



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
31.10.2018 Bulletin 2018/44

(51) Int Cl.:
F24D 5/08 (2006.01) **F23C 3/00** (2006.01)
F23D 14/12 (2006.01)

(21) Application number: **18169790.5**

(22) Date of filing: **27.04.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Carlieuklima S.r.l.**
33074 Fontanafredda (PN) (IT)

(72) Inventor: **MARTOREL, Gastone**
31020 San Fior (TV) (IT)

(74) Representative: **Caldon, Giuliano**
Gallo & Partners S.r.l.
Via Rezzonico, 6
35131 Padova (IT)

(30) Priority: **28.04.2017 IT 201700046757 U**

(54) **HEATING SYSTEM WITH RADIANT STRIPS**

(57) Heating system with radiant strips, which comprises a closed loop provided with a delivery pipe (2A) and with a return pipe (2B), which are extended side-by-side and parallel to each other and are traversed by a carrier fluid (F) of combustion gas generated by a burner (3), in order to heat an underlying room by radiation. The radiant strip (2) comprises a sleeve (10) pro-

vided with a screen (11) placed as an external cover of the delivery pipes (2A) and return pipes (2B), on the upper part and laterally, and a shaped reflection plate (14), which is interposed between the delivery pipe (2A) and the return pipe (2B), in order to reflect the relative thermal radiation waves towards the room to be heated.

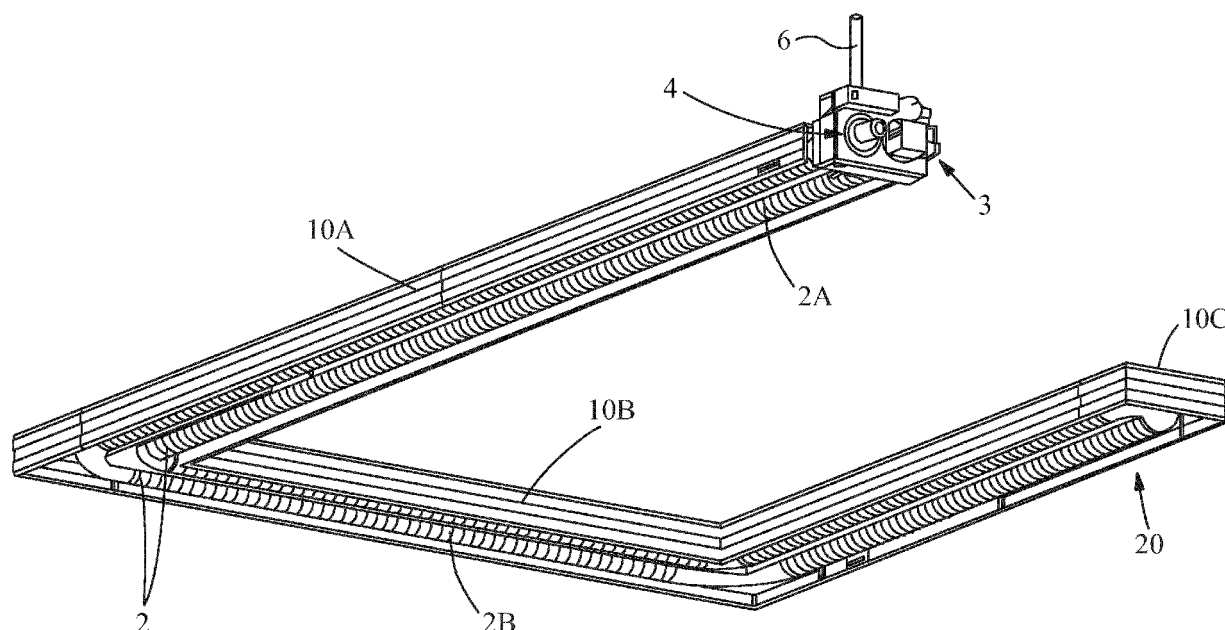


Fig. 1

Description

Field of application

[0001] The present finding refers to a heating system with radiant strips, according to the preamble of the main independent claim No. 1.

[0002] The present system is intended to be employed in order to heat settings, generally of large size and in general of buildings, and more particularly of industrial and commercial buildings, such as sheds, warehouses, hangars, supermarkets, shopping malls, sports centers or other buildings.

[0003] The system according to the finding is therefore inserted in the heat technology field, or in the technical field of production of heating systems.

State of the art

[0004] Heating systems with radiant strips have been known and used for some time, especially in industry. Such systems comprise one or more closed-loop radiant pipes adapted to be fixed to the ceiling or to a wall of a room that one wishes to heat and susceptible of being internally traversed by a heated carrier fluid constituted by exhaust gases and/or overheated air as better explained hereinbelow, in order to heat the underlying setting mainly by radiation.

[0005] The radiant strip forms a closed loop defined by a delivery pipe and by a return pipe, connected to each other at the respective ends by a connector duct in order to obtain the closure of the loop and allow the recirculation of the carrier fluid at their interior, which in particular is constituted by exhaust gases.

[0006] More in detail, the aforesaid delivery and return pipes are constituted by metal piping, generally made of steel, which are extended within the room to be heated parallel to and side-by-side each other, at a short distance from each other (usually about 30 mm) and for a length that generally varies from several tens of meters, i.e. up to even 100-150 meters. The pipes are on the upper part and laterally enclosed by a sleeve comprising a screen, usually constituted by metal sheet, aimed to reflect the heat waves downward, and a layer of insulating material placed outside the screen in order to limit the heat dispersions upward and laterally. The sleeve is associated with a support structure that is generally hung from the roof of the shed or more generally of the building to be heated.

[0007] The system also comprises a burner inserted in a combustion chamber, which is in connection with the initial section of the delivery pipe of the radiant strip in order to introduce hot gas fumes or overheated air therein.

[0008] The burner is connected to first means for supplying fuel, in particular pressurized gas, and second means for supplying a comburent, in particular air for obtaining a mixture in the burner that produces a com-

bustion reaction and produces hot fumes that are directly introduced into the delivery pipe, heating the carrier fluid that flows therein and in turn constituted by previously-burned exhaust gas. The mixing can also occur outside the combustion chamber, for example with the use of burners of premix type which are directly fed with a gas and air mixture in which the air and gas were closely premixed with each other.

[0009] The system also comprises a ventilator operating in a suction fashion, which is arranged at the terminal section of the return pipe of the radiant strip, in proximity to the burner. The ventilator is adapted to suction the carrier fluid which traversed the delivery pipe and the return pipe of the radiant strip and to force part of such carrier fluid laterally with respect to the burner by means of the connector duct, into the inlet section of the delivery pipe (generally around the combustion chamber) in order to close the circuit of the carrier fluid, enabling the recirculation thereof.

[0010] A fumes expulsion flue is also provided, preferably connected to the connector duct between the ventilator and the burner, which expels that amount part of the circulation carrier fluid that is substituted by new exhaust gases created in the burner.

[0011] The systems with radiant strips usually have a box-like containment body in which the following are housed: the burner with its combustion chamber, the ventilator for the circulation of the exhaust gases, the means for injecting air and gas into the combustion chamber and the connector between the delivery pipe and the return pipe with the bypass for the expulsion flue.

