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(54) **Ash capture plate for electrostatic precipitators**

(57) An ash capture plate for electrostatic precipitators comprises a box-like body (1) with two extended main walls (1a, 1b) delimiting a channel-like chamber (2). A plurality of spaced apart windows (3) is formed on the two walls, each wall having inclined fins (4) extending from an edge thereof. Fins (4) are bent toward the inside of the chamber and constitute, along with the surface portions (4a) of the wall delimited by the windows (3), the capture surface of the plate.

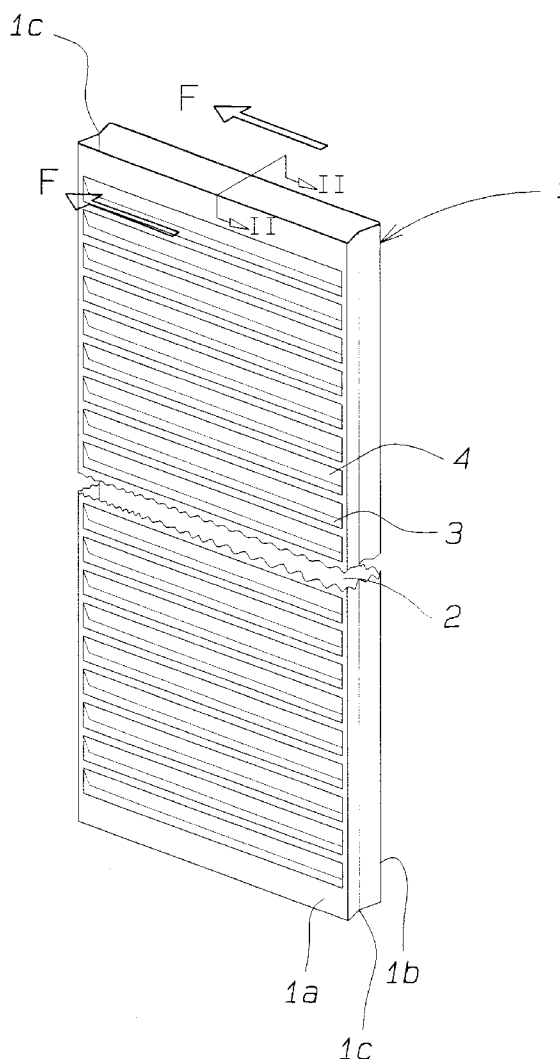


Fig. 1

Description

The present invention relates to a new type of ash capture plate for electrostatic precipitators which is able, because of its particular design, to increase the efficiency of the removal of the ash thus reducing its emission into the environment.

In many industrial processes smokes or flue gas are produced carrying more or less significant amounts of solid particulate and, therefore, must be cleaned in order to limit the environmental pollution to acceptable levels. Among the various, currently known systems of ash removal, those which use electrostatic precipitators have been widely adopted.

Known electrostatic precipitators are metallic structures composed of channels that are travelled by the flue gas. Such channels are composed of parallel plates (capture electrodes) between which groups of wires are placed (emitting electrodes) parallel to one another and to the plates. The plates are electrically connected to one other and to the ground of the precipitator which, in turn, is connected to the earth wiring.

The wires are electrically connected to one another and are brought, usually, to a negative voltage with respect to the ground by means of a high-voltage power supply.

Inside each channel two areas can be distinguished which, from an electrical point of view, are rather different from each other. The first area, close to the emitting electrodes, is subjected to a high intensity electric field and the corona effect, which causes the ionization of the surrounding gas and the attachment of the ions to the ash particles entrained by the flue gas, occurs therein. The second area, comprised between the boundary of the first area and the capture plates, houses a lower intensity electric field in which the charged particles are made to move. This motion is such that it overlaps with the component of motion related to the flow of the flue gas, the resultant motion causing the ash particles to deposit on the capture electrodes where they gather in a layer as a result of cohesive forces of electrostatic nature as well as adhesive forces of chemical-physical nature.

The plates are periodically shaken to remove the layer of ash deposited on them. The detached ash falls under the force of gravity into collection hoppers placed in the lower part of the precipitator.

Normally, a precipitator is subdivided into several stages arranged in series called sections. When high flow rates of gas must be handled, it is formed by several parallel rows of sections.

