(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 167 689**
B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **19.10.88**

(51) Int. Cl.[4]: **F 27 B 9/30**, F 27 D 7/04, C 21 D 9/00, B 23 K 1/00

(21) Application number: **84304752.3**

(22) Date of filing: **11.07.84**

(54) **Gas atmosphere heating furnace.**

(43) Date of publication of application:
15.01.86 Bulletin 86/03

(45) Publication of the grant of the patent:
19.10.88 Bulletin 88/42

(84) Designated Contracting States:
DE FR GB

(56) References cited:
DE-A-2 712 842
DE-A-3 982 887
FR-A-2 512 715
GB-A-2 045 137

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EP 0 167 689 B1

Courier Press, Leamington Spa, England.

Description

Background of the invention

This invention is to provide a heating furnace having such means which can adjustably control a flow of gas atmosphere within the furnace. More specifically, this invention is to provide, to a continuous gas atmosphere heating furnace consisting of a preheating chamber, a chamber for heat treatment such as brazing, and a cooling chamber, with means for adjustably controlling a flow direction and amount of an atmosphere gas which has been supplied into the furnace and is circulated within one or both of the preheating and cooling chambers by fan means in a direction transverse to and substantially at a right angle with the longitudinal axis of the furnace so as to be repeadly in contact with heating or cooling means in the chambers, heated or cooled thereby, and in contact efficiently with articles under the heat treatment.

A continuous gas atmosphere heating furnace of the kind mentioned above and as illustrated in Figure 1 which shows as an example of this invention a heating furnace for brazing aluminum articles, employs a gas atmosphere of N_2 gas and so on of a high purity for the prevention of oxidation of aluminum articles and brazing materials applied thereto. In order to keep the purity of such gas atmosphere, the furnace employs a metallic muffle case, or inner walls of the furnace which are made from refractory materials, are lined with metals. In case of the furnace utiziling a muffle, the heating of a gas atmosphere and consequently of articles passing through said gas atmosphere is made indirectly by heating means which are located outside the muffle (the heating means could be bare in this instance). And, in case of the furnace, refractory inner walls of which are lined with metals, heating means such as a pipe heater which is not bare, has to be used. At any rate, the heating of articles to be treated depends primarily on radiation transmission of heat. Under such heating, however, it takes much time until the articles such as aluminum products having bright surfaces are heated to a desired temperature, because their surfaces have extremely low emissitivity. When it takes much time to heat articles to a predetermined temperature, and consequently when the articles stay within a furnace gas atmosphere for a comparatively long period of time, outer surfaces of aluminum articles and brazing alloys applied thereupon tend to be oxidized even by a very trace amount of O_2 and H_2O contained in the furnace gas atmosphere such as N_2 gas. Oxidation of the articles at their surfaces most adversely affects brazing thereof.

Under the circumstances, it is required, therefore, to heat the articles rapidly. And, in order to achieve this end, it has been proposed to heat the articles in a preheating chamber into which they are first introduced, not only by the aforementioned radiation transmission of heat but also by forced heat convection, medium of which is the furnace gas atmosphere such as N_2 gas. This kind of forced heat convection is produced in the preheating chamber by circulation fans provided at an elevated position in the chamber. In this instance, the gas atmosphere in the preheating chamber is circulated along planes in transverse and vertical to a longitudinal axis of the furnace or forwarding direction of articles within the furnace, and repeatedly makes contact with heating means which are provided outside a moving path of the articles, to be heated by the heating means and to heat the articles in turn. The gas atmosphere thus circulated along the above-mentioned vertical planes in the chamber does work, on one hand, as if it were pneumatic curtains extending transversely to the furnace. To wit, such vertically extending curtains of circulation gas bar the free flow of furnace gas atmosphere which slowly streams from a gas inlet to an intake opening of the furnace via heat-treatment and preheating chambers, and from the gas inlet to an outtake opening for articles via a cooling chamber. Since the gas atmosphere which has been introduced first to the heat-treatment chamber, heated and expanded therein, tends to be a kind of resistance against the above-mentioned free flow of furnace gas atmosphere, the vertical curtain-like circulation of gas further retards said free flow. This has to be avoided really. Retardation of the flow of atmosphere gas within the furnace chambers though it is slow, lowers high purity of the gas as it is not continuously refreshed. It shall be noted also that when the gas flows too much in a single direction, viz., toward the cooling chamber, being barred in the heating and/or preheating chambers, air is sucked from the other direction, viz., into the preheating chamber, whereby the mosphere gas becomes impure.