[0012] Normally, the radiant pipes are obtained starting from a continuous strip of metal material, e.g. aluminized steel, which is formed as a spiral, fixed together along the longitudinal edges so as to make a tubular body, according to production processes that are *per se* known to the man skilled in the art.

[0013] The thermal power emitted by radiation from the radiant pipe towards the environment to be heated depends of course on the temperature difference between the radiant pipe and the environment and on the capacity of the radiant pipe to direct the heat waves towards the underlying setting to be heated.

[0014] However, the systems with radiant strips of known type, described in brief above, have in practice proven that they do not lack drawbacks.

[0015] A first drawback lies in the fact that the return pipe returning to the thermal unit generally runs alongside the delivery pipe such that it receives thermal energy from the latter, with the result that the temperature of the carrier fluid is maintained high even in the return pipe. Such circumstance causes the expulsion of the exhaust fumes at the flue while they are still hot and thus limits the thermal efficiency of the entire system.

[0016] A further drawback lies in the fact that in accordance with the present configuration of the radiant strips, the delivery and return pipes generally lie about 30 mm from each other and are generally spaced another 30

mm or slightly more from the lateral sleeve; such circumstance in fact prevents the radiation emitted by the radiant pipe in the upper and partially lateral part of the pipes from descending downward, limiting the specific emissivity of the radiant strip, i.e. limiting the power delivered per unit of length of the radiant strip.

[0017] For example, it can be observed that the radiant strips of conventional type limit the circumference part used in the pipe as radiant emitter to about 36% of the entire circumference, while a greater emission area would instead be desirable.

[0018] A further drawback of the radiant strips of known type lies in the fact that since they are unable to introduce a sufficient quantity of heat per unit of length of radiant strip, they require using a high strip length. With this, both the costs of the materials used and the costs of system installation are increased.

Presentation of the finding

[0019] Therefore, in this situation, the main object of the present finding is to overcome the drawbacks of the abovementioned prior art, by providing a heating system with radiant strips which is able to improve the efficiency by reducing the temperature of the exhaust gases expelled at the flue.

[0020] A further object of the present finding is to provide a heating system with radiant strips, which has an improved specific emissivity, increasing the power delivered per unit of length of the radiant strip.

[0021] A further object of the present finding is to provide a heating system with radiant strips, which is inexpensive and entirely reliable in operation.

Brief description of the drawings

[0022] The technical characteristics of the finding, according to the aforesaid objects, can be clearly seen in the contents of the enclosed claims and the advantages thereof will be more evident in the following detailed description, made with reference to the enclosed drawings, which represent a merely exemplifying and non-limiting embodiment of the finding, in which:

- Figure 1 shows a schematic view of a heating system with radiant strips;
- Figure 2 shows a schematic view of a heating system portion with radiant strips, object of the present finding, mounted in a room;
- Figures 3A and 3B show a schematic cross-section view respectively of the heating system with radiant strips, object of the present finding, and of a heating system with radiant strips of known type, with several sections highlighted of the angular sectors of the pipes that radiate directly to the ground, the sectors which reflect, the sectors from which the radiations do not exit from the sleeve and - in the case of the prior art system - the sector of the pipe directed to-

wards the flanking pipe;

- Figure 4 shows a comparative table indicating the angles of the different sectors of the radiant pipe, pursuant to the preceding figure, both for the system, object of the present finding, and for the system of the prior art;
- Figures 5A and 5B show a schematic cross-section view respectively of the heating system with radiant strips, object of the present finding, and of the heating system with radiant strips of known type, with the size of the different parts highlighted;
- Figure 6 shows a perspective view of a portion of the heating system with radiant strips, object of the present finding, with the following illustrated: the two delivery and return pipes and the covering sleeve above and lateral thereto, with insulation removed in order to better show an underlying screen.

Detailed description

[0023] With reference to the enclosed drawings, reference number 1 indicates the heating system with radiant strips, object of the present finding.

[0024] The heating system 1, according to the finding, is intended to be employed for heating large-cubature settings, i.e. characterized by large surfaces and high heights ($\geq 4\text{m}$), usually in industrial or commercial buildings, such as sheds, hangers, warehouses, supermarkets, shopping malls, cinemas or the like.

[0025] In particular, the system 1 according to the present finding is intended to be installed in the room that one wishes to heat with a distance from the ground and with an orientation that are suitably selected for ensuring the desired heating of a selected zone of the room or of the entire room itself.

[0026] The heating system 1, object of the present finding, comprises a closed loop with radiant strips 2, susceptible to be fixed to the ceiling or to a wall of a room to be heated, maintained suspended and spaced from the ground of the room itself, and adapted to be internally traversed by a carrier fluid F, in order to heat the room itself by radiation.

[0027] Of course, the system 1, rather than being fixed directly to the ceiling or to a wall, can also be fixed to beams or to columns or to poles associated therewith or to any structure susceptible to safely support the radiant strips 2 themselves and hence the system 1, without departing from the protective scope defined by the present patent.

[0028] More in detail, the aforesaid closed loop with radiant strips 2 comprises at least one delivery pipe 2A and at least one return pipe 2B, which are extended side-by-side and parallel to each other and are susceptible of being internally traversed by a carrier fluid F of combustion gas, in order to heat the room by radiation.

[0029] Each pipe is formed by a metal tube which is extended with a length that for example can vary from several tens of meters up to reaching even 100-150 me-

ters.

[0030] Advantageously, the aforesaid pipes 2A, 2B are made of metal subjected to a process of calorization.

[0031] Preferably, the metal pipes 2A, 2B are obtained starting from a continuous strip of metal material, for example aluminized steel, which is formed as a spiral with the longitudinal edges fixed together so as to obtain a continuous tubular body, according to the production processes *per se* known to the man skilled in the art.

[0032] The delivery pipe 2A and the return pipe 2B are connected to each other at the respective ends in order to define the closed loop and allow the circulation of the carrier fluid F at its interior. Of course, the system 1 can comprise multiple radiant strips 2 without departing from the defined protective scope defined by the present patent.

[0033] The pipes are on the upper part and laterally enclosed by a sleeve 10, which defines a containment body open downward and formed by two lateral walls 10A and 10B and by an upper wall 10C. The sleeve 10 comprises a screen 11, for example constituted by a metal sheet, aimed to reflect the heat waves downward, and a layer of insulating material 12 placed outside the screen 11 in order to limit the heat dispersions. The sleeve 10 is associated with a support structure (not illustrated) which is generally hung from the ceiling of the shed or more generally of the building to be heated.

[0034] The sleeve 10 also supports, within the containment body defined by its walls 10A, 10B and 10C, the delivery and return pipes 2A and 2B for example by means of chains 16.

[0035] The system 1, object of the present finding, also comprises - in an entirely conventional manner - a burner 3 for producing the flow of combustion gas F. In operation, the latter transfers the heat to the pipes of the radiant strip 2 which in turn heats by radiation the underlying areas of the settings in which the radiant strip 2 is extended.

[0036] The radiant strip 2 makes a closed loop, in order to recover part of the flow of exhaust gases F with the relative residual heat and in order to make it circulate in the pipes 2A and 2B together with the new exhaust gas flow emitted by the burner 3.

[0037] The burner 3 of the system 1 is inserted in a combustion chamber, which is in connection with the initial section of the delivery pipe 2A of the radiant strip 2 in order to introduce the hot gas fumes therein.

