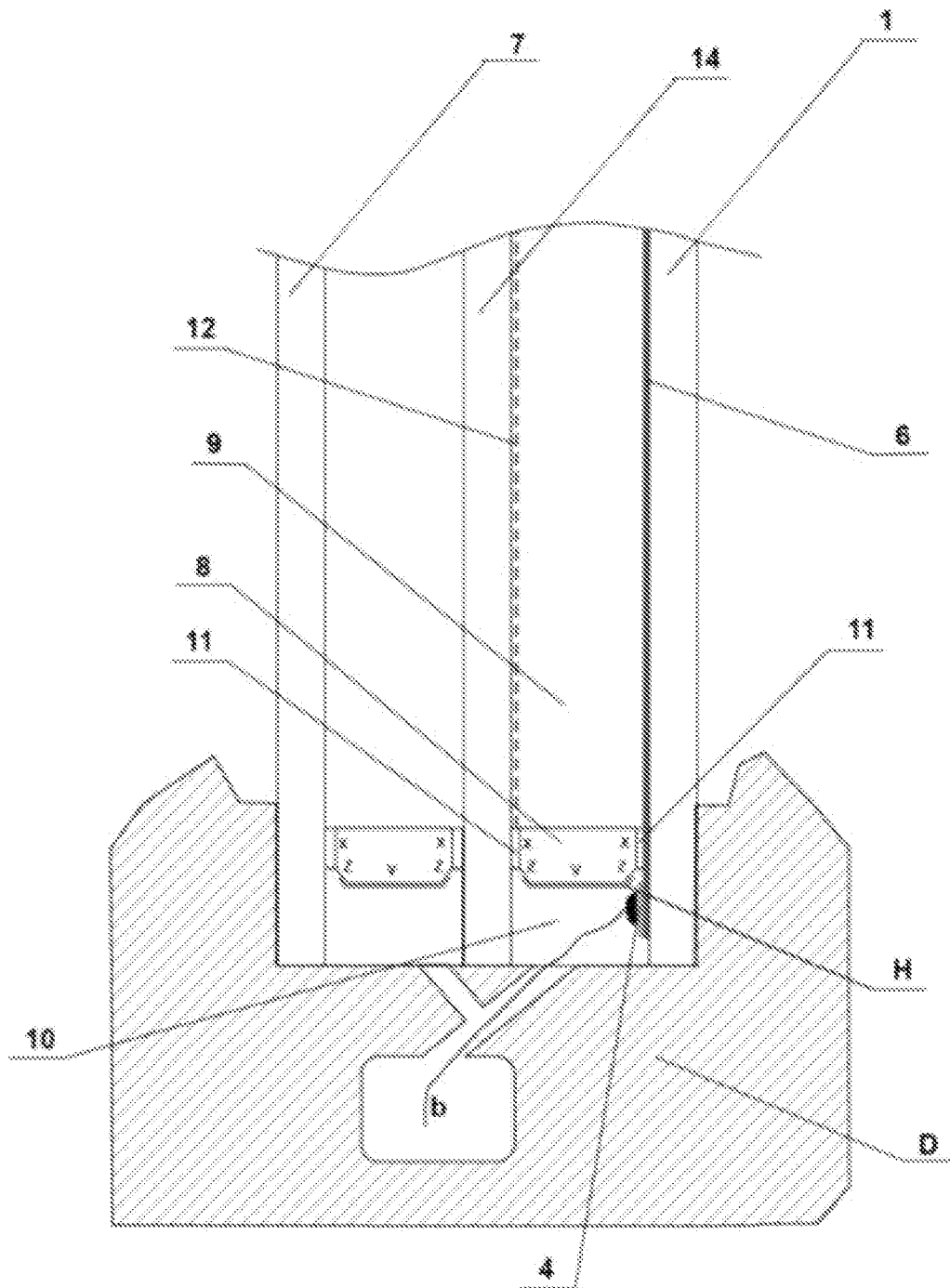
[Fig. 1]



[Fig. 2]