German patent specification OS 2 712 842 describes a furnace arrangement in which glass pieces are fed through a chamber on a conveyor. In the chamber, the glass pieces are subjected to a stream of atmosphere gas which flows in a downward direction. This downward direction is transverse with respect to a longitudinal path defined by the passage of the glass pieces carried by the conveyor. The atmosphere gas is forced to flow in the downward direction by means of a fan. The chamber is divided into a number of compartments each of which contains an adjustable plate which is rotatable about an axis which extends in the longitudinal direction. Orientating the plates in a horizontal position serves to control the downward flow rate of the atmosphere gas.

Brief summary of the invention

In view of the above and in order to eliminate drawbacks accompanied to conventional gas atmosphere heating furnaces of the kind mentioned above, this invention aims to provide the furnaces with novel means which adjustably control the flow direction and amount of gas atmosphere.

According to the present invention, there is provided a continuous heating furnace compris-

ing a plurality of chambers in communication with each other; means for conveying articles in a predetermined path successively through the plurality of chambers, within at least one of the chambers, the articles pass through a baffle casing which is mounted in said one chamber in spaced relation to walls defining the one chamber; means for forcing atmosphere gas to be circulated as a heating or cooling gas convectionally along a flow path extending substantially transversely of the longitudinal axis of the one chamber; and plate means, positioned in the one chamber outside the predetermined path of the articles and within the flow path of the forced atmosphere gas; characterised by means for inducing the atmosphere gas to pass longitudinally through the one chamber; the plate means being arranged for deflecting some of the forced atmosphere gas circulating along said flow path to flow longitudinally, thereby to assist the longitudinal passage of atmosphere gas through the one chamber; wherein the one chamber is a preheating chamber for communicating with an adjacent heat-treatment chamber of the furnace; and the plate means is mounted in a space between the walls of the preheating chamber and the baffle casing, which space defines the flow path of the forced atmosphere gas, and the plate means is arranged for adjustment between one position in which the plate means extends substantially parallel with the flow path of the forced atmosphere gas, and another position in which the plate means extends substantially transversely of the flow path.

Brief description of the drawing

Figure 1 is a vertical sectional explanatory view of a continuous heating furnace made in accordance with this invention;

Figure 2 is an enlarged explanatory sectional view of a preheating chamber of the furnace; and

Figure 3 is a section of the preheating chamber taken along the line III—III in Figure 2.

Detailed description of the preferred embodiment of the invention

This invention shall be explained more in detail with reference to the accompanying drawing and with reference to the brazing of aluminum articles employing a furnace made in accordance with this invention.

A preheating chamber *A*, brazing chamber *B*, cooling chamber *C*, and forced cooling chamber *D*, housing walls 1 of which are respectively made from refractory or heat-insulating materials, are communicated each other. Though not shown specifically in the drawing, walls 1 of the preheating chamber *A* and the forced cooling chamber *D* are lined on their inside with metals. Numeral 2 indicates metallic baffle cases which are provided the chamber *A* and *D* so as to extend coaxially with said chambers, each one end of which is communicated with muffle cases 7, and sections of which are rectangular, same as the sections of the muffle cases and as best shown in Figure 3. While the muffle cases 7 are completely sealed at their outer peripheries, the baffle cases 2 have at top and bottom walls thereof openings for having gas atmosphere circulated therethrough. Heating means which could be bare as aforementioned and which are provided in a space between the wall 1 of the brazing chamber *B* and the muffle case 7 for heating the gas atmosphere indirectly over the muffle case, are eliminated in the drawing for the simplicity thereof. And, in the preheating chamber *A*, there is provided heating means 6 which shall not be bare and be such as pipe heaters.

Numeral 3 indicates circulation fans which are provided in the preheating and forced cooling chambers *A*, *D* and above the top walls of baffle cases 2. Numeral 5 is an inlet which opens to the furnace, adjacently to the brazing chamber *B* for supplying an atmosphere gas into the furnace via the brazing chamber *B*. The furnace walls of the cooling chamber *C* and the forced cooling chamber *D* are cooled by the circulation of cooling water which comes into the walls from inlets 8 and comes out from the walls at outlets 9. And, numeral 11 indicates conveyor means which circulatingly pass through the baffle and muffle cases of the chambers *A*, *B*, *C* and *D* for the transportation of articles into and out of the furnace.

