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(54) **PNEUMATIC CHARGER FOR FEEDING PULVERIZED AND GRANULAR MATERIALS INTO METAL MELTS.**

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(73) Proprietor: **CEGLEDI VAS- ELEKTROMOS ES  
MŰSZEREZIPARI SZÖVETKEZET  
Szabadság tér 5  
H-2701 Cegled (HU)**

(72) Inventor: **SOMOGYI, Béla  
Abonyfalva u 2/a  
H-1182 Budapest (HU)  
Inventor: **HOFFMANN, István  
Erdősor u 181  
H-1213 Budapest (HU)****

(74) Representative: **Kern, Wolfgang Dipl.-Ing. et al  
Patentanwälte Kern, Brehm & Partner Albert-  
Rosshaupter-Strasse 73  
D-8000 München 70 (DE)**

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## Description

## Technical field

The invention relates to a pneumatic charger for the transport of granular or pulverized inflammable and explosive materials as well as materials of high density into metal melts.

Metallurgical processes used in metallurgy show a new trend of development. A considerable part of the processes have been relocated from the metallurgic furnace into the ladle. One of the most important branches of the ladle-metallurgic processes thus developed is represented by the blowing technologies, in course of which the gas carrying the diverse materials is blown, resp. transported pneumatically into the metal bath.

## Background art

As a result of the process several material qualities not having been manufactured as mass-produced goods up to now can be produced in a large quantity, or production of traditional qualities can be rendered more economical. In dependence of metallurgic processes the materials to be blown vary in respect to chemical composition and grain distribution within wide ranges. Accordingly, grain size may vary from a few microns to several millimetres, while chemical composition may vary from the treating materials on calcium basis through ground ferro-alloys to the granular alloys containing magnesium having a thermite character and being inflammable and explosive. In dependence of the quality of treating materials chargers of different structures are in use. In the initial period methods developed from mechanical feeders well proved in pneumatic material delivery to mechanic-pneumatic modes of feeding, arriving at last to chargers based exclusively on the principle of pneumatics.

The most known equipment for treating steels is the blower available in sale with the trade-mark "Scandinavian Lancers". In course of said technologies pulverized treating material having a calcium-silicon content is introduced pneumatically into the steel. The main part of the charger is a conical fluidizator, consisting of a dense screening cloth and the nozzles with a small cross-section arranged behind the screening cloth, which enables the uniform distribution of the gas.

The equipment is operated with an indifferent gas, with argon, pressure prevailing in the tank amounts to 6—8 bars. In the fluidizator the gas gets mixed with the pulverized reagent. High pressure presses the mixture of gas and powder into the delivery pipeline and via the lancer into the metal bath. Due to wear of the screen and obstruction of the nozzles the fluidizator requires permanent maintenance. The powder tends to clogging in the tank, material to be blown cannot be stored for a longer time. A further disadvantageous feature of the equipment lies in that it can be operated with high-pressure gas only.

Another mechanical equipment is also known which is different from that specified above, in so far as its fluidizator is formed by a screening cloth arranged at an angle of 30° and it is provided with a lower discharge opening with variable cross-section. Speed of material stream is controlled by a mechanical feeder. In respect to construction this equipment is far more complicated, possibilities of failure are greater. At the same time vibrations of the mechanical feeder make weighing more difficult.

The aforementioned equipments operate on the principle of fluidization. When passing through the fluidizing element, the carrier gas transfers its pulse to the material grains to be transported. If the force resulting from the pulse is higher, than the effect resulting from the weight of the grains and the frictional force arising inbetween, the particles are carried away by the gas, accordingly delivery is performed. As a consequence, state of fluidization depends partly on the streaming conditions of the carrying gas, partly on the grainsize and density of the material to be transported. Accordingly, this condition cannot be realized with materials of large grain-size and density—e.g. with ferro-alloys—and if, with considerable difficulties only.

