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(54) Method and device for automatic filling of insulating glass with gas different from air

(57) The introduction of the gas and the expulsion of the air happen in laminar regime, avoiding therefore the mixing of the gas in entry with the present air inside the panel of insulating glass (4). To allow the obtaining of the laminar regime, the inferior side of the spacer frame is properly used with functions of distribution manifold. Such procedure and device, due to their peculiar configurations, allow a notable saving in the costs reducing, respect the traditional automatic methods, the quantity of the gas necessary to the filling at a quantity nearly close to that corresponding to the volume of the room of the panel of glass.

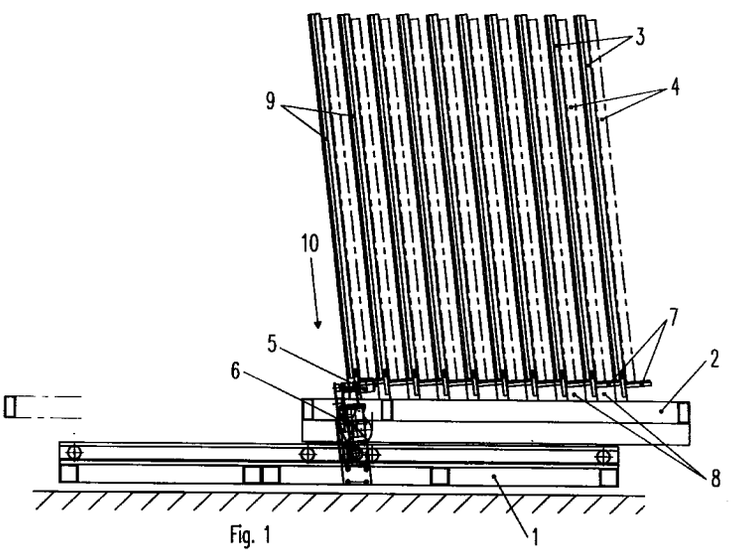

Fig. 1

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Description

The present application has for object an automatic procedure and an automatic device for the filling of panels of insulating glass with gas different from the air, gas employed for the improvement of the characteristics of thermal and acoustic insulation of the panels, as well as of other characteristics connected with the peculiar characteristics of the employed gas.

Nowadays the techniques notes for the filling of the panels of insulating glass with gas different from the air are distinguished in manual techniques and in automatic techniques.

The first can found on the principle to measure the flow of gas and the time of introduction of the same or on the principle to measure the concentration of the gas or the concentration of the residual oxygen inside the panel of insulating glass during the introduction of the same gas. The seconds are usually based on the system to measure the concentration of the gas or the concentration of the residual oxygen inside the panel of insulating glass during the introduction of the same gas until the obtaining of the wanted concentration of the gas.

Forgetting the manual technique, even if it has really constituted the school and the base for the development of the automatic technique, we confine to describe the known technique related to the only automatic solution, in how much it's that object of the present application as well as it' is also that which has reached an industrial diffusion of notable interest.

Moreover, the sensitive increase of the request of panels of insulating glass filled with gas won't do what, of necessity, to direct the producers of panels of insulating glass to the employment of the only automatic machines or at least semiautomatic and, above all to the selection of those automatic machines that, to parity of all the other characteristics, have a limited consumption of gas for the filling of the same panel like that object of the present application. The above-mentioned request of the panels of insulating glass filled with gas has become in fact diffused not only for those uses where an improvement of the thermal insulation characteristics is requested (in the last years imposed also by specific rules and laws binding the obtaining of the same building license to the employment of material having a thermal exchange under of determined values) but, above all recently, for that uses, for instance in the surroundings of the airports residential zones or in the hotel complexes situated in the big metropolis, where the acoustic insulation becomes important constituting a connected requisite with the quality of the life. Of here the diffusion of the gases having more and more peculiar characteristics, more appreciated and therefore more expensive (even more of two orders of greatness more expensive), from which the exigency of using methods and machines of filling that minimizes the consumption of gas.