Under the above-explained constructions of the furnace, the articles which is first brought in the preheating chamber *A*, is rapidly preheated therein, further heated in the brazing chamber *B* to a predetermined brazing temperature and brazed, cooled in the chamber *C*, thereafter completely cooled in the forced cooling chamber *D*, and then discharged from the furnace. These heating and cooling of articles are made by gas atmosphere, flow directions of which are preferably to be as represented by arrows 10 in the drawing. However, the gas atmosphere is hard to flow in the directions 10. To wit, the atmosphere gas which has been first introduced into the muffle 7 of the brazing chamber *B* and into the muffle case 7 of the cooling chamber *C*, is heated and expanded in the brazing chamber, while it is cooled in the cooling chamber *C*, whereby the expanded gas in the brazing chamber *B* works as a resistance against the flows 10, and whereby the atmosphere gas tends to flow much toward an outtake opening 13 of the furnace through the cooled chambers *C* and *D*. The flow of gas thus inclined to flow much in one direction invites the suction of air at the other direction, resulting in making the air impure.

The flow of gas 10 toward an intake opening 12 of the furnace is further retarded in the preheating chamber *A*. That is, the flow of gas 10 is generally changed in the preheating chamber *A* to a circulation flow which is represented by numeral 10′ for producing forced heat convections. This forced heat convections 10′ constitute streams which are in transverse to the longitudinal axis of baffle case 2 substantially with a right angle thereto. In other words, the circulating streams 10′ work as if they

were vertical curtains standing in the way of the preferred flow of gas 10.

In this invention, as best shown in Figure 3, there are provided at spaces between the walls 1 of the preheating and forced cooling chambers *A*, *D* and the baffle cases thereof those guide plates 4 which are for producing branch flows within the circulation flows 10'. The guide plates 4 for producing the branch flows extend along a plane transverse to the longitudinal coaxial lines of the preheating and forced cooling chambers *A* and *D*, and can be inclined about shafts 4' thereof to a desired angle between a vertically erected position where the plane of plate 4 extends transversely to the above-mentioned longitudinal coaxial lines with a right angle thereto and a position where the plane of plate 4 lies down in parallel with said longitudinal coaxial lines. The guide plates 4 at the vertically erected position give substantially no effects on the flow 10', because the planes of plates are in parallel with said flow. However, when the plates 4 are kept slanted, a part of the flow 10' changes into branch streams running toward the intake opening 12 and in transverse to the said flow 10'. Consequently, the gas atmosphere in the furnace is led as a whole in arrow directions represented by numerals 10.

In order to know how gas flows in a heating furnace for brazing works made in accordance with this invention, following four examples are given, in which a dew point of the gas atmosphere was measured for an indication of purity of the gas passing through the chambers.

Example 1:

N_2 gas having a dew point of −68°C was supplied into the furnace from the gas inlet 5 at a velocity of 50 m^3/hour, while the preheating chamber *A* was kept at 520°C and the brazing chamber *B* at 610°C. The branch flow-forming guide plates 4 were kept, of effective planes thereof, in the directions which are in transverse with the longitudinal axis of the furnace (that is, in the direction in parallel with the planes of streams 10', wherein the plates 4 are ineffective to said streams).

The dew point of gas atmosphere in the brazing chamber *B* was measured as −38 to −42°C, which showed that the flow 10 had directed much toward the outtake opening 13.

Example 2:

The plates 4 in the preheating chamber *A* were kept slanted toward the intake opening 12 so that a ratio between an outlet flow of gas from the intake opening 12 and that from the outtake opening 13 was about 2:1. The dew point of atmosphere gas 10 in the brazing chamber *B* became lowest in this instance, that is, −55°C to −62°C. The flow of gas was recognized as a whole as represented by the arrows 10.

Example 3:

The plates 4 were kept slanted as in Example 2. The dew point of gas in the brazing chamber *B* was sustained below −50°C, even when the supplying velocity of N_2 gas was reduced to 35 m^3/hour. This means that N_2 gas at a low velocity could make smooth flows 10 on account of provisions of plates 4.