If—in spite of the arising difficulties—the desired condition can be achieved, streams of high speed occurring in course of fluidization are considerably wearing the fluidizing elements, simultaneously friction arising between the grains to be transported may lead to self-ignition. Hazard of fire and explosion increases with material having magnesium content. With these types inflammability is increased by the small grainsize and arising high speeds, being otherwise most advantageous for the fluidizing process. By these reasons alloys with magnesium content are blown in not frequently.

Further by the DE—B—1148938 a device for charging a gas stream with pulverized materials is known, comprising a closed cylindrical material storage tank, being set under pressure and constructed at its lower portion as a conus, which is provided with a screen-like device, enabling the gas suspending the pulverized material. The top of the tank, the conus and the end of conus are provided with openings, connected with conduits or pipes communicating with a delivery duct, containing the pressurized transport gas. The pressure and the flow through of the gas are controlled by several valves, a pressure gauge and a flow through meter. This device needs high pressure to press the mixture of gas and powder into the delivery duct. Thus, due to the wear of the screen and the obstruction of the nozzle of the conus permanent maintenance is required.

The aim of the invention is to develop a solution with which parameters of transport, so transport capacity, density of delivery, quantity of carrier gas are constant, while at the same time, in case of necessity these values could be easily changed to the desired extent and in dependence of mode of operation. The solution according to the invention is well adapted for the transport of materials with a grain

size of 3 to 5 mm and a density of 4 to 6 kg/dm<sup>3</sup>. Construction of the equipment is resistant to increased loads occurring under metallurgical circumstances.

**Disclosure of the invention**

5 Accordingly, the invention relates to a pneumatic charger for the transport of pulverized and granular materials into metal melts, comprising a windbox connected to the conical bottom of the material storage tank, a porous element of cylindrical shape being arranged in a vertical position forming a structural unit with said wind-box, an exchangeable insert with a bore, the top of which being positioned in the free room  
10 formed by said porous element, and further comprising a tap communicating with the insert and a T-pipe connection.

**Brief description of drawings**

The invention will now be described in detail by means of a preferred embodiment of the invention, by the aid of the drawing enclosed, illustrating the pneumatic charger in a sectional view.

**Best mode of carrying out the invention**

The material storage tank 1 receives the material to be transported, being a pressure-proof tank with a conical lower part and provided with an opening for material filling. The cone of the tank 1 ends in the flanged connection 2. The wind-box 4 is forming a unit with the counter-part of the flange 2. Said wind-box  
20 is formed with the sleeve 3 which is clamping the porous element 5 at the top, while the lower part of the element 5 is seated on the bottom of the box 4. The box 4 communicates with the inlet stud 6 introducing the gas at a pre-set pressure. The mixture of gas and material is flowing through the cylindrical bore of the insert 7. The insert 7 with the bore is clamped with a releasable bond 8 and is provided with the sealing 9. Material flow is interrupted by the tap 10, while the mixture of gas and material flowing through the tap 10  
25 streams by the aid of the T-pipe connection 11 into the pipeline system. Gas in a controlled quantity is introduced into the inlet stud of the T-pipe connection 11, whereas its output branch is connected to the injecting lancer through the delivery duct.

As the T-pipe connection 11 does not contain any structural element which would impede material flow, it does not exert a higher flow resistance, than an average pipe tract. In such a manner it becomes  
30 possible to connect the feeders of two or more material storage tanks in series.

This fact opens new possibilities in respect to blowing technology.

