CONVENTION APPLICATION FOR A PATENT

COMMONWEALTH OF AUSTRALIA
Patents Act 1952-1969

15 919/63

We hereby apply for the grant of a Patent for an invention entitled:

PROCESS AND DEVICE TO EMPTY METALLURGICAL CONTAINERS

which is described in the accompanying complete specification. This application is a Convention application and is based on the application numbered

84 213 and 84 237

for a patent or similar protection made in Luxembourg on 18th June 1982 and 29th June 1982

My address for service is Messrs. Edwd. Waters & Sons, Patent Attorneys. Our address is 50 Queen Street, Melbourne, Victoria, Australia.

DATED this 16th day of June 1983.

ARBED S.A.

by W. F. Dancer

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COMMONWEALTH OF AUSTRALIA

Patents Act 1952-1969

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

In support of the Convention Application made by

ARBED S.A.
Avenue de la Liberté, L - 2930 LUXEMBOURG

(herinafter referred to as the applicant) for a Patent for an invention entitled:

(Procédé et dispositif pour vidanger des récipients métallurgiques) PROCESS AND DEVICE TO EMPTY METALLURGICAL CONTAINERS

WE, RENE NEYEN and E. SCHUMACHER both of Avenue de la Liberté, L-2930 Luxembourg

do solemnly and sincerely declare as follows:

1. WE, are authorised by the applicant for the patent to make this declaration on its behalf.

2. The basic applications as defined by Section 141 of the Act were made in Luxembourg on the 18th day of June 1982, by ARBED S.A.

3. François Schleimer, Jean Goedert, Ferdinand Goedert Romain Henrion, Fernand Tiill, Henri Klein, Jean-François Liesch, Jean Peckels

(addresses see overleaf)

are the actual inventors of the invention and the facts upon which the applicant is entitled to make the application are as follow:

The applicant is the assignee of the said actual inventors

4. The basic applications referred to in paragraph 2 of this Declaration were the first applications made in a Convention country in
Claim 1. A process to empty tilting metallurgical containers, in particular steel converters, provided with a tap hole in the side wall and containing molten metal on which floats a layer of slag, characterised in that the tight closure of the tap hole is ensured at the latest after the end of the metallurgical operations and before the tilting of the container by means of a plug capable of being attacked by the molten mass, in that the container is tilted, in that a bubbling gas is introduced in the vicinity of the tap hole into the container through porous elements, in that the tap hole is closed by means of a new plug as soon as the first elements of slag are detected and in that the container is tilted into the starting position.

Claim 4. A device for the implementation of the process according to claims 1 to 3, characterised in that the elements permeable to the gas comprise at least one elongated segment having preferably a rectangular section and are fitted on the cold side with a distribution chamber for the gas linked through a pipe to a source of bubbling agent and in that the said plug is fixed transiently on a pivoting arm actuated by a jack.
PROCESS AND DEVICE TO EMPTY METALLURGICAL CONTAINERS

The following statement is a full description of this invention, including the best method of performing it known to: US

1.
Process and device to empty metallurgical containers

The present invention concerns a process and a device to empty tipping metallurgical containers, in particular steel converters, provided with a tap hole set in the side wall and containing molten metal over which slag is floating.

During pouring of the metal, in particular steel, into the ladle or any other transport or treatment container, a certain amount of slag generally passes through the tap hole. Indeed, at the beginning of the emptying, when the converter is tilted into the pouring position, the hole first fills up with slag before the steel bath covers the latter completely. During the pouring of the metal a whirlpool is formed above the tap hole, called vortex, which carries slag towards the ladle. Towards the end of the pouring, before the converter is brought back to its starting position, a supplementary quantity of slag flows into the ladle. The slag present a risk of rephosphorization of the steel. On the other hand, due to the high activity of the oxygen in the slag, the metallurgical treatment of killed or semi-killed steels is then carried out with difficulty. Moreover, desulphurization of steel becomes critical.