[0038] The burner 3 is connected in a *per se* known manner to first means for feeding fuel, in particular pressurized gas, and to second means for feeding a comburent, in particular air, in order to achieve a mixture in the burner 3 that produces a combustion reaction and develops the hot fumes which are directly introduced into the delivery pipe 2A by heating the carrier fluid F that flows therein, in turn constituted by previously-burnt exhaust gas. The mixing can also occur outside the combustion chamber, for example with the use of burners of premix type fed directly with a mixture of gas and air, in which

the air and gas were closely premixed with each other.

[0039] The system 1 also comprises a ventilator 4 operating in a suction manner, which is arranged at the terminal section of the return pipe 2B of the radiant strip 2, in proximity to the burner 3. The ventilator 4 is adapted to suction the carrier fluid F that has crossed the delivery pipe 2A and the return pipe 2B of the radiant strip 2 and to force part of such carrier fluid F into a jacket placed around the burner 3 by means of a recirculation chamber 5, up to conducting it into the inlet section of the delivery pipe 2A placed immediately downstream of the combustion chamber, in order to close the circuit of the carrier fluid F and allow the recirculation thereof.

[0040] A fumes expulsion flue 6 is also provided, preferably linked to the recirculation chamber 5 between the ventilator 4 and the burner 3, which expels that amount part of the carrier circulation fluid F which is substituted by the new exhaust gases created by the burner 3.

[0041] The system 1 with radiant strips also has, in an entirely conventional manner, a containment structure 7, preferably box-like and metallic, for example made of steel, advantageously positioned in an external setting with respect to the environment to be heated, where instead the strips 2 are placed. Within the containment structure 7, the following are housed: the burner 3 with its combustion chamber, the ventilator 4 for the circulation of the exhaust gases, the means for injecting the air and the gas into the combustion chamber and the recirculation chamber 5 between the delivery pipe 2A and the return pipe 2B, with the bypass for the expulsion flue 6.

[0042] The recirculation chamber 5 connects together the initial section of the delivery pipe 2A and the final section of the return pipe 2B.

[0043] Therefore, the two delivery and return pipes 2A, 2B lead, with one end thereof, to the recirculation chamber 5 placed within the containment structure 7 while at the other end they are preferably connected, in a *per se* conventional manner, with a 180-degree connector 20 or connector with U-shaped extension, well-known to the man skilled in the art.

[0044] The ventilator 4 is provided with a fan inserted in the recirculation chamber and operating in a suction manner to force the carrier fluid F within the circuit of radiant strips 2, from the final section of the return pipe 2B to the initial section of the delivery pipe 2A.

[0045] The fuel is advantageously in gaseous form and is for example constituted by methane, or it can be in liquefied form, and be for example constituted by LPG.

[0046] The part of exhaust gases suctioned by the ventilator 4, and not sent to the connector duct 5 towards the burner 3 to close the loop of the carrier fluid F, is sent to the expulsion flue 6, which is therefore pressurized.

[0047] In accordance with the idea underlying the present finding, the screen 10 comprises at least one shaped reflection plate 14, which is interposed between the delivery pipe 2A and the return pipe 2B, in order to reflect most of the relative thermal radiation waves towards the room to be heated.

[0048] In accordance with the embodiment illustrated in the enclosed figures, the shaped reflection plate 14 defines a concavity 15 directed upward in an opposite direction with respect to the room to be heated. The afore-said concavity 15 of the shaped reflection plate 14 is advantageously obtained with V shape by means of bending of a metal sheet, with the two tilted sides aimed to reflect the thermal radiation of the two contiguous delivery and return pipes 2A, 2B, towards the room to be heated.

[0049] In accordance with a different embodiment, not illustrated in the enclosed figures, the shaped reflection plate 14 comprises a sheet, possibly also with flat shape, interposed between the delivery pipe 2A and the return pipe 2B and positioned with its opposite faces directed towards the corresponding pipes 2A, 2B.

[0050] The shaped reflection plate 14 is advantageously part of a sheet which is extended to cover at least on the upper part of said pipes with two lateral portions 14A and 14B, in particular horizontal according to the example of the enclosed figures and in particular well-illustrated in figure 6. The same lateral portions 14A and 14B could otherwise assume a downward concave shape, substantially following the convexity of the pipes.

[0051] In accordance with a particular embodiment of the finding, the screen 11 is substantially entirely constituted by the shaped reflection plate 14. Otherwise, the screen 11 can comprise further components besides the shaped reflection plate 14.

[0052] Advantageously, the lateral walls 10A and 10B of the sleeve 10 are respectively spaced from the delivery pipe 2A and from the return pipe 2B by a first distance D1 comprised in the interval between 60 mm and 200 mm, and preferably the delivery pipes 2A and return 2B pipes are spaced from each other by a second distance D2 comprised in the interval between 100 mm and 350 mm.

[0053] In particular, if the delivery and return pipes 2A, 2B have diameter comprised between about 250 mm and 350 mm (and preferably about 300 mm), the first distance D1 of each pipe 2A, 2B from the respective lateral wall 10A, 10B is comprised between 80 mm and 200 mm and preferably on the order of 150 mm, and advantageously the second distance D2 between the two pipes 2A, 2B is comprised in the interval between 200 mm and 350 mm and preferably on the order of 275 mm.

[0054] If the delivery and return pipes 2A, 2B have diameter comprised between about 150 mm and 250 mm (and preferably about 200 mm), the first distance of each pipe 2A, 2B from the respective lateral wall 10A, 10B is comprised between 60 mm and 120 mm and preferably on the order of 80 mm, and advantageously the second distance D2 between the two pipes 2A, 2B is comprised in the interval between 90 mm and 150 mm and preferably on the order of 120 mm.

[0055] As can be appreciated in figure 5B relative to a conventional prior art system, in which the equivalent elements are indicated with the subscript, the values of D1'

and D2' are much less, and generally 30 mm, with delivery and return pipes with diameter of about 300 mm

[0056] Preferably, with reference to the example of figure 3A, the lateral radiation angle α of each of the two delivery 2A and return 2B pipes (which is extended between the line joining the lower end of each lateral wall 10A, 10B with the center of the respective pipe 2A, 2B and the vertical line that passes through the center of such pipe 2A, 2B) is comprised in the interval between 50 and 70 degrees and in particular is approximately 60 degrees.

[0057] The delivery pipe 2A and the return pipe 2B advantageously have diameter H comprised between 150 and 400 mm and in particular approximately comprised between 200 and 300 mm as a function of the capacity.

[0058] Advantageously, if the delivery and return pipes 2A, 2B have diameter comprised between about 250 mm and 350 mm (and preferably about 300 mm), the width L of the sleeve 10 is comprised between 1100 mm and 1300 mm and in particular is approximately about 1200 mm (while the sleeves 10' of conventional systems are narrower, with width L' on the order of about 800 mm with pipes of diameter of about 300 mm).

[0059] If the delivery and return pipes 2A, 2B have diameter comprised between about 150 mm and 250 mm (and preferably about 200 mm), the width L of the sleeve 10 is comprised between 700 mm and 900 mm and in particular is approximately about 800 mm (while the sleeves 10' of conventional systems are narrower, with width L' on the order of about 600 mm with pipes of diameter of about 200 mm).