An automatic procedure and an automatic device already object of other application of industrial monopoly and also exposed in two international fair demonstrations (Düesseldorf 1994 and Milan 1995) even if not yet installed in production factories is TV94A000125, then extended to other nations (deposits: European 95116237.9; U.S.A. 08/545,275; Japan 7 - 280198; South Korea 95 - 37588). Applicant and inventor are the same of the object of the present application that constitutes a variation regarding only the mechanics and the automation of the precedents mentioned deposits. The inventive principle is the same one therefore the only variations that don't constitute equivalence and that have a content of novelty and invention will be claimed.

Other automatic procedures and automatic devices belonging to the known technique are those following listed, all however having the big limit to apply to a process in which the speed of the gas in movement to get the pseudo-filling of the panel of insulating glass, is in the TURBULENT field (unlike the invention object of the present application in which the speed of the gas during the filling is in LAMINAR regime) with consequent continuous mixing of the entering gas with the air present inside the panel of insulating glass, as consequence the filling of the panel with gas doesn't happen for substitution on the contrary for dilution.

Such known technique have had in fact as target that to effect the filling in a time rate equal or inferior to that of the longest phase of the cycle of automatic production of the line producing panels of insulating glass.

As consequence such all process involve that the flow of the gas within the chamber of the panel of insulating glass happens with such flow rate to operate in turbulent regime necessarily. The process that derives results therefore to involve a move for dilution, that is that the effect of every introduction of a volume of gas of filling equal to the volume of the chamber is that to halve the concentration of the present air inside the panel of insulating glass. More clearly, every introduction of a volume of gas equal to the volume of the room involves the following progression in the concentration of the air inside the panel of insulating glass: 1/2 1/4 1/8 1/16 1/32..., that is, to reduce the concentration of the contained air inside the panel of insulating glass to value at 3 % really 5 volumes of gas are necessary, with consequent waste of the same or air concentrations highly superior have to be accepted.

In the case of employment of gas Argon (the most diffused to the beginnings of the development of the gas filling technology of the of the panels of insulating glass) the problem of the gas waste resulted economically bearable, but in the case of recourse to gas more noble, and therefore more expensive, for the achievement of better physical characteristics of the panels, the incidence of the cost has become unbearable. It' s enough to reflect on the fact that the Argon has a price of market around the 10 It. Liras/Nlitre while, not to name the most expensive, the Krypton arrives to more than 1000 It.

Liras/Nlitre and the Xenon reaches 6000 lt. Liras/Nlitre.

Synthetically, the known techniques supported by patent documentation references, accompanied by brief comments, are hereunder listed. We can exclude the existence of different anterior techniques as in the sector of the machines for the insulating glass filling with gas, so technologically crowded and from so many people faced with efforts of search and investments, all the builders always have protected theirs found with patent deposits.

The followings are known brevets or deposits:

Italian Patent n. 1.142.062: substantially it foresees a chamber, provided of seals, in way from to contain the panel of insulating glass not yet joined in its components, glasses and spacer frame, inside which chamber the gas is fluxed and therefore the same gas also invades the inside of the panel of insulating glass before the phase of joining that is conducted in the same machine. The limits of this system, that work in turbulent regime, is the elevated consumption of gas and the not achievement of an high concentration of gas (or the one improves with damage of the other). Besides a quantity of additional gas must also be used for the saturation of the volume of the machine chamber not occupied by the glass and an ulterior gas quantity is lost in the phases of transit for the entry and the exit of the panel of insulating glass.

European Patent EP 0 267 647: the main claim concerns on the concept to use means agent on the external surfaces of the panel, for example planes of a press, to oppose the overpressure that is established inside the panel during the phase of introduction of the gas, in fact also a small overpressure interesting a very wide surface involves considerable efforts to the point to cause or the separation of the plates from the spacer frame to which the glass plates are bound through the primary sealant or, that is worse, the explosion of the same plates. Besides the troubles of the preceding case, this technique introduces the additional problem to require at least two holes (one situated in the bottom part and one in the superior part of the panel) crossing both the walls of the spacer frame.