The pneumatic charger according to the invention operates, as follows:

Material storage tank 1 is filled with the material to be blown, now the tap 10 is closed. After having closed the filling opening, gas at a pre-set pressure is led to the tank 1 through the inlet stud 6. First one  
35 starts with the diving of the lancer into the metal bath and simultaneously gas in a controlled quantity is introduced into the inlet stud of the T-pipe connection 11, the pressure of which prevents penetration of metal into the inside of the lancer. In the lower position of the lancer, when it is already dipped into the metal bath, material feeding begins by opening the tap 10. Through the inlet stud 6 gas is streaming among the material grains, through the porous element 5 to the insert 7. Material grains to be found on the upper  
40 bevelled part of the insert 7 are carried away by the streaming gas. The gas-material mixture is considerably accelerated in the bore of the insert and arrives with a significant kinetic energy to the T-pipe connection 11. Taking into consideration that in respect to the proportion gas/solids this mixture is very dense, controlled gas quantity, as previously mentioned, is admixed here. In such a manner it can be achieved that the material arrives pneumatically from the storage tank to the metal bath through the  
45 delivery duct and the lancer.

As the material to be transported is forwarded by its own weight to the insert 7, it is to be considered as specifically advantageous, that feeding is independent of material density and grain size.

Operational safety of the equipment is far increased by the fact that in course of feeding no fluidization flow is taking place, the porous element is neither mechanically nor abrasively loaded. Flows with a higher  
50 velocity are transferred to the insert 7, which can be easily manufactured from a wear-resistant structural material. At the same time the insert 7 is clamped into the wind-box with a releasable bond 8, enabling an easy and quick exchange.

The porous element 5 is a cylinder with a vertical axis, so powder fraction of the material to be delivered cannot deposit in the opening thereof, so required cleaning and maintenance are minimal.

55 Delivery output is uniform, at the same time it can be easily controlled in dependence of mode of operation, magnitude depends on the flow velocity having been developed in the bore of the insert 7. Control can be easily performed without changing any structural element, simply by regulating the pressure of gas streaming through the stud 6.

In course of the blowing process, up to the full immersion of the lancer, the pressure of the streaming  
60 gas on the inlet side of the T-pipe connection 11 prevents intrusion of metal into the inside of the lancer. The streaming of the material to be blown begins in the lower position of the lancer, i.e. in a completely immersed position, with the opening of the tap 10. In contrast to known equipments, by using the solution according to the invention accidents resulting from considerable squirting—occurring frequently with alloys containing magnesium—can be avoided. This phenomenon can be observed especially, if in course  
65 of the immersion of the lancer material is blown into low bath depth.

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The charger according to the invention yield several new possibilities in the field of blowing technology. In case, if the T-pipe connection 11 of the blowers of two or more material storage tanks are connected in series, a plurality of metallurgic processes can be performed with the same equipment. In the immersed state of the lancer, by opening the tap 10 of one or of the other tank, different materials can be introduced one after the other, or by the simultaneous opening of the taps 10 mixing of the materials while blowing becomes also possible.

As it becomes obvious from all what has been said, inspite of the simple construction, the equipment performs all the functions required by the special circumstances of blowing technology in course of pneumatic transport.

Some advantageous features of the invention will be demonstrated by the way of examples.

### Example 1

In course of the experiment calcium containing mineral material and—without lifting the lancer—magnesium containing auxiliary alloy were introduced by the aid of a blower with two storage tanks.

### Particulars of the treatment

	Grain-size mm	Density kg/dm <sup>3</sup>	Transport output kg/min
Calcium containing material	0 to 4	1,8—2	8
Magnesium containing alloy	0—3,5	3,6—4,0	14

Materials were delivered uniformly into the metal bath, stoppage could not be observed.

### Example 2

In course of this experiment chemical composition of the metal melt was set by blowing ferro-alloy into the melt.

### Particulars of treatment

Grain-size	0 to 5 mm
Density	4,8 to 5,0 kg/dm <sup>3</sup>
Transport output	18 kg/min

In course of blowing process no failure could be observed in material transport.

## Claims

1. Pneumatic charger for the transport of pulverized and granular materials into metal melts, comprising a wind-box (4) connected to the conical bottom of a material storage tank (1), a porous element (5) of cylindrical shape being arranged in a vertical position forming a structural unit with said wind-box, an exchangeable insert (7) with a bore, the top of which being positioned in the free room formed by said porous element (5), and further comprising a tap (10) communicating with the insert (7) and a T-pipe connection (11).