[0060] The screen 11 comprises at least one lateral shaped band (110), and preferably two lateral bands (110), in particular obtained with a layer of insulation covered with a reflecting layer.

[0061] The two lateral shaped bands 110 of the screen 11 are connected with the lateral portions 14A and 14B of the shaped reflection plate 14 and with the lateral walls 10A, 10B of the sleeve 10. Such lateral shaped bands 110 can be made of sheet as a continuation of the lateral portions 14A and 14B of the shaped reflection plate 14 or they can be formed by insulating layers covered with a reflecting layer, such as an aluminum sheet.

[0062] Advantageously, such lateral shaped bands 110 are extended with multiple flat sections in succession 15A, 15B, 15C, connected together by bends 160 or by curvilinear connectors, in order to approximate the cylindrical extension of the pipes 2A, 2B.

[0063] Due to the shape of the shaped reflection plate 14 (or also of the two lateral shaped bands 110), the arc percentage of the circular section of the radiant pipes 2A, 2B useful for radiating the room directly or due to the reflection of the shaped plate (and/or of the lateral shaped bands 110 for example, as stated, being formed even only by covered insulator) is comprised between 50 and 70% while in the case of the prior art system it is on the order of 36%, as highlighted in the table of figure 4.

[0064] The pipes 2A, 2B are positioned with respect to

the screen 11 at a distance such to allow most of the heat radiated towards said screen 11 to be reflected downward.

[0065] The system 1 according to the finding as described above allows attaining the following advantages with respect to the prior art systems: a greater overall efficiency of the system; a greater specific emissivity of the radiant strip; a substantial reduction of the costs of the radiant strip given the same delivered power.

[0066] The greater efficiency of the radiant strip 2 is due to the interposition of the shaped reflection plate 14 between the two radiant pipes 2A and 2B, which does not allow the return pipe 2B to receive thermal energy from the delivery pipe 2A, with the result of being able to lower the temperature of the exhaust products, hence expel less energy at the fumes expulsion flue 6 and thus increase the system efficiency.

[0067] The greater specific emissivity of the radiant strip 2, i.e. greater power delivered per unit of length of the radiant strip 2, is due to the fact that while presently the pipes lie about 30 mm from each other and the same lie another 30 mm or slightly more from the insulation of the lateral walls 10A, 10B of the sleeve, actually preventing the upper and lateral radiation emitted by the radiant pipe 2A, 2B from descending downward, the system 1 according to the finding, providing for a distance between the radiant pipes 2A, 2B of about 275 mm and a distance between pipes 2A, 2B and lateral insulating wall 10A, 10B of about 150 mm, allows most of the radiation emitted by the upper part of the radiant pipes 2A, 2B to be reflected downward, i.e. towards the part of the building to be heated.

[0068] Therefore, while in the radiant strip known up to now the circumference part used as radiant emitter is about 36% of the circumference, in the configuration of radiant strip 2 according to the finding the percentage of surface employed for the radiant emission is greater than 60%.

[0069] Therefore, the system 1 according to the finding, being able to obtain a considerable increase of the heat quantity emitted into the environment in radiant form, given the same power, does not require the same length of radiant strip but a clearly smaller strip length, thus reducing both the costs of the materials used and the costs of installation of the considered equipment.

[0070] In particular, the present system 1 is particularly suitable for being employed with pipes (delivery 2A and return 2B) obtained starting from metal strips subjected to calorization treatment, in particular calorized aluminized steel; indeed such pipes 2A, 2B, being treated over the entire circumference, allow increasing the radiation associated with the reflection of the shaped reflection plate 14 of the screen 11, obtaining an emission that is higher, more uniform and constant over time. This contrasts with the pipes of known type, which are only partially painted in the lower part.

[0071] In particular, the pipes 2A, 2B obtained from the aforesaid calorized metal strips are able to irradiate heat

at 360° (hence more greatly exploiting the arrangement of the shaped reflection plate 14) without having to execute painting on the pipes (and in particular over the entire surface thereof), with a consequent saving in terms of manufacturing costs, production waste, etc.

[0072] The finding thus conceived therefore attains the pre-established objects.

10 Claims

1. Heating system (1) with radiant strips, which comprises:

- at least one closed loop with radiant strips (2), which comprises at least one delivery pipe (2A) and at least one return pipe (2B), which are extended side-by-side and parallel to each other, is susceptible of being associated with the ceiling and/or with the wall of a room to be heated, and it is adapted to be internally traversed by a carrier fluid (F) of combustion gas and/or overheated air, in order to heat said room by radiation;
- at least one burner (3), which is adapted to generate said carrier fluid (F) and to introduce said carrier fluid (F) in said delivery pipe (2A);
- at least one sleeve (10) comprising at least one screen (11) placed as an external cover of said delivery pipe (2A) and return pipe (2B), on the upper part and laterally;

said heating system (1) being **characterized in that** said screen (11) comprises at least one shaped reflection plate (14), which is interposed between said delivery pipe (2A) and said return pipe (2B), in order to reflect at least part of the relative thermal radiation waves towards the room to be heated.

2. Heating system (1) with radiant strips according to claim 1, **characterized in that** said shaped reflection plate (14) defines a concavity (15), which is intended to be directed in the opposite direction with respect to said room to be heated.

3. Heating system (1) with radiant strips according to claim 2, **characterized in that** the concavity (15) of said shaped reflection plate (14) is substantially V-shaped with two tilted sides aimed to reflect the thermal radiation towards the room to be heated.

4. Heating system (1) with radiant strips according to claim 3, **characterized in that** said V shape of the shaped reflection plate (14) is obtained by means of bends from a metal sheet.

5. Heating system (1) with radiant strips according to any one of the preceding claims, **characterized in**

that said shaped reflection plate (14) is part of a sheet that is extended with two lateral portions (14A, 14B) to cover, at least on the upper part, said delivery pipe (2A) and return pipe (2B).

6. Heating system (1) with radiant strips according to any one of the preceding claims, **characterized in that** said sleeve (10) comprises two lateral walls (10A, 10B), which are respectively spaced from said delivery pipe (10A) and from said return pipe (10B) by a first distance (D1) comprised in the interval between 60 mm and 200 mm. 5
7. Heating system (1) with radiant strips according to any one of the preceding claims, **characterized in that** said delivery pipe (2A) and said return pipe (2B) are spaced from each other by a second distance (D2) comprised in the interval between 100 mm and 350 mm 10
8. Heating system (1) with radiant strips according to any one of the preceding claims, **characterized in that** said delivery pipe (2A) and said return pipe (2B) have diameter comprised between 150 mm and 400 mm. 15
9. Heating system (1) with radiant strips according to claim 8, **characterized in that** the width (L) of said sleeve (10) is comprised between 1100 mm and 1300 mm, with said delivery pipe (2A) and said return pipe (2B) having diameter comprised between 250 mm and 350 mm. 20
10. Heating system (1) with radiant strips according to claim 8, **characterized in that** the width (L) of said sleeve (10) is comprised between 700 mm and 900 mm, with said delivery pipe (2A) and said return pipe (2B) having diameter comprised between 150 mm and 250 mm. 25
11. Heating system (1) with radiant strips according to claim 5, **characterized in that** said screen (11) comprises at least one lateral shaped band (110), which is connected with a corresponding one of said lateral portions (14A, 14B) of said shaped reflection plate (14) and is connected with the corresponding said lateral wall (10A, 10B) of said sleeve (10). 30
12. Heating system (1) with radiant strips according to claim 11, **characterized in that** it comprises two said two lateral shaped bands (110), which are extended with multiple flat sections (15A, 15B, 15C) in succession connected together by bends (160), in order to approximate the cylindrical extension of said delivery pipe (2A) and return pipe (2B). 35
13. Heating system (1) with radiant strips according to any one of the preceding claims, **characterized in** 40

that the arc percentage of the circular section of said delivery pipe (2A) and of said return pipe (2B) adapted to radiate the room, directly or by means of the reflection of said shaped plate (14), is comprised between 50% and 70%. 45