All the emitting electrodes of each section are usually fed by a common power supply. The parameter characterizing the electrostatic precipitators is the capture efficiency which is defined by the one-complement of the ratio between the mass of the ash per Nm^3 of gas at the outlet and at the inlet of the precipitator.

In each electric section, the progressive aggrega-

tion of the ash into a layer under the action of the electrostatic forces is followed by leakage. The leakage can be defined as the part of ash deposited on the intercepting surface of the section which undergoes a detachment from the plates and is captured by the next sections or is released into the environment, rather than being removed by means of precipitation into an underlying hopper as a consequence of a cleaning action. The cause of such leakage can be found in the erosion by the same dusty and turbulent gas on the progressively aggregated layer of ash. However, the erosion caused by the gas increases also as a function of electric parameters and phenomena relating to the layer, such as the resistivity value of the particulate, the micro-discharges within the layer and the occasional discharges between the electrodes, said parameters being further correlated to the chemical-physical properties of the ash.

The leakage becomes gradually greater as the thickness of the layer increases, in such a manner that the periodic removal of the ash from each section by means of the shaking of the plates becomes essential. However, even this action causes leakage produced by the turbulent motion of the gas and by the fact that the shaking also produces vibrations perpendicular to the plane tending to fracture the layer of ash, thus facilitating the entrainment of the pulverized particulate by the flow of gas. As a result, it is impossible for all the ash removed to fall into the hopper of the same electric section and a considerable portion of the removed particulate is entrained in the flow of gas.

The phenomenon just described is known as the carrying-over of the captured ash. It assumes an increasing importance moving from the first to the next electric sections in the direction of flow since the recapture of the particulate by the remaining sections becomes less and less probable, until reaching the last section where the carried-over ash has no further possibility of being recaptured and is therefore irremediably transported by the flow of the gas to the stack and released into the environment.

In order to achieve high capture efficiency, it is necessary to limit as much as possible the phenomenon of the ash carrying-over by minimizing, in each electric section, both the erosion carried out by the gas as well as that due to the periodic cleaning of the plates.

As regards the leakage due to erosion, known electrostatic separators are equipped with specially profiled plates which are mounted in an alternating manner with conventional plates on each row, making it possible to act against the erosion on 50 % of the capture surfaces.

On the contrary, there are no suggestion in the art specifically directed to the reduction of leakage caused by the cleaning of the plates. In such a way the consequences caused by the shaking on the carrying-over and emissions of ash particles are completely neglected, and this is the case both for precipitators of European design (shakers with lateral beating masses) as well

as those of American design (electrodynamic or pneumatic upper vibrators). In other words, with known plates that are up to 13-15 meters tall, it is impossible to obtain an effective fall of the ash layer into the hopper, even when using the most effective devices and the most suitable shaking strategies.

With regard to the cleaning of the plates it should furthermore be noticed that it would also be desirable to obtain the most effective and complete detachment of the ash from the same, but this is a condition that is rarely achieved. In practice it happens that due to a ineffective shaking consistent layers of ash, even if formed on small portions of the entire capture surface of a section, cause unsatisfactory operation of the electric power supply. Such operating condition, in particular when high resistivity ash is involved, seriously and steadily limits the capture efficiency of the interested electric section.

The general object of the present invention is to improve the capture efficiency of industrial electrostatic precipitators.

A particular object of the present invention is to provide a new structure of capture plate for electrostatic precipitators suitable to reduce the important phenomenon of carrying-over of the ash and to make possible a better operation of the electric power supply.

These results are achieved with the ash capture plate according to the present invention which is formed of a box-like body with two extended main walls delimiting a channel-shaped chamber, at least one of the two walls having a plurality of windows spaced from one another, from an edge of each window extending an inclined fin, bent toward the inside of said chamber and constituting the capture surface of the plate along with the portions of the surface of said wall delimited by said windows.

This way, the carrying-over of the ash due to erosion can be reduced by collecting a lot of the deposited ash in a protected area with respect to the erosive effect of the gas stream on the layer. Also the cyclic carrying-over due to the cleaning of the plates, caused by the shakers which provoke the detachment and falling of the ash into the hoppers and responsible, among other things, for the higher emissions, occurs in a protected manner and with less leakage. Furthermore, because the accumulation of consistent layers of ash is impossible, the consequential unsatisfactory operation of the power supply to the electric sections and the relative reduction of the local capture efficiency are avoided.