Example 4:

The furnace was kept under the same conditions as in Example 3. Ten pieces of aluminum articles each having a weight of 3 Kg. were brazed. Excellent brazing was attained. The dew point of atmosphere gas N_2 in the brazing chamber *B* was −48 to −54°C.

These examples show that on account of the vane means 4 which are simple in their constructions, gas flow or streams in the furnace can be readily and adjustably controlled, and desired purity of the gas flows is easily maintained. In addition, the consumption of atmosphere gas can be reduced without adversely effecting the brazing or heating performance by a furnace.

Claims

1. A continuous heating furnace comprising a plurality of chambers (A, B, C, D) in communication with each other; means (11) for conveying articles in a predetermined path successively through the plurality of chambers (A, B, C, D), within at least one of the chambers (A), the articles pass through a baffle casing (2) which is mounted in said one chamber in spaced relation to walls (1) defining the one chamber; means (3) for forcing atmosphere gas to be circulated as a heating or cooling gas convectionally along a flow path (10') extending substantially transversely of the longitudinal axis of the one chamber (A); and plate means (4), positioned in the one chamber (A) outside the predetermined path of the articles and within the flow path (10') of the forced atmosphere gas; characterised by means for inducing the atmosphere gas to pass longitudinally through the one chamber; the plate means (4) being arranged for deflecting some of the forced atmosphere gas circulating along said flow path (10') to flow longitudinally, thereby to assist the longitudinal passage of atmosphere gas through the one chamber; wherein the one chamber (A) is a preheating chamber (A) for communicating with an adjacent heat-treatment chamber of the furnace; and the plate means (4) is mounted in a space between the walls (1) of the preheating chamber (A) and the baffle casing (2), which space defines the flow path (10') of the forced atmosphere gas, and the plate means (4) is arranged for adjustment between one position in which the plate means (4) extends substantially parallel with the flow path (10') of the forced atmosphere gas, and another position in which the plate means (4) extends substantially transversely of the flow path (10').

2. A continuous heating furnace according to claim 1, wherein another one of the chambers is a forced cooling chamber (D) which communicates with the heat-treatment chamber (B) via a prelimi-

nary cooling chamber (C), means (3) is provided in the forced cooling chamber (D) for forcing atmosphere gas to be circulated along a flow path extending substantially transversely to the longitudinal axis of the chamber (D), and a further baffle casing is mounted in the forced cooling chamber (D) in spaced relation to the surrounding walls of the forced cooling chamber, and further plate means (4) are provided in the space between the walls of the forced cooling chamber and the further baffle casing.

3. A continuous heating furnace according to claim 2, comprising means (5) for feeding the atmosphere gas into the furnace between the heat-treatment chamber (B) and the preliminary cooling chamber (C), the first mentioned plate means (4) being operable to deflect some of the forced atmosphere gas so as to cause a portion of the atmosphere gas from the feeding means (5) to flow successively through the heat-treatment chamber (B) and the preheating chamber (A), and the further plate means (4) is operable to deflect some of the forced atmosphere gas so as to cause another portion of the atmosphere gas from the feeding means (5) to pass successively through the preliminary cooling chamber (C) and the forced cooling chamber (D).

Patentansprüche

1. Kontinuierlicher Schutzgasofen mit mehreren in Verbindung miteinander stehenden Kammern (A, B, C, D), mit einer Transporteinrichtung (11) zum Transport von Gegenständen auf einem vorgegebenen Weg nacheinander durch die verschiedenen Kammern (A, B, C, D), wobei mindestens in einer Kammer (A) die Gegenstände sich durch ein Leitgehäuse (2) bewegen, das in dieser Kammer im Abstand von den Wänden (1) der Kammer angeordnet ist, mit einer Einrichtung (3) zur zwangsweisen Umwälzung einer Gasatmosphäre als Heizgas oder Kühlgas auf einem Strömungsweg (10'), der sich im wesentlichen im rechten Winkel zur Längsachse dieser einen Kammer (A) erstreckt, und mit einer Plattenanordnung (4), die innerhalb der einen Kammer (A) außerhalb des vorgegebenen Weges der Gegenstände und innerhalb des Strömungsweges (10') des Gasumlaufes angeordnet ist, dadurch gekennzeichnet, daß eine Einrichtung zur Einleitung einer Längsströmung der Gasatmosphäre durch die eine Kammer vorgesehen ist, daß die Plattenanordnung (4) im Sinne einer Ablenkung eines Teils der Umlaufströmung der Gasatmosphäre längs des Strömungsweges (10') in eine Längsströmung angeordnet ist, um dadurch die Längsströmung der Gasatmosphäre durch diese eine Kammer zu unterstützen, daß ferner diese eine Kammer (A) eine Vorwärmkammer (A) in Verbindung mit einer benachbarten Wärebahandlungskammer des Schutzgasofens ist, daß die Plattenanordnung (4) in einem Raum zwischen den Wandungen (1) der Vorwärmkammer (A) und dem Leitgehäuse (2) angeordnet ist, welcher Raum den Strömungsweg (10') des erzwungenen Gasumlaufes festlegt, und daß die Plattenanordnung (4) zwischen einer Stellung, in der die Platten im wesentlichen parallel zu dem Strömungsweg (10') des erzwungenen Gasumlaufes stehen, und einer anderen Stellung, in der die Platten (4) im wesentlichen im rechten Winkel zu dem Strömungsweg (10') stehen, verstellbar ist.