14. Heating system (1) with radiant strips according to any one of the preceding claims 1 to 12, **characterized in that** the arc percentage of the circular section of said delivery pipe (2A) and of said return pipe (2B) adapted to radiate the room, directly or due to the reflection of said shaped plate (14), is greater than 60%. 50
15. Heating system (1) with radiant strips according to any one of the preceding claims, **characterized in that** said sleeve (10) comprises a layer of insulating material (12) placed as an external cover of said screen (11). 55

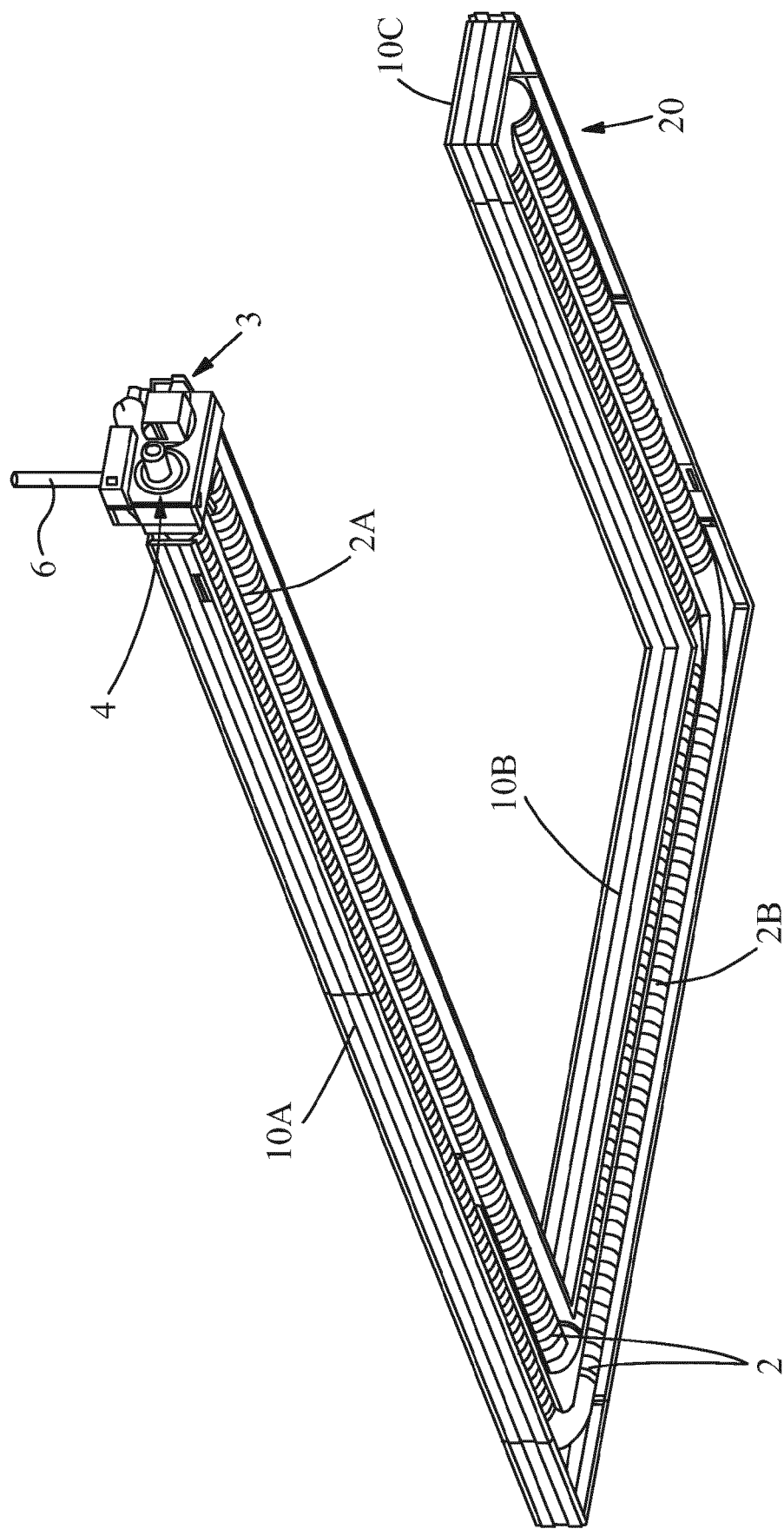


Fig. 1

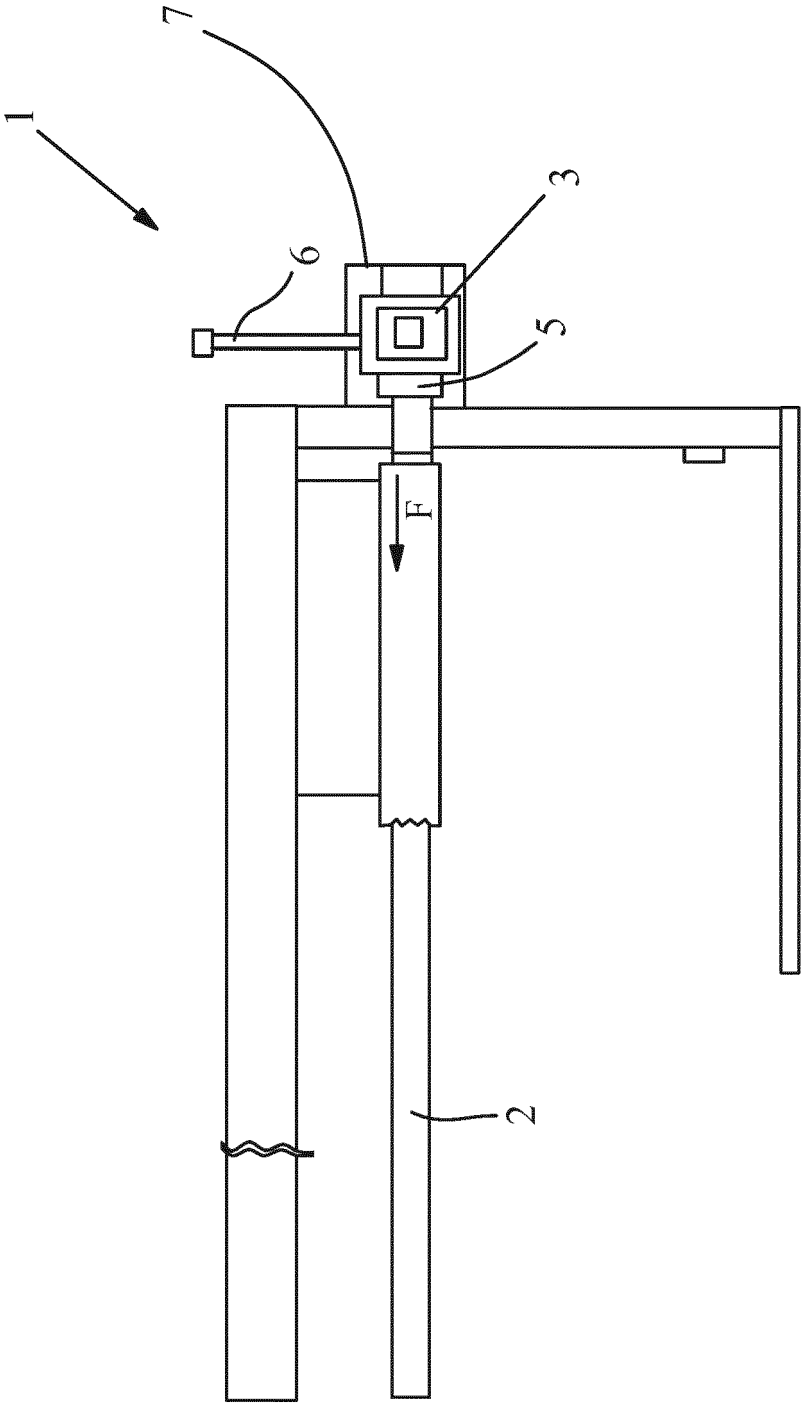


Fig. 2

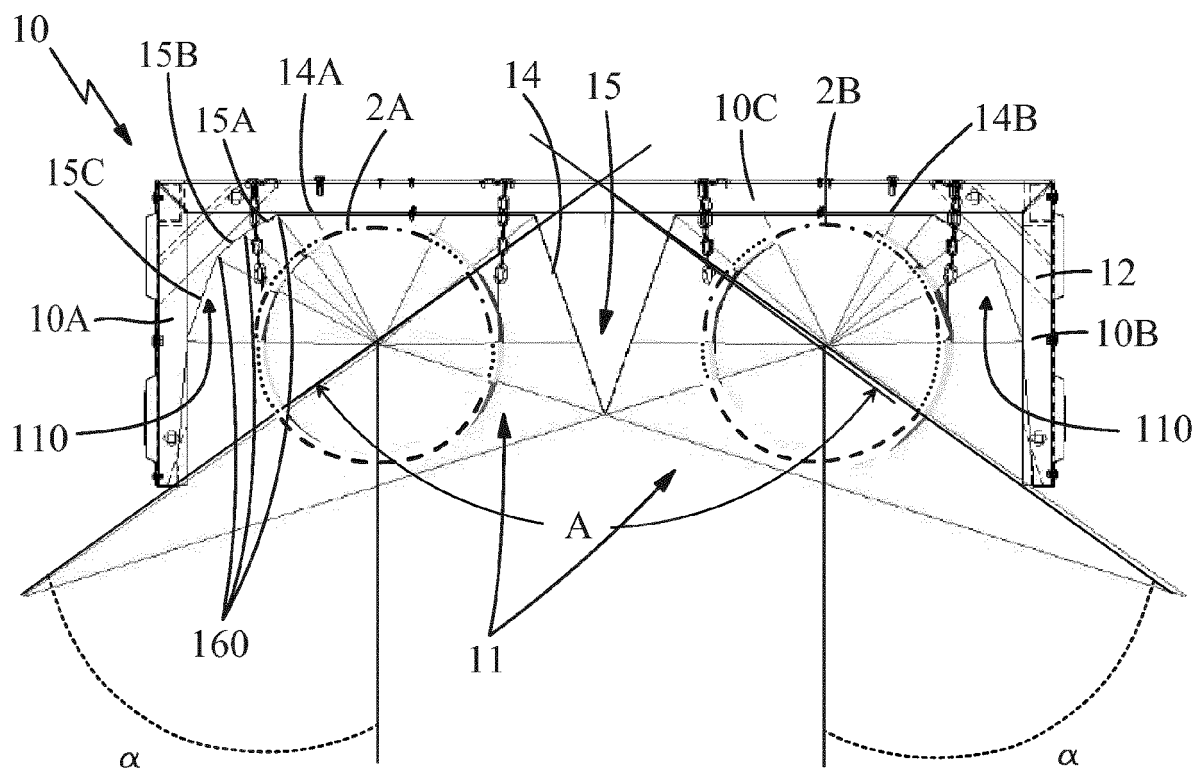