Further characteristics and advantages of the ash capture plate in electrostatic precipitators according to the present invention will become more apparent in the following description of one of its possible embodiments, given as an example and not limitative, with reference to the attached drawings in which:

- figure 1 is a perspective side view of an ash capture plate according to the present invention;
- figure 2 is a longitudinal section of the capture plate

of figure 1 according to arrows II-II of figure 1;

- figure 3 is an enlarged view of a detail of figure 2;
- figure 4 is a longitudinal section of a capture plate with only one fin-shaped wall.

With reference to figures 1 and 2, the ash capture plate according to the present invention is formed of a substantially flat box-like body 1, i.e. with its longitudinal and transverse dimensions many times greater than its thickness, comprising two extended main walls 1a and 1b, which, in use, are lapped by the gas flow F, and two edge members 1c which connect said walls, defining between them a channel-shaped chamber 2 of a substantially rectangular cross-section. On each of the two walls, a plurality of transversal cuts or windows 3 are formed parallel to and spaced from one another which have an elongated rectangular cross-section and are delimited by two main edges 3a and 3b i.e. the longer sides (figure 3).

In correspondence with each window 3 a fin 4 extends from walls 1a and 1b inside chamber 2, said fin being inclined by a certain angle with respect to walls 1a and 1b. In particular, each fin 4 extends from one of the two edges of corresponding window 3.

In one particularly preferred embodiment of the invention windows 3 formed on one of the walls of the capture plate are not aligned with windows 3 formed on the other wall. Consequently, inside chamber 2, fins 4 extending from one wall are staggered with respect to those extending from the facing wall. This allows for the distance between the free ends of two opposite fins to be kept to the highest value while maintaining the same inclination between them, and thus makes it possible to define a median channel inside chamber 2 and between the fins which provide minimum resistance to the flow during their discharge, due to gravity, of the ash that has accumulated on the fins.

According to the configuration described above of the capture plate according to the present invention and with reference also to figure 3, two distinct capture areas are defined in it: a vertical area 4a composed of the portion of surface of walls 1a and 1b comprised between two adjacent windows 3, and an inclined area 4b inside chamber 2 composed of the surfaces of fins 4 facing the corresponding windows 3. As shown in the detailed view of figure 3, in each window 3, edge 3a of the side opposite that from which the corresponding fin 4 extends is advantageously rounded to prevent the presence of sharp edges that would cause excessive intensity of the electric field in proximity to the surface of the plates, thus bringing about undesired discharge phenomena.

In figure 4, a variation of the capture plate according to the invention is shown in which fins 4 extend from only one of the two walls, for example wall 1b, whereas the other wall 1a is solid. This variation creates two embodiments of the plate, a "right side" and a "left side" plate respectively, to be used in each section respectively to form the first row of plates to the left with respect to the

direction of gas flow and the last row of plates to the right with respect to the same direction of gas flow with the purpose of avoiding accumulation of ash on the side walls of the precipitator.

The capture plate according to the invention works in the following manner. The particulate, electrically charged by the ions produced by the corona effect, migrates under the action of the electric field towards the plates of opposite polarity forming a layer which deposits both on the vertical interception area 4a as well as on the broader surface of fins 4b. During the time in which the layer increases in thickness, the ash deposited on the fins is protected to a large extent from the erosive action of the gas stream and, furthermore, the particulate that may be removed by the fins is in any case confined to the inside of the three-dimensional structure of the plate, precipitating inside it within the hopper. Subsequently, as in known precipitators, once an adequate thickness of ash is reached, shaking is carried out which causes the detachment of the particulate. With the new interception plate, the ash which becomes detached from the fins, already being inside chamber 2, falls in a manner in which it is protected from the turbulent gas flow and precipitates into the internal vertical channel thanks to the funneling effect created by the opposite facing fins. Also the ash which detaches from the vertical capture areas can be collected effectively since it is conveyed towards the inside of the plate by the particular conformation the electric field assumes in correspondence with the fins.