European Patent EP 0 323 333: is dealt with a similar device to the precedent one except that, for the optimization both of the mechanics of the machine and of the process working cycle, the holes for the introduction of the gas and the expulsion of the mixture air-gas are displaced in the inferior part of one of the sides (generally that of exit) of the spacer frame; it is avoided so the time for the translation of the mechanisms that have to operate in correspondence of the hole of expulsion. In this device the turbulence of the process is emphasized even more and, even if globally the process happens in less time, the consumption of gas results between the tallest in comparison with the other systems of which to the known technique.

European Patent EP 0 444 391: to fill the inside of the panel of insulating glass, one of the two plates, during the staying between the planes of the press, is pulled in one its portion in correspondence of an edge, far from the spacer frame for action of a part of the same plan of the press provided of suckers. In such way a space is created through which the operations of introduction of the gas and expulsion of the mixture air-gas are carried out. This device also operates in regime of turbulent flow with the inconveniences already above described. The only advantage of this method resides in the fact to leave entire the inside part of the spacer frame, with consequent valuable aesthetic result. Its limit, besides the known problem of the turbulence, is tied to the exigency of deforming elastically one of the two plates constituent the panel of insulating glass, exigency not applicable to all the typologies of glass, for example to those having high thickness.

International Patent WO 92/01137: it traces the previous European one with the difference that the pulling of the glass plate to create the space for the introduction of the gas and the expulsion of the mixture air-gas is carried out on a part of the bottom side rather than in correspondence of an edge.

European Patent EP 0 603 148: the operation of filling of the panel of insulating glass with gas happens, always inside the press, with one of the two glasses joined against the spacer frame only in correspondence of the horizontal top side and on a part of the vertical sides for the portion along which the elasticity of the glass allows the relative deformation of it. The gas is introduced from the bottom part of the spacer frame and the mixture air-gas is expelled through the part of the vertical sides where the glass is detached from the spacer frame. The inconveniences above named are even amplified in this procedure as the bottom side being open, and for a notable extension, constitutes an escape for the same introduced gas.

Main purpose of the object of the present application is therefore that to resolve the underlined technical problems eliminating the inconveniences of which to the known technique, contriving an automatic procedure and an automatic device for the filling of the panels of insulating glass with gas different from the air that, differently from the known automatic correspondents methods and machines, allow a notable economy about what concerns the consumption of the gas of filling and respect the request for grant TV94A000125 (and correspondent EP 0 715 053 application) allows to have a device having better functionality and reliability and reduces the consumption of gas furtherly.

Within the assignment above exposed another important purpose it is that to obtain a device that, being also inserted in the lines of automatic production of the panels of insulating glass, reaches the productivity of the same lines allowing in the meantime to reach to an acceptable economy in the consumption of gas and an achievement of an elevated concentration of the gas inside the ended insulating panel and, not secondary aspect, a maintenance in the time of the same obtained

concentration.

This is obtained, with the object of the present application, applying to a collector container able to receive, to contain and to distribute at least two (typically but not exclusively from 8 to 10) panels of insulating glass. The innovative and inventive concept, respect the technique note of which to the deposit TV94A000125 of the same applicant and inventor, consists in the use of a free logic of selection rather than sequential, in way from to welcome the panels of insulating glass in entrance on one of the available lodgings, to contain the panels of insulating glass during the phase of filling with gas, to distribute the panels of insulating glass to the following station, for example that working the process of automatic sealing of the peripheral edge of the panel of insulating glass, of the line of workmanship of the insulating glass, according to the logic required by the same line. Only to name some of the possibilities, said logic can be determined from one of the following criterions: 1) to let go out the first ready panel in way of to minimize in absolute the times of waiting of the following station; 2) to let go out, in the limits of the availability, the panels with the same thickness of the spacer frame in way from not to change the parameters of workmanship of the automatic sealing machine; 3) to let go out, in the limits of the availability, the panels assembled for customer; 4) to give priority to the small pieces in way not to have too many glasses already completed relatively to the phase of filling but not yet sealed in the openings of introduction of the gas and expulsion of the air, this in the case the version of the machine foresees a separate position for such sealing, and therefore held back in filling status, even if with a reduced flow of gas; 5) priority on demand of the operator; 6) additional use of the collector container, in connection to its principal function of filling of the panels with gas, as accumulation / waiting container in the case the stations of process after the same are inactive temporarily; 7) etc..