Fig. 3A

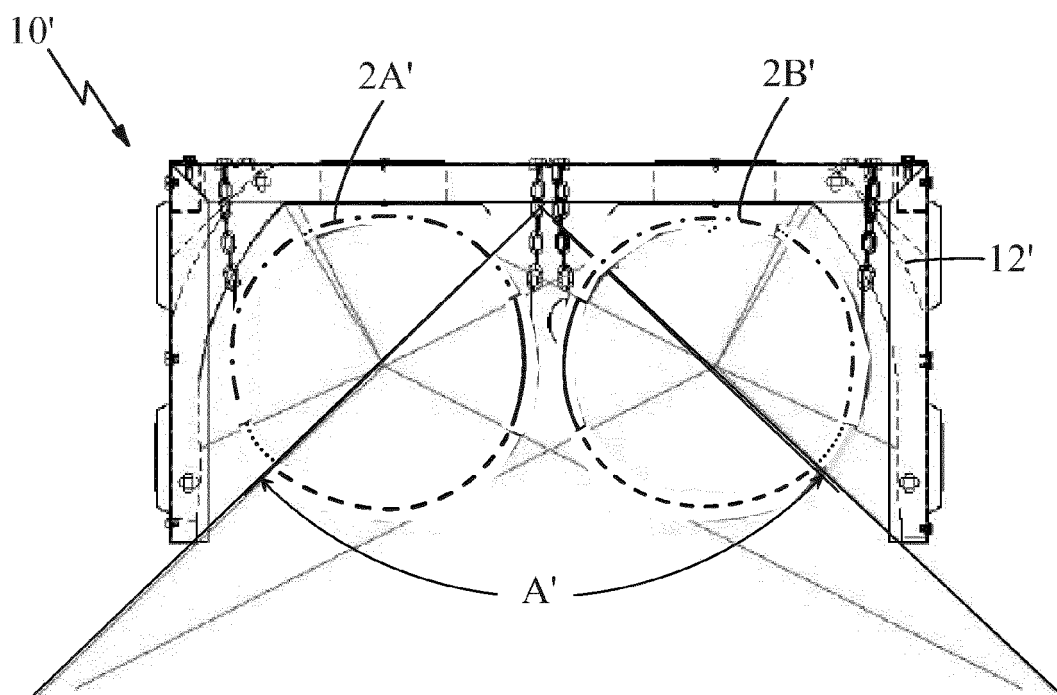


Fig. 3B

RADIAN EMISSION	ARC GRAPHICS IN THE FIGURE	STANDARD ARC LENGTH (mm)	300 (mm) ARC LENGTH ACCORDING TO THE INVENTION	% OVER THE TOTAL PERIMETER OF THE STANDARD STRIP	% OVER THE TOTAL PERIMETER OF THE INVENTION STRIP	RADIANT SURFACE AREA (m2) FOR 75m STANDARD SYSTEM	RADIANT SURFACE AREA (m2) FOR 75m HE 300 INVENTION SYSTEM
TUBE AGAINST TUBE		148,5	0,0	15,6	0,0	22,3	0,0
DOES NOT EXIT FROM THE MODULE		457,2	349,1	48,0	36,7	68,6	52,4
NON-EMITTED TOTAL		605,7	349,1	63,6	36,7	90,9	52,4
DIRECT EMISSION		286,6	337,8	30,1	35,5	43,0	50,7
REFLECTED EMISSION		59,6	265,1	6,3	27,8	8,9	39,8
EMITTED TOTAL		346,2	602,8	36,4	63,3	51,9	90,4