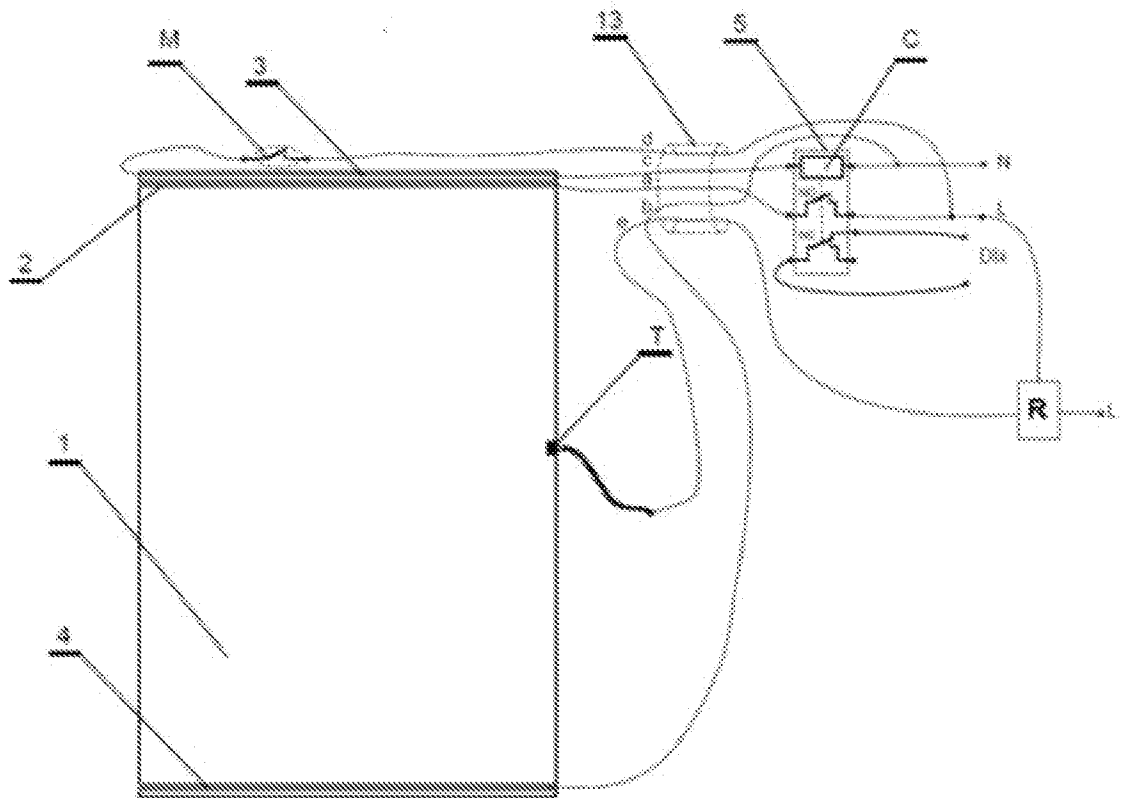


[Fig. 3]