2. Kontinuierlicher Schutzgasofen nach Anspruch 1, bei dem eine andere der Kammern eine Umlaufkühlkammer (D) ist, die mit der Wärmebehandlungskammer (B) über eine Vorkühlkammer (C) in Verbindung steht, wobei in der Umlaufkühlkammer (D) eine Einrichtung (3) vorgesehen ist, die einen Zwangsumlauf der Gasatmosphäre längs eines Strömungsweges im wesentlichen im rechten Winkel zur Längsachse der Kammer (D) erzeugt, und wobei ein weiteres Leitgehäuse in der Umlaufkühlkammer (D) in einem Abstand von den Seitenwänden der Umlaufkühlkammer vorgesehen ist, wobei eine weitere Plattenanordnung (4) innerhalb des Raumes zwischen den Seitenwänden der Umlaufkühlkammer und dem Leitgehäuse angeordnet ist.

3. Kontinuierlicher Schutzgasofen nach Anspruch 2, mit einer Einrichtung (5) zur Einspeisung der Gasatmosphäre in den Ofen zwischen der Wärmebehandlungskammer (B) und der Vorkühlkammer (C), wobei die zuerst genannte Plattenanordnung (4) so einstellbar ist, daß sie einen Teil der Gasströmung ablenkt, um diesen Teil der Gasströmung von der Einleiteinrichtung (5) nacheinander durch die Wärmebehandlungskammer (B) und die Vorwärmkammer (A) strömen zu lassen, und wobei die weitere Plattenanordnung (4) so betätigbar ist, daß Sie einen Teil der Gasströmung derart ablenkt, daß ein anderer Teil dieser Gasströmung von der Einleitungseinrichtung nacheinander durch die Vorkühlkammer (C) und die Umlaufkühlkammer (D) strömt.

Revendications

1. Four à chauffage continu, comprenant une pluralité de chambres (A, B, C, D), en communication l'une avec l'autre, des moyens (11) pour transporter des articles selon un chemin prédéterminé successivement à travers la pluralité des chambres (A, B, C, D), dans au moins une des chambres (A), les articles passant à travers un carter (2) à chicanes qui est monté dans une desdites chambres et est espacé des parois (1) délimitant ladite chambre; des moyens pour mettre en circulation forcée les gaz de l'atmosphère, en tant que gaz de chauffage ou de refroidissement, par convection le long d'un chemin (10') d'écoulement s'étendant essentiellement de façon transversale par rapport à l'axe longitudinal de ladite chambre (A), et des plaques (4) positionnées dans ladite chambre (A) en dehors du chemin prédéterminé des articles et à l'intérieur du chemin (10') d'écoulement des gaz de l'atmosphère en circulation forcée; caractérisé par des moyens pour amener les gaz de l'atmosphère à passer longitudinalement à travers ladite cham-

bre, les plaques (4) étant disposées de façon à dévier une partie des gaz de l'atmosphère en circulation forcée le long dudit chemin (10') d'écoulement afin qu'elle s'écoule longitudinalement, en favorisant ainsi le passage longitudinal des gaz de l'atmosphère à travers ladite chambre; dans lequel ladite chambre (A) est une chambre (A) de préchauffage destinée à communiquer avec une chambre adjacente de traitement thermique du four; et dans lequel les plaques (4) sont montées dans un espace entre les parois (1) de la chambre (A) de préchauffage et le carter (2) à chicanes, cet espace définissant le chemin (10') d'écoulement des gaz de l'atmosphère en circulation forcée, les plaques (4) étant disposées de façon à être ajustées entre une position dans laquelle les plaques (4) s'étendent de façon essentiellement parallèle au chemin (10') d'écoulement des gaz de l'atmosphère en circulation forcée, et une autre position dans laquelle les plaques (4) s'étendent essentiellement de façon transversale par rapport au chemin (10') d'écoulement.