In its essential lines, not naturally excluding equivalent solutions that reach the same purpose, the machine object of the present application is constituted by a fixed horizontal base frame 1 on which a counter-frame mobile 2 translates, on which superior face, at least two (but typically, even if not exclusively, from 8 to 10) racks 3 vertical or slightly sloped in respect to the vertical plane which the panels of insulating glass 4 are supported. The same panels are carried on the mentioned racks through the rollers conveyor 5 that, other than the rotatory motion has also an alternate vertical movement parallel to the same racks 3 s through suitable mechanisms globally indicated with 6. Such alternate movement allows, when the rolls are in the lifted position, to receive the panel in entry or to evacuate the panel in exit, when the same are in the position lowered of to deposit the panel on the feet-supports 7 displaced with opportune distribution in the inferior part of the rack 3and rigidly connected with the same one. In position 8 are displaced the nozzles-holder carriages for the introduction of the gas through a pre-drilled (in the same machine) hole on the external face of the bottom side of the spacer frame, while along the guides 9 the probe-holder carriages are located; these probe-holder carriages, through an automatic device, insert the probe on the pre-drilled holes displaced on the superior part of the lateral side of the spacer frame. The above named holes are performed respectively, that on the inferior side of the spacer frame through an automatic device situated immediately before the collector container, that on the lateral side of the spacer frame on the same automatic machine that fabricate the spacer frame through folding and junction of rectilinear profiles or manually or semi-automatically by means of a drilling device in the case of spacer frames with the sides cut to measure and united in correspondence of the vertexes through inserts in metallic or plastic material. In the zone 10 are respectively situated the devices for the centering of the nozzles-holder carriages and for the sealing of the opening in correspondence of the bottom side of the spacer frame and the devices for the centering of the probe-holder carriages and for the sealing of the opening in correspondence of the lateral side of the spacer frame.

The function of the collector container, to make an example with 10 compartments, is that to be able to have, for the filling with gas a time multiplied for the number of compartments, in this case 10, in respect to the time of the most critical station of the line of production of the panels of insulating glass. Contrarily, the known technique more above described grants to the operation of gas filling a time of big amount inferior to the time of the most critical station of the line, in how much the machine that carries out the filling with gas is the same one that also has to effect the joining and the pressing of the components constituent the panel of insulating glass. For these motives the automatic procedure and the automatic device object of the present application can operate with flow of gas in laminar regime while all the other automatic procedures and automatic devices of which to the known technique, are forced to operate in turbulent regime.

Claims

1. automatic procedure for the filling of insulating glass panels with gas, where the panel is constituted typically by two plates of glass with interposed a spacer frame joined to the same plates through side cords of primary sealant constituent the first sealing of tight, these five elements coming validly united through the action of a press, and eventually provided also of a sealing on the peripheral edge constituent the second sealing of resistance, the gas of filling being able to be any gas different from the air and admitted to the employment, characterized by the fact that a series from one to n panels is

received in a rack, mobile transversally respect the same panels, constituted from two to n compartments that receives the panels to be filled, coming from the process of preparation of the insulating glass working "upstream" and that returns the panels filled with gas to the following process, the filling of the same panels happening with the gas in regime of laminar flow, through a micro-holed collector constituted by the same bottom side of the spacer frame or through one or more crossing holes, and that the execution of none or part or all the necessary holes for the introduction of the gas and for the expulsion of the air, the operations of introduction of the filling gas, of analysis of the air and the exhausted mixture, of sealing of the holes on the walls of the spacer frame all happen in automatic way.