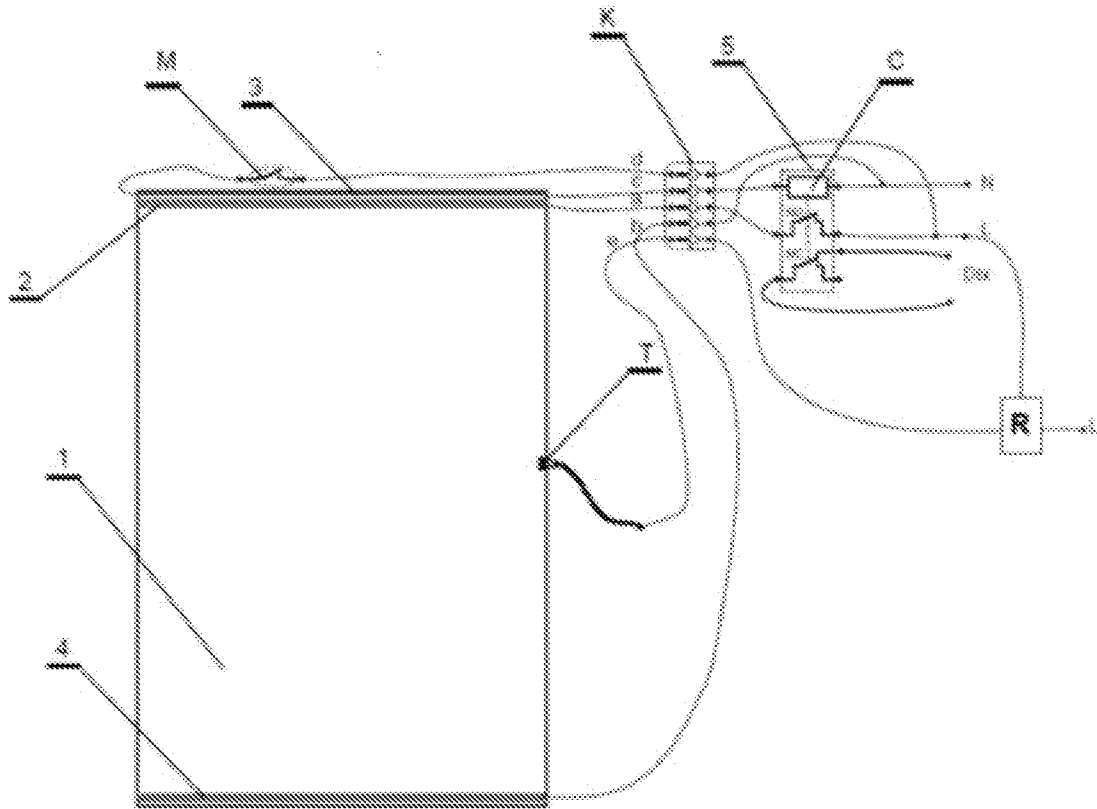




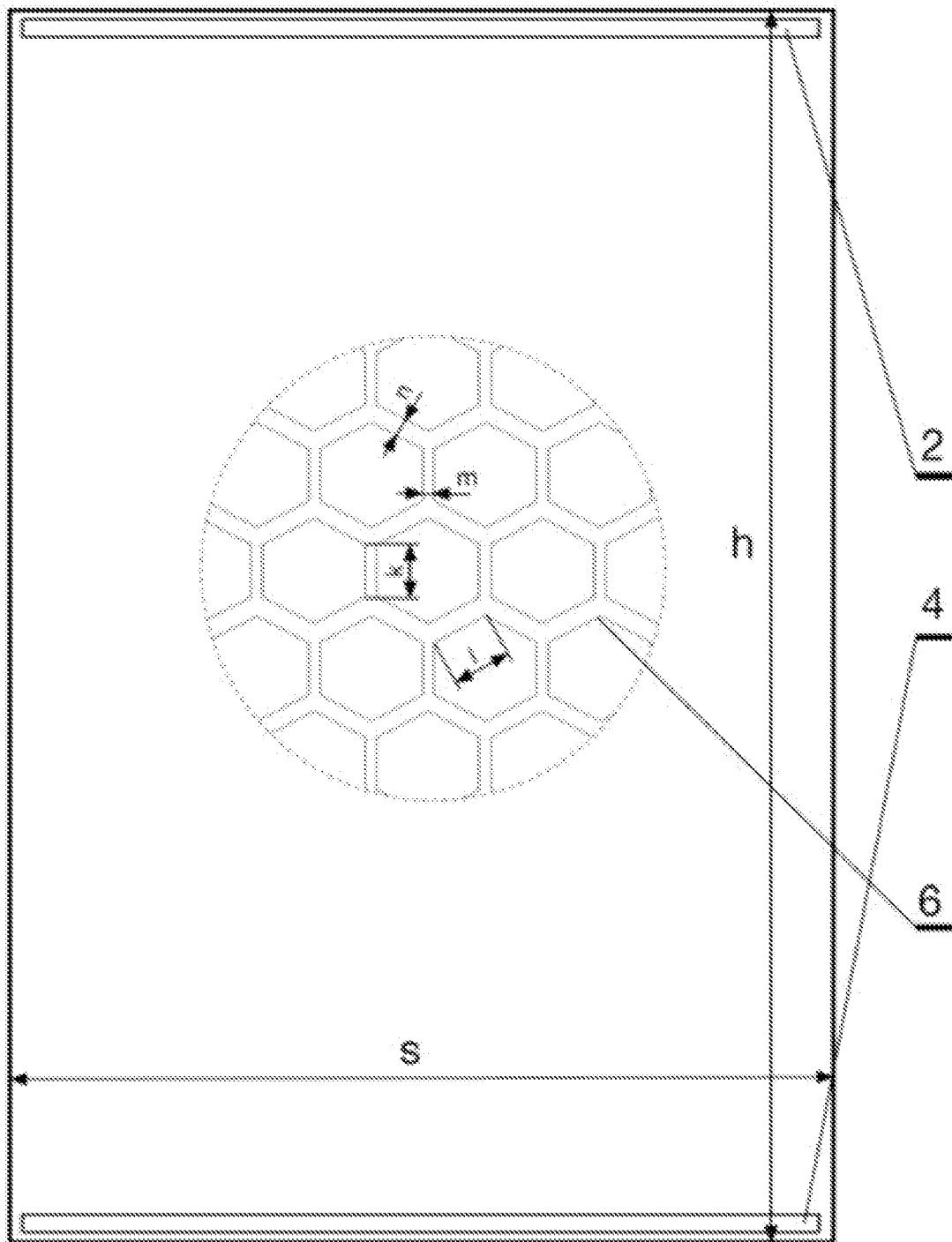
[Fig. 4]