2. Pneumatic charger as claimed in claim 1, characterized in that the insert (7) is cylindrical and its bore is concentrically arranged and that the part of the outer mantle facing the porous element (5) is bevelled, while the insert (7) is fixed in the house formed in the wind-box (4) with a releasable bond (8) with the insertion of the seal (9).

3. Pneumatic charger as claimed in claims 1 and 2, characterized in that it is connected via the T-pipe connection (11) to delivery duct or connected in series with the T-pipe connection (11) of another charger, so that diverse materials can be mixed while being delivered, or the structure is such that gas is allowed to stream.

## Patentansprüche

1. Pneumatisches Beschickungsgerät zum Zuführen von pulverigen und körnigen Stoffen in Metallschmelzen, mit einem Windkasten (4), der mit dem konischen Boden eines Stoffvorratsbehälters (1) verbunden ist, einem porösen Element (5) zylindrischer Form, das senkrecht angeordnet ist und mit dem Windkasten eine bauliche Einheit bildet, einem austauschbaren Einsatz (7), in dem sich eine Bohrung befindet, deren oberes Ende in dem freien Raum liegt, welcher von dem porösen Element (5) gebildet wird, und mit einem Sperrhahn (10), der mit dem Einsatz (7) und einer T-Rohrverbindung (11) in Verbindung steht.

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2. Pneumatisches Beschickungsgerät nach Anspruch 1, dadurch gekennzeichnet, daß der Einsatz (7) zylindrisch ist und daß seine Bohrung konzentrisch angeordnet ist und daß der Teil des Außenmantels, der dem porösen Element (5) zugewandt ist, abgeschrägt ist, während der Einsatz (7) in dem Gehäuse, das in dem Windkasten (4) ausgebildet ist, mittels einer lösbaren Verbindung (8) unter Verwendung der Dichtung (9) festgelegt ist.

3. Pneumatisches Beschickungsgerät nach Ansprüchen 1 und 2, dadurch gekennzeichnet, daß es über die T-Rohrverbindung (11) an die Abgabelleitung angeschlossen ist oder mittels der T-Rohrverbindung (11) mit einem anderen Beschickungsgerät in Reihe geschaltet ist, so daß verschiedene Stoffe während ihrer Abgabe gemischt werden können, oder die Konstruktion so getroffen ist, daß Gas strömen kann.

### Revendications

1. Dispositif de chargement pneumatique pour le transport de matières pulvérisées et granulaires dans des coulées de métal, comportant une boîte à vent (4) reliée au fond conique d'un réservoir de stockage de matières (1), un élément poreux (5) de forme cylindrique disposé en position verticale et formant un ensemble avec ladite boîte à vent, un insert interchangeable (7) comportant un alésage, le sommet de l'insert étant placé dans l'espace libre formé par ledit élément poreux (5), et comportant en outre un robinet (10) relié à l'insert (7) et un raccord à tige en forme de T (11).

2. Dispositif de chargement selon la revendication 1, caractérisé en ce que l'insert (7) est cylindrique et son alésage est disposé de façon cylindrique et que la partie de la paroi extérieure en face de l'élément poreux (5) est conique, pendant que l'insert (7) est fixé dans le carter formé dans la boîte à vent par une fixation déserrable (8) à l'aide d'un moyen d'étanchéité.

3. Dispositif de chargement selon les revendications 1 et 2, caractérisé en ce qu'il est relié via le raccord en forme de T (11) à un conduit de décharge ou relié en parallèle à un raccord en forme de T (11) d'un autre dispositif de chargement, de façon telle que différentes matières peuvent être mélangées pendant qu'ils sont convoyés, la structure étant telle qu'une circulation du gaz est possible.