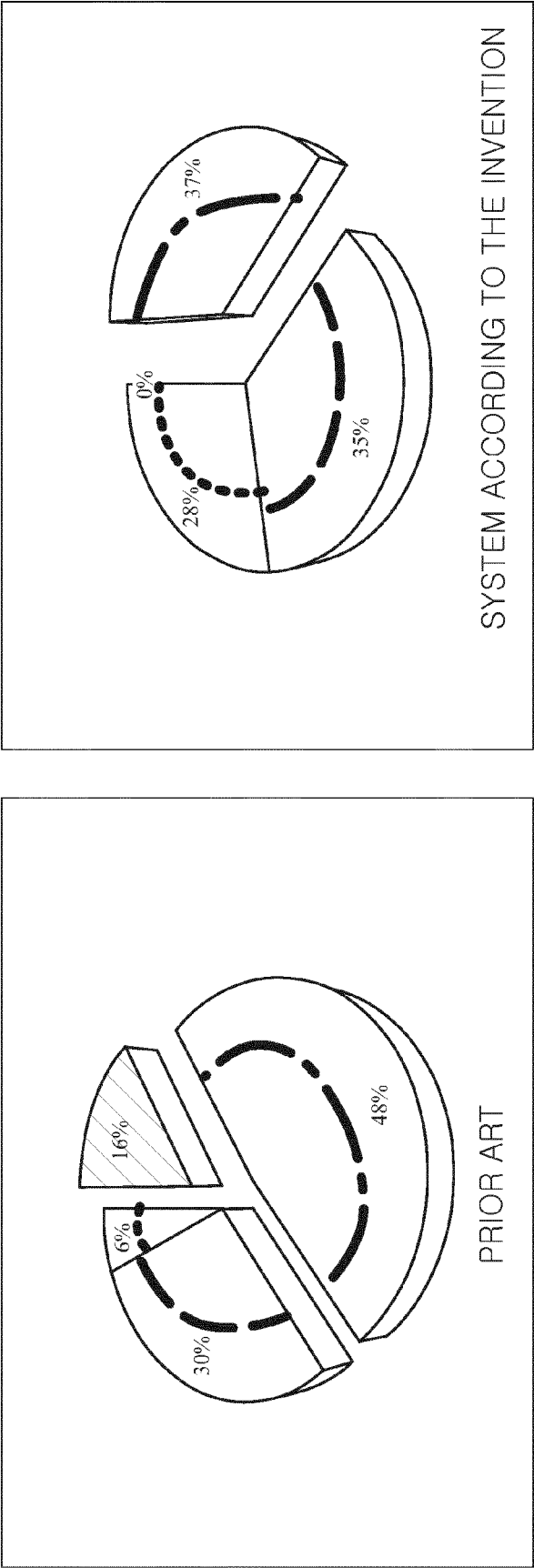


Fig. 4

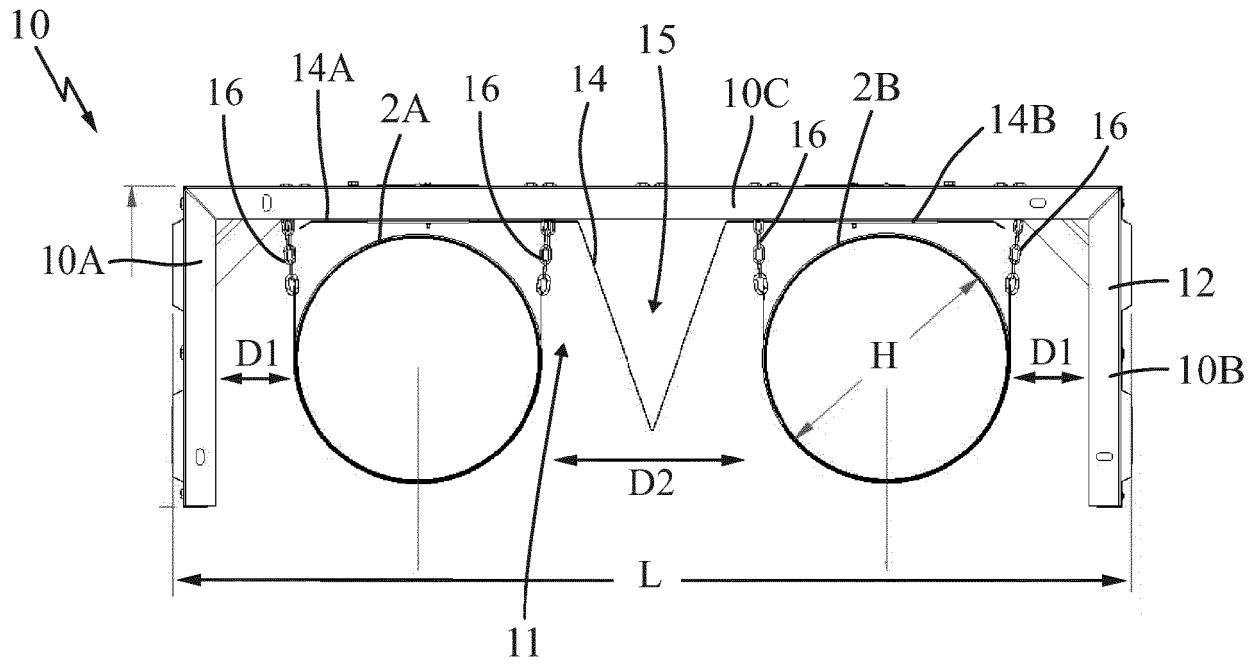


Fig. 5A

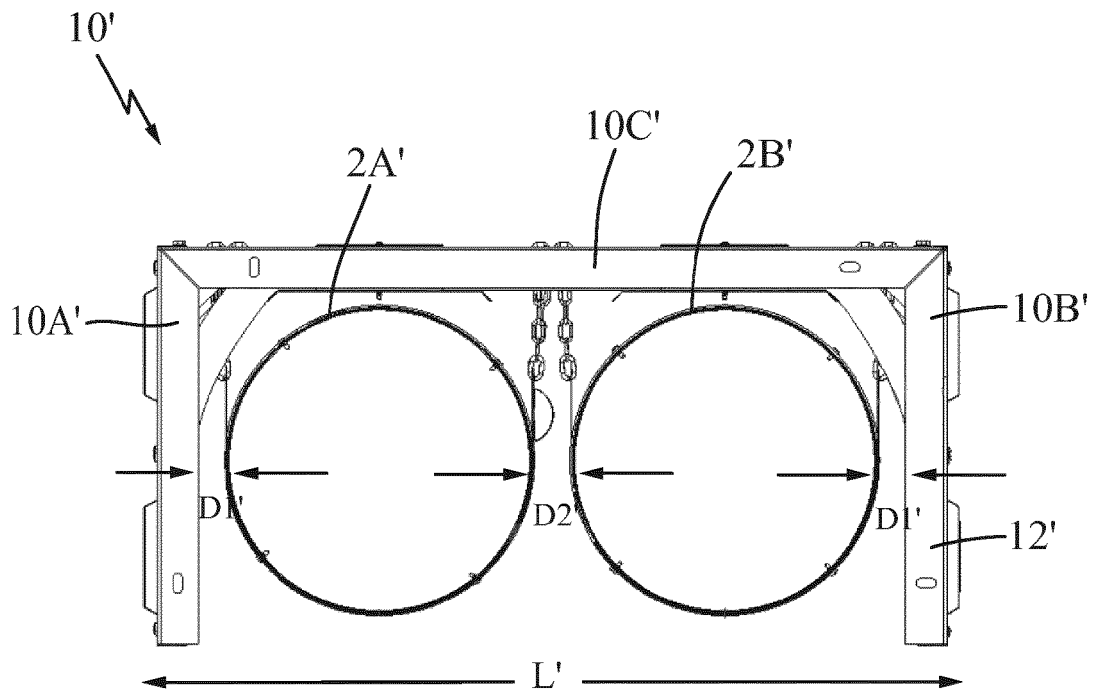


Fig. 5B

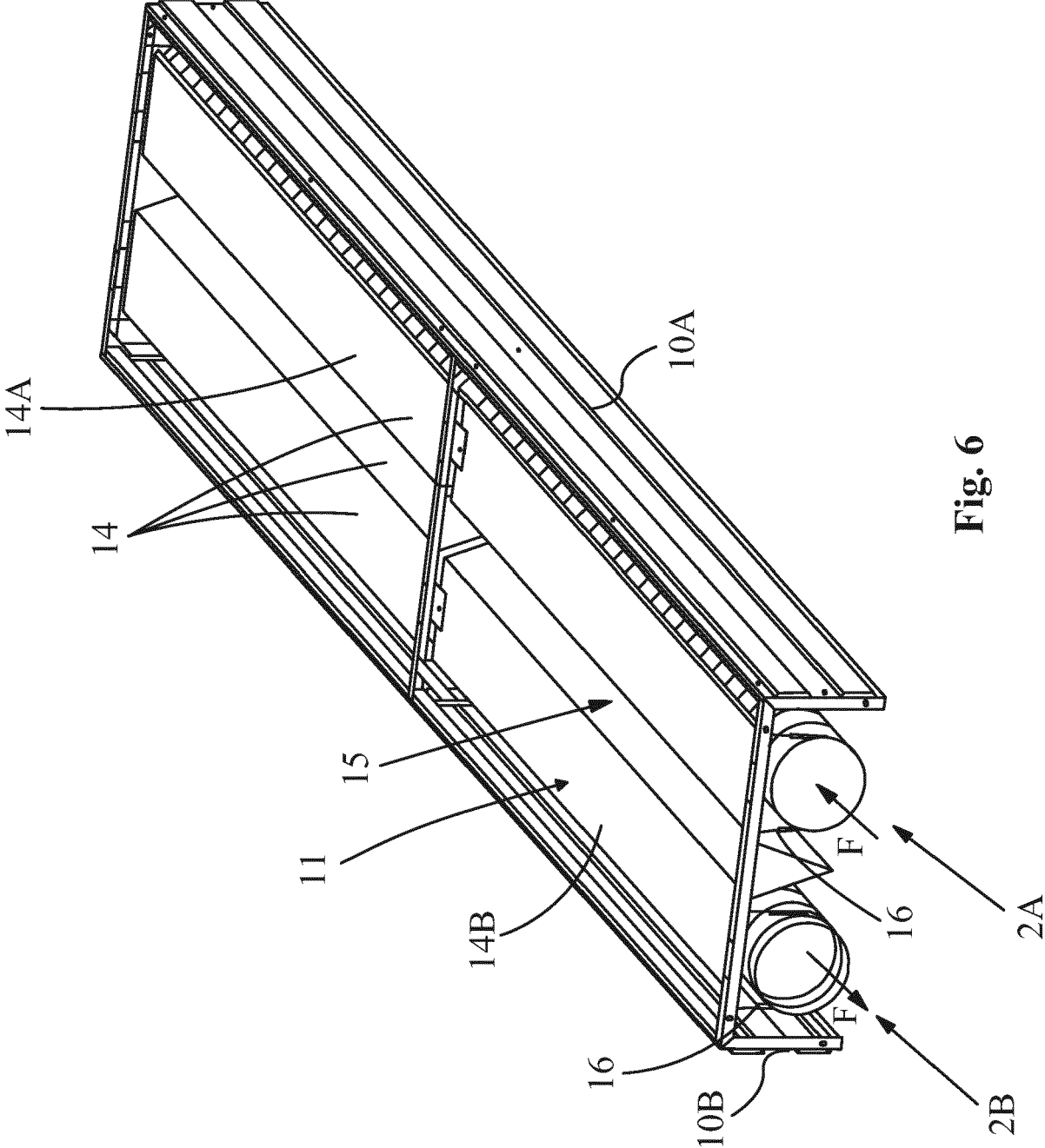


Fig. 6



EUROPEAN SEARCH REPORT

Application Number
EP 18 16 9790

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2015/204538 A1 (BRICE MARTIN [US] ET AL) 23 July 2015 (2015-07-23)	1-11, 13-15	INV. F24D5/08 F23C3/00 F23D14/12
Y	* paragraphs [0044] - [0048]; figures 1, 2 *	12	
X	WO 96/10720 A1 (JONES PHILOMENA JOAN [GB]; JONES DAVID MERVYN [GB]) 11 April 1996 (1996-04-11)	1-11, 13-15	
Y	* pages 17-21; figures 1-5 *	12	
X	WO 91/06810 A1 (GAZ IND [FR]) 16 May 1991 (1991-05-16)	1,5-10, 15	
Y	* pages 5-7; figures 1-3, 8 * * page 9, line 30 - page 10, line 29 *	12	
TECHNICAL FIELDS SEARCHED (IPC) F24D F23C F23D			
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 August 2018	Examiner Schwaiger, Bernd
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 16 9790

5

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

29-08-2018

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015204538 A1	23-07-2015	NONE	
WO 9610720 A1	11-04-1996	AU 3572495 A CA 2201167 A1 EP 0783653 A1 EP 1099909 A2 US 6138662 A WO 9610720 A1	26-04-1996 11-04-1996 16-07-1997 16-05-2001 31-10-2000 11-04-1996
WO 9106810 A1	16-05-1991	FR 2653536 A1 IT 1242725 B JP 3147379 B2 JP H04504302 A WO 9106810 A1	26-04-1991 17-05-1994 19-03-2001 30-07-1992 16-05-1991
WO 9709569 A1	13-03-1997	AU 6947296 A EP 0848797 A1 NL 1001129 C2 WO 9709569 A1	27-03-1997 24-06-1998 05-03-1997 13-03-1997