[Fig. 5]

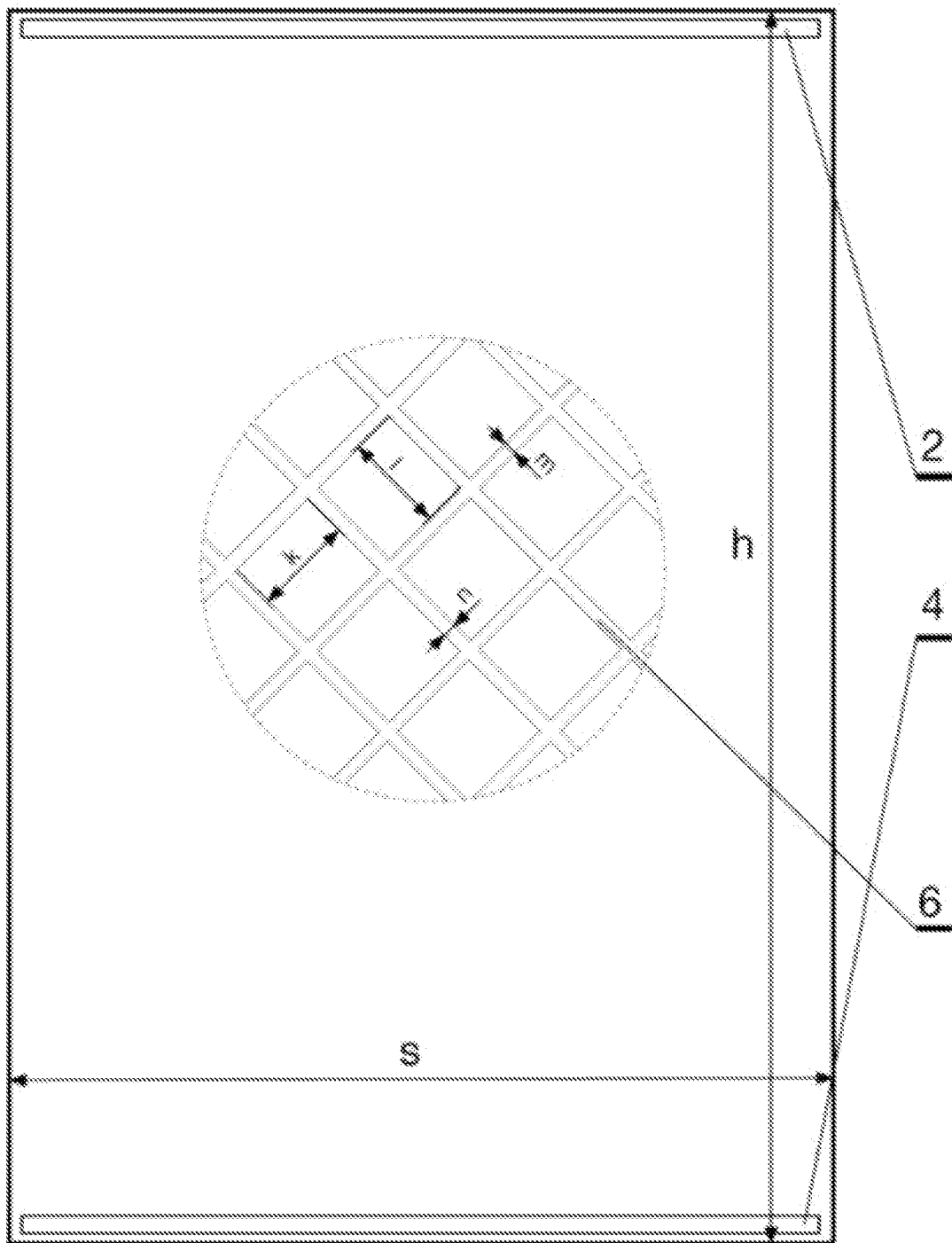


[Fig. 6]