The capture plate according to the invention can be conventionally realized by pairing two U-shaped semi-plates along the entire length of the short sides of the U, uniting the two elements by welding them at a few points on both the adjacent sides. The fins can be welded in correspondence with each window or, more simply, can be cut from walls 1a and 1b in the formation step of the windows and bent toward the inside.

The inclination of fins 4 can vary from 10° to 50° with respect to the wall of the plate from which they extend. An angle of 30° was found to be a particularly advantageous angle of inclination of the fins.

Besides using the new capture plate in the design and construction of future precipitators, it is possible to utilize it also in currently operating precipitators, adapting it, with the dimensions that each specific case requires, to the most various operational conditions, being it compatible with the majority of the existing configurations of electrodes.

Variations and/or modifications can be brought to the ash interception plate for electrostatic precipitators according to the present invention, without departing from the scope of the invention itself as defined in the appended claims.

Claims

1. An ash capture plate for electrostatic precipitators, characterized by the fact that it comprises a box-like body (1) with two extended main walls (1a, 1b) delimiting a channel-shaped chamber (2), at least one of said walls being provided with a plurality of windows (3) spaced from one another, each window having an inclined fin (4) extending from one of its edges (3b) toward the inside of the chamber and constituting, along with the surface portions (4a) of the wall comprised between adjacent windows (3), the capture surface of the plate, the free ends of inclined fins (4) extending from the opposite walls (1a, 1b) being spaced apart to define a median channel therebetween.
2. The capture plate according to claim 1, wherein both walls (1a, 1b) are provided with said windows (3) spaced from one another, from each of said windows said inclined fins (4) extending toward the inside of said chamber (2).
3. The capture plate according to the previous claims, wherein the fins (4) extending from one of said walls are staggered with respect to those extending from the opposite wall.
4. The capture plate according to the previous claims, wherein the edge (3a) of said windows opposite the edge from which the fins extend is rounded.
5. The capture plate according to the previous claims, wherein said fins are inclined at an angle comprised between 10° and 50° with respect to the wall from which they extend.
6. The capture plate according to claim 5, wherein the inclination of said fins is 30°.