2. procedure as to the claim 1 characterized by the fact to use a logic of selection of the insulating panels not sequential but free, in such a way to receive the panels of insulating glass in entrance on one of the available lodgings, to contain the panels of insulating glass during the phase of gas filling, to distribute the panels of insulating glass to the following station, for example that working the process of automatic sealing of the peripheral edge of the panel of insulating glass, of the line of processing of the insulating glass according to the logic required by the same.

3. automatic device for the filling of insulating glass panels with gas, where the panel is constituted typically by two plates of glass with interposed a spacer frame joined to the same plates through side cords of a primary sealant constituent the first sealing, these five elements coming validly united through the action of a press, and eventually provided also of a sealing on the peripheral edge constituent the second sealing of resistance, the gas of filling being able to be any gase different from the air and admitted to the employment, characterized by the fact that a series from one to n panels is received in a rack, mobile transversally respect the same panels, constituted from two to n compartments, that receives the panels to be filled, coming from the process of preparation of the insulating glass working "upstream" and that returns the panels filled with gas to the following process, the filling of the same panels happening with the gas in regime of laminar flow, through a micro-holed collector constituted by the same bottom side of the spacer frame or through one or more crossing holes, and that the execution of none or part or all the necessary holes for the introduction of the gas and for the expulsion of the air, the operations of introduction of the filling gas, of analysis of the air and the exhausted mixture, of sealing of the holes on the walls of the spacer frame all happen in automatic way.

4. device as to the claim 3 characterized by the fact that the positioning of the insulating glass holder rack that has to result precise for its alignment not only with the stations of entrance and exit, but above all with the mechanisms of command of the nozzles of introduction of the gas and the probe of analysis, is obtained with a drive with controlled electric axis but always maintaining the same rack pushed in a direction through a pneumatic cylinder combined with an accumulator with settable pressure, in such a way to annul the effect of the inevitable clearances of the mechanical cinematisms used for the motion.

5. device as to the claim 3 characterized by the fact that during the vertical motion of the carriage holding the probe for the analysis, a small wheel is approached to the back part of the panel, detaching it from the rack to get a reference of zero for the transversal centering of the probe.

6. device as to the claim 3 characterized by the fad that the nozzle of insertion of the gas has, in the part that goes in junction with the pre-drilled hole on the external surface of the bottom side of the spacer frame, a conic shape, with such taper to obtain a joining to the annular wall of the same hole, in way to allow tightening to the gas, avoiding so possible losses.

7. procedure as to the claim 1 characterized by the fact that as the concentration of the gas inside the chamber, measured through the complementary content of oxygen analyzed by an instrument that is connected to the probe, reaches the wanted value, the flow of gas is reduced to a very low value so to maintain the reached concentration in despite the inevitable small present losses till the moment of the sealing of the holes of gas introduction and vent mixture analysis.

8. procedure as to the claim 1 characterized by the fact that an only analyser (or to the maximum some, in the case of collectors containing numerous panels of insulating glass) keeps under control all the compartments as a system of scanning managed by a sequential logical programmer puts cyclically, but with an optimization logic, in communication the varied probes with the analyser.

9. procedure as to the claim 8 characterized by the fact that, the system of scanning of the collectors for the analysis keeps always drained with the actual gas the pipes of connection to the analyser in such a way that, at its turn the actual gas is found the

most possible next to the analyser.

10. procedure as to the claim 8 characterized by the fact that the analyser of oxygen is of the type paramagnetic or to the zirconium oxide.

11. device as to one or more than the preceding claims, characterized by the fact that a process calculator is combined with the machine that, besides the functions of government of the machine, carries out the functions of interface with the user, of diagnostics and statistics, representing in synoptic way the state of filling of every panel of insulating glass.

12. device as to one or more than the preceding claims, characterized by the fact that every system of gas introduction is endowed with an individual safety valve to avoid that a damage of the system of distribution of the gas or an error of the operator involve an overpressure inside the chamber of the insulating glass panel that overcome the allowable value for the same panel.