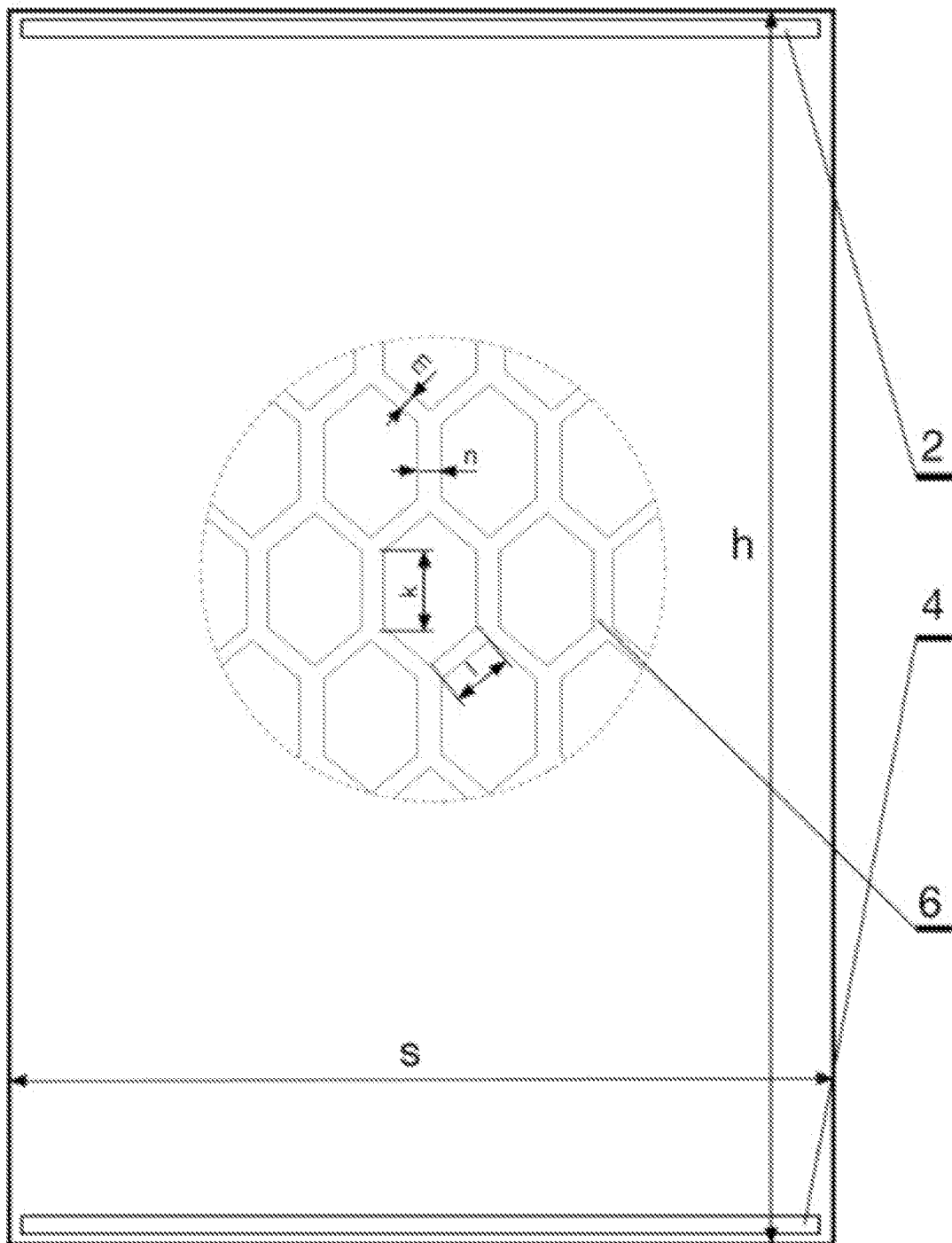




[Fig. 8]



[Fig. 9]



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CZ2019/050055

## A. CLASSIFICATION OF SUBJECT MATTER

H05B3/84, H05B3/86, C03C17/36, E06B3/663, H05B3/14, E06B7/12, G05D23/19

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H05B, C03C, E06B, G05D

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

Database IPO CZ

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

EPODOC, PATENW, X-Full, STN

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                          | Relevant to claim No. |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | DE 68908848 T2 (SAINT GOBAIN VITRAGE) 16 May 1990; descr. [0008], [0030] to [0033], [0036], fig. 3, 6                                                                                                                                       | 1 - 7                 |
| A         | US 2006292380 A1 (SAINT GOVAIN GLASS FRANCE) 28 December 2006; descr. [0033] to [0059], fig. 1                                                                                                                                              | 1 - 7                 |
| A         | US 5125195 A1 (HELMOT LINGEMANN GMBH & CO) 30 June 1992; pg. 2 to 3, 6, fig. 1                                                                                                                                                              | 1 - 7                 |
| A         | TOKUNO T., NOGI M., JIU J. SUGAHARA T. SUGANUMA K.: Transparent electrodes fabricated via the self-assembly of silver nanowires using a bubble template; 09 July 2012; Langmuir Vol. 28, No. 25, pp. 9298-9302, E-ISSN: 1520-5827; abstract | 1 - 7                 |

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

|                                                                                                                                                                         |                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| * Special categories of cited documents:                                                                                                                                | "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                                              |
| "A" document defining the general state of the art which is not considered to be of particular relevance                                                                | "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone                                                                     |
| "D" document cited by the applicant in the international application                                                                                                    | "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 |