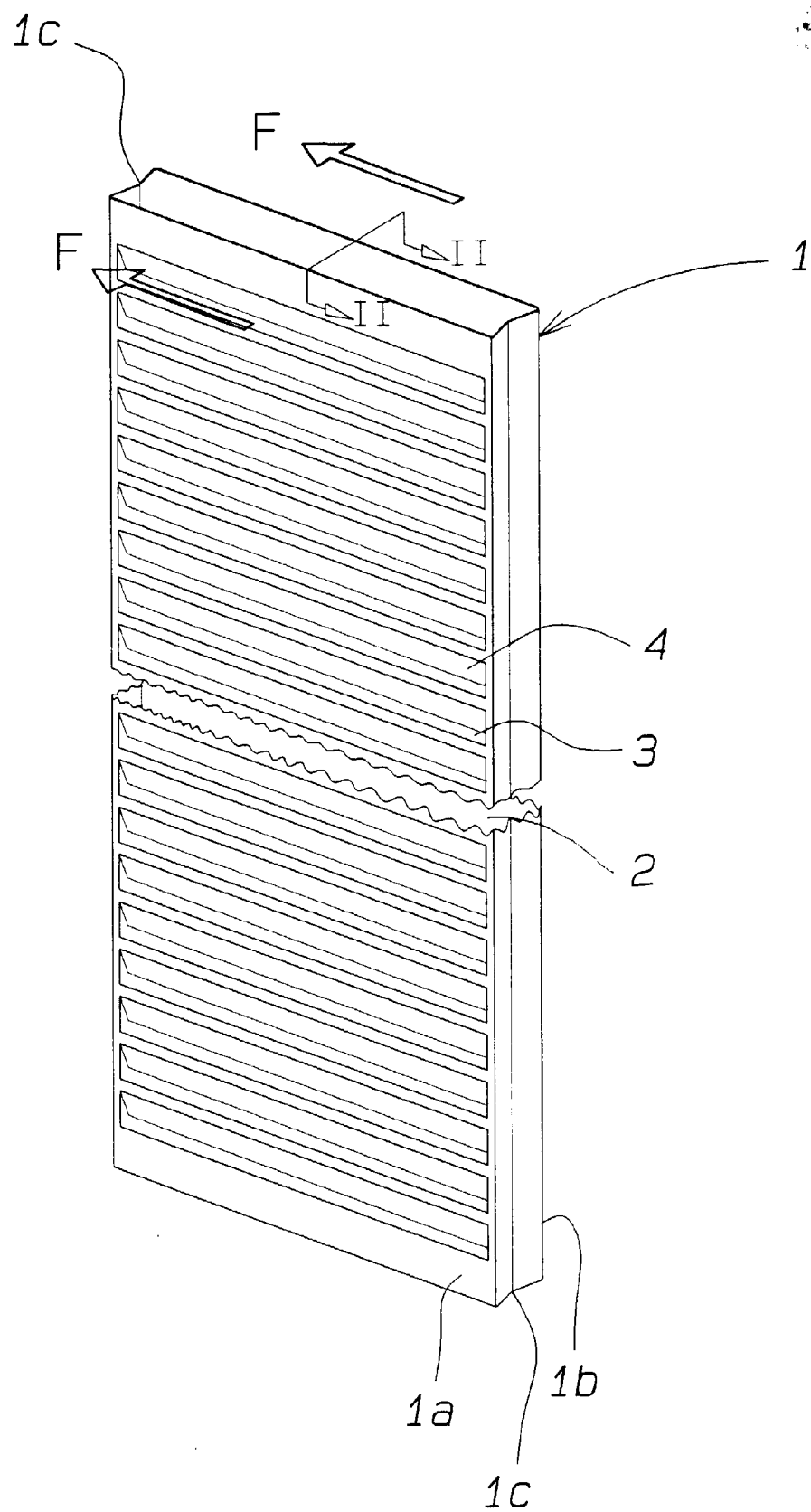


Fig. 1

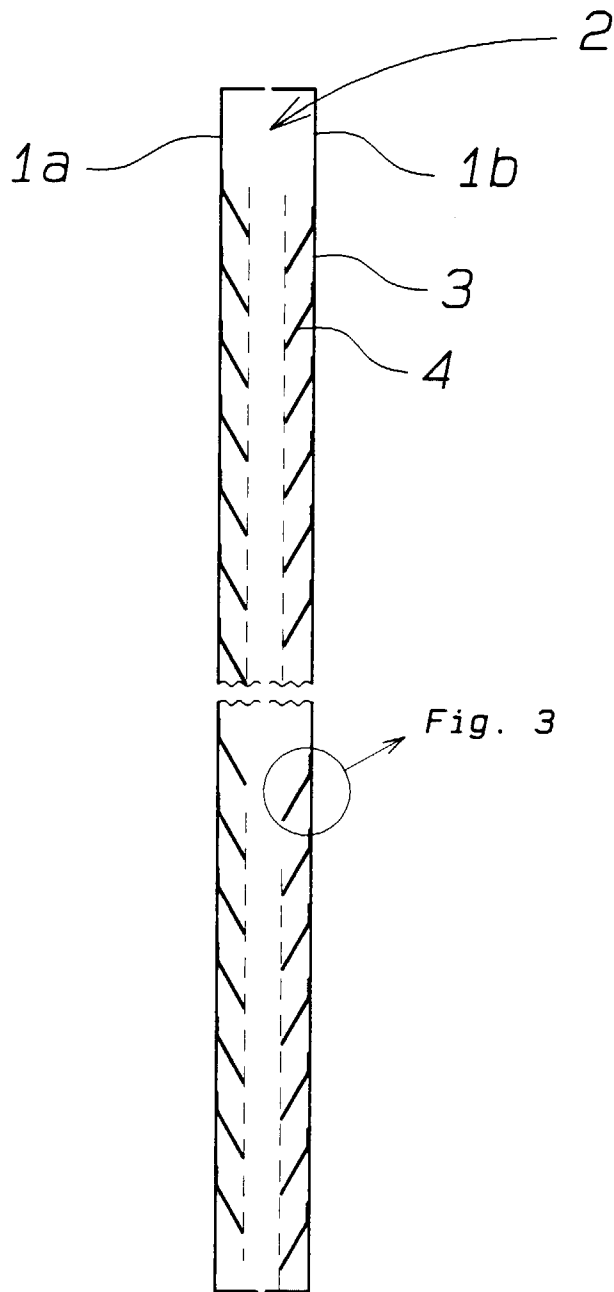


Fig. 2

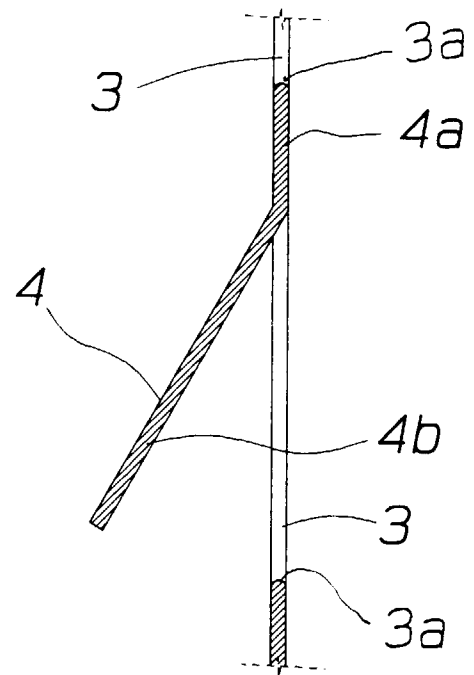


Fig. 3

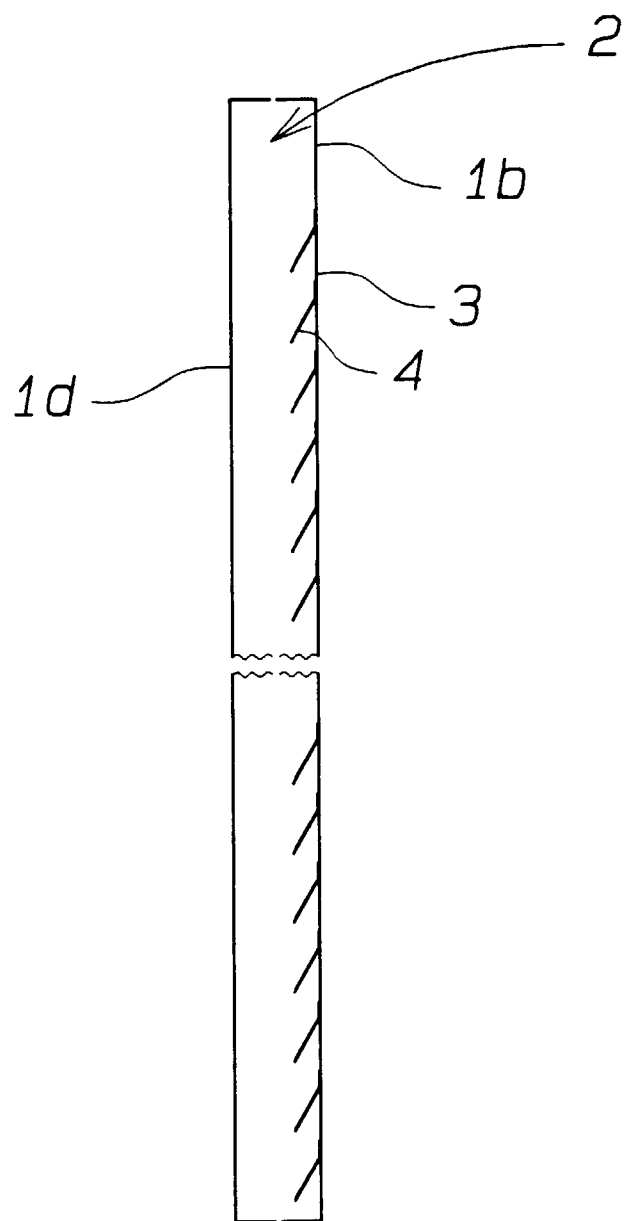


Fig. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 96 83 0535

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	DE-C-438 972 (SIEMENS-SCHUCKERTWERKE G.M.B.H.) 5 January 1927 * page 2, line 96 - line 115; claims 1,6; figure 4 * -----	1-4	B03C3/51
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B03C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 2 January 1997	Examiner Decanniere, L
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