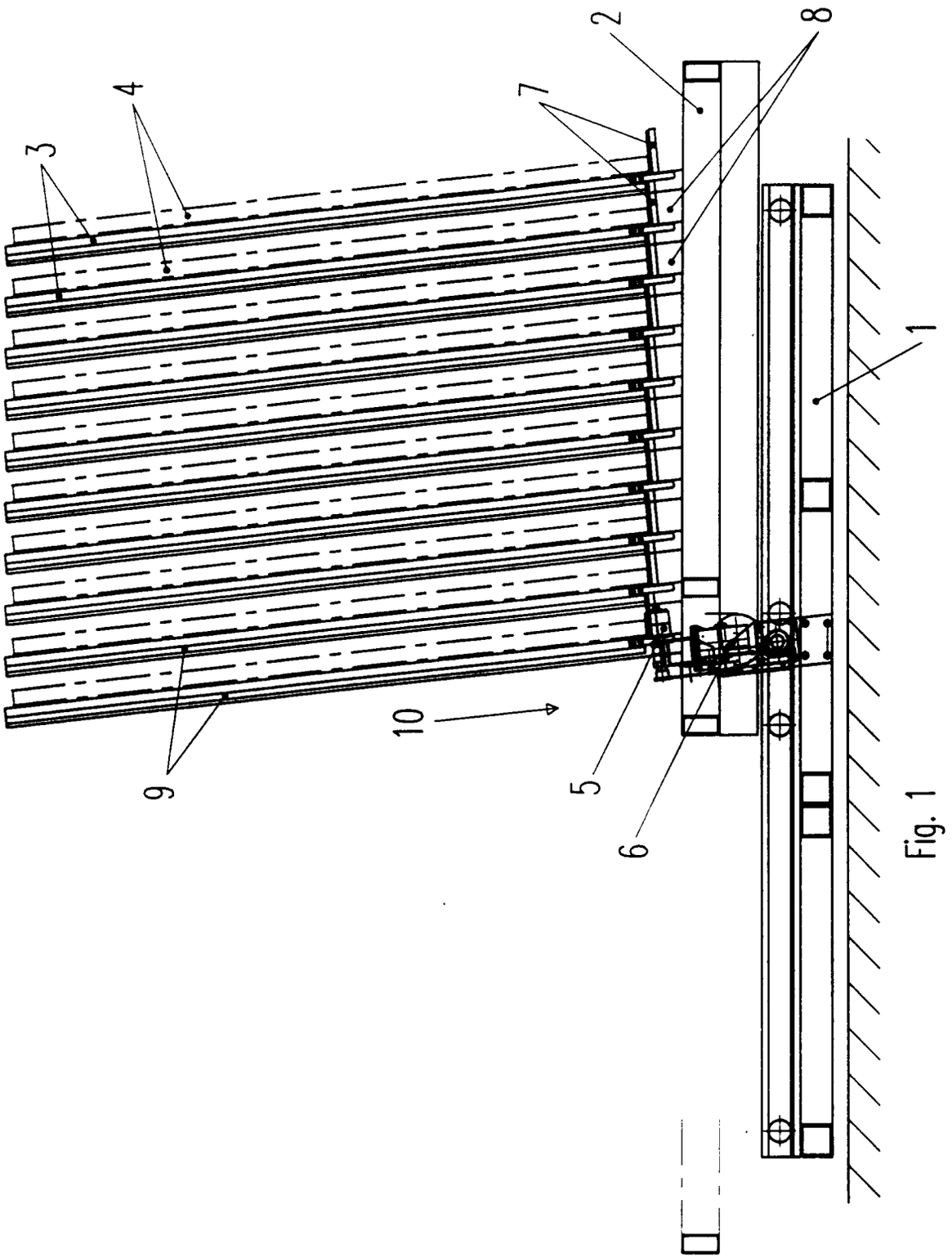

Fig. 1