| "E" earlier application or patent but published on or after the international filing date                                                                               | "&" document member of the same patent family                                                                                                                                                                                                    |
| "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                                                                  |                                                                                                                                                                                                                                                  |

Date of the actual completion of the international search  
20.02.2020

Date of mailing of the international search report

12. 03. 2020

Name and mailing address of the ISA/

VISEGRAD PATENT INSTITUTE  
 Branch Office CZ  
 Antonína Čermáka 2a, 160 68 Praha  
 Czech Republic

Facsimile No. +420 224 324 718

Authorized officer

Ing. Diana Sedláčková

Telephone No. +420 220 383 487

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CZ2019/050055

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

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                               | Relevant to claim No. |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | WO 2012018000 A1 (BRIDGESTONE CORP); 09 February 2012; abstract, fig. 1 to 3                                                                                                                                                                                                     | 1 - 7                 |
| A         | WO 9729616 A1 (FORMA SCIENT INC); 14 August 1997; pg. 17, fig. 2                                                                                                                                                                                                                 | 1 - 7                 |
| A         | GERHARDINGER P.: Coated Glass for Transparent Heating Elements, 01 November 2008<br><a href="https://www.techbriefs.com/component/content/article/tb/techbriefs/materials/3363">https://www.techbriefs.com/component/content/article/tb/techbriefs/materials/3363</a> ; web page | 1 - 7                 |
| A         | CZ 216594 A3 (SPLINTEX S.A.) 18 October 1995; pg. 7 to 8, fig. 1, 2                                                                                                                                                                                                              | 1 - 7                 |