2. Four à chauffage continu selon la revendication 1, dans lequel une autre des chambres est une chambre (D) de refroidissement forcé, qui communique avec la chambre (B) de traitement thermique par l'intermédiaire d'une chambre (C) de refroidissement préliminaire, des moyens (3) étant prévus dans la chambre (D) de refroidissement forcé pour mettre les gaz de l'atmosphère en circulation forcée de long d'un chemin s'étendant essentiellement de façon transversale par rapport à l'axe longitudinal de la chambre (D), un autre carter à chicanes étant monté dans la chambre (D) de refroidissement forcé et étant espacé des parois environnantes de la chambre de refroidissement forcé, et d'autres plaques (4) étant prévues dans l'espace entre les parois de la chambre de refroidissement forcé et cet autre carter à chicanes.

3. Four à chauffage continu selon la revendication 2, comprenant des moyens (5) pour introduire les gaz de l'atmosphère à l'intérieur de four, entre la chambre (B) de traitement thermique et la chambre (C) de refroidissement préliminaire, les plaques (4) mentionnées en premier lieu pouvant fonctionner de façon à dévier une partie des gaz de l'atmosphère en circulation forcée, afin d'amener une partie des gaz de l'atmosphère venant des moyens (5) d'introduction à s'écouler successivement à travers la chambre (B) de traitement thermique et la chambre (A) de préchauffage, et les plaques (4) mentionnées en dernier lieu pouvant fonctionner de façon à dévier une partie des gaz de l'atmosphère en circulation forcée, afin d'amener une autre partie des gaz de l'atmosphère venant des moyens (5) d'introduction à passer successivement à travers la chambre (C) de refroidissement préliminaire et la chambre (D) de refroidissement forcé.

Fig. 1

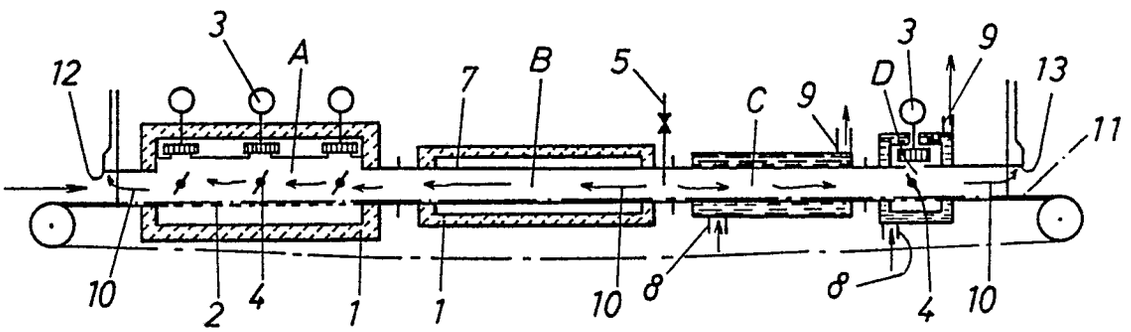

Fig. 2

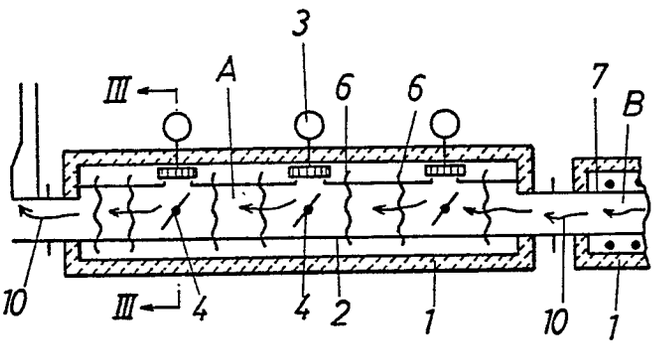

Fig. 3