**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.  
PCT/CZ2019/050055

|                  |                    |                   |
|------------------|--------------------|-------------------|
| DE 68908848 T2   | AT 93926 T         | 15 September 1993 |
|                  | CA 2001598 A1      | 27 April 1990     |
|                  | CA 2001598 C       | 30 May 2000       |
|                  | DK 173950 B1       | 04 March 2002     |
|                  | DK 532689 A        | 28 April 1990     |
|                  | EP 0368707 A1      | 16 May 1990       |
|                  | EP 0368707 B1      | 01 September 1993 |
|                  | ES 2045509 T3      | 16 January 1994   |
|                  | FI 91012 B         | 14 January 1994   |
|                  | FI 91012 C         | 25 April 1994     |
|                  | FR 2638513 A1      | 04 May 1990       |
|                  | FR 2638513 B1      | 04 January 1991   |
|                  | JP 2877386 B2      | 31 March 1999     |
|                  | JPH 02157385 A     | 18 Juni 1990      |
|                  | NO 176893 B        | 06 March 1995     |
|                  | NO 176893 C        | 14 Juni 1995      |
|                  | NO 894077 L        | 30 April 1990     |
| US 2006292380 A1 | AT 346476 T        | 15 December 2006  |
|                  | DE 602004003370 T2 | 27 September 2007 |
|                  | DK 1627555 T3      | 19 March 2007     |
|                  | EP 1627555 A1      | 22 February 2006  |
|                  | EP 1627555 B1      | 22 November 2006  |
|                  | ES 2277289 T3      | 01 July 2007      |
|                  | JP 2007500807 A    | 18 January 2007   |
|                  | JP 4638873 B2      | 23 February 2011  |
|                  | KR 100985075 B1    | 04 October 2010   |
|                  | KR20060017813 A    | 27 February 2006  |
|                  | US 7423239 B2      | 09 September 2008 |
| US 5125195 A1    | WO 2004110102 A1   | 16 December 2004  |
|                  | AT 105911 T        | 15 Juni 1994      |
|                  | CA 2043915 A1      | 21 September 1992 |
|                  | DE 9103448 U1      | 16 July 1992      |
|                  | DK 0504561 T3      | 26 September 1994 |
|                  | EP 0504561 A1      | 23 September 1992 |

|                  |                  |                   |
|------------------|------------------|-------------------|
|                  | EP 0504561 B1    | 18 May 1994       |
|                  | ES 2054512 T3    | 01 August 1994    |
|                  | FI 921198 A      | 21 September 1992 |
|                  | FI 97414 B       | 30 August 1996    |
|                  | FI 97414 C       | 10 December 1996  |
|                  | JP H05133168 A   | 28 May 1993       |
|                  | NO920443 L       | 21 September 1992 |
| WO 2012018000 A1 | JP 2012036019 A  | 23 February 2012  |
|                  | JP 5840831 B2    | 06 January 2016   |
| WO 9729616 A1    | AU 1850397 A     | 28 August 1997    |
|                  | US 2002047311 A1 | 25 April 2002     |
|                  | US 5792427 A     | 11 August 1998    |
|                  | US 6117687 A     | 12 September 2000 |
|                  | U S6503751 B2    | 07 January 2003   |
| CZ 216594 A3     | CZ 286724 B6     | 14 Juni 2000      |
|                  | DE 4431890 A1    | 16 March 1995     |
|                  | GB 2281683 A     | 08 March 1995     |
|                  | IT 1268092 B1    | 20 February 1997  |
|                  | IT TO940686 A1   | 07 March 1995     |