To avoid slag being carried along at the beginning or at the end of the emptying operation for tipping metallurgical containers various devices have been suggested. The best known of these are the cut-off valve, the slide cut-off and above all the massive float, the section of which is larger than the opening of the slag-eye and which floats above the mouth of the gate. These floats have a density comprised between that of the slag and that of the metal and their function is to block the gate, when practically all the metal has been poured out. As the lines of the gate vary continually due to the wear, the use of floats does not lead to convincing results. According to the DE-OS 26 39 712 a device for closing the gate is known comprising a closing body which can be driven into the gate and leaves an annular slit free in relation to the wall of the gate and which contains a conduit for a gas under pressure. The slag is driven
back into the container under the effect of the gas flow. This device which is subjected to a sizeable wear in large converters, has been improved (cf. EP 10.082) in that the external lateral surface of the cut-off is constituted by a surface in the shape of a spherical cap which, on the side of the mouth, is transformed into a surface in the shape of a truncated cone. In its preferential form of embodiment, the cut-off is made of grey cast iron. The two devices present the disadvantage that they require large quantities of gas to make the gate slag tight. Moreover one is confronted with problems of blocking of the mouth of the gas conduit of the cut-off.

To decrease the quantity of slag carried away by the whirlpool, called vortex, which forms above the gate from the start of pouring into the ladle, it has already been suggested that a bubbling gas be blown by means of tuyeres into the metallic bath in the immediate vicinity of the gate. Unfortunately the tuyeres require, to avoid their obstruction, large quantities of gas, not only during the emptying process, but also during the whole run. A considerable cooling of the molten metal results therefrom. On the other hand the tuyeres coming into contact with the slag and the molten metal, present clearly shorter lifetimes than those of the lining of the crucible. The disappointing results are probably explained by the fact that the gas bubbling originating in the tuyeres does not disperse sufficiently into the whirlpool and does not succeed, therefore, in countering sufficiently its whirling action and in retaining the slag.

The aim of the present invention is to propose a remedy to the disadvantages described, and to eliminate in large proportions the carrying away of slag when emptying metallurgical containers.

This aim is reached by the process according to the invention which is characterised in that, the tight closure of the tap hole is ensured by means of a plug capable of being attacked by the molten mass, in that the container is tipped, in that a bubbling gas is introduced in the vicinity of the tap hole into the container through porous elements, in that the tap hole is closed by means of a new plug as soon as the first portions of slag are detected and in that the container is tilted into the starting position. Preferential implementations of the invention are described in the sub-claims.
The advantages obtained by means of this invention consist in that a thorough separation of the metal from the slag is carried out, at the beginning as well as during and towards the end of the emptying of the crucible. As far as the crucible is concerned, in the case of a two phase operation with intermediary stirring of the metal and skimming off of the dross and recovery of the slag from the second blow, savings of lime are made due to a reduction of the loss of slag. As far as the container is concerned, a clear decrease in repoloshification of the metal is noticed; the output of ferro-alloys introduced after the emptying increases in a notable manner. Moreover an increase in the wear of the refractory material of the container by about 10% is observed.

The invention is explained in more details by means of drawings, which show, in a non-limitative manner, a possible form of embodiment.

Fig. 1 shows a diagrammatic section through a device to empty metallurgical containers.

Fig. 2 shows a section through a form of embodiment of a plug which is used to close the tap hole as well as its support.

Fig. 3 shows, seen from inside the converter, details of the vicinity of the tap hole.

On Fig. 1 part of a refining crucible 1 is seen, the tap hole of which 2 is blocked by a plug 3. The plug 3 is mounted on an arm 4, which pivots around a shaft fixed onto the wall of the tap hole. The arm 4 is provided with a thrust 6. (The counter-thrust mounted on the wall of the converter is not shown). A hydraulic jack 7, capable of being activated in both directions, acts through a rod 8 and of a fork 9 on the arm 4. The jack 7 can pivot around a shaft integral with the wall of the converter. The plug 3 has the shape of a truncated cone, slightly chamfered. The longer base of the truncated cone has a cylindrical recess 14 into which a lug mounted on the arm 4 embeds itself (see also Fig. 2). The plug which is held on the lug by friction is preferably made of a cheap material, easily machined and relatively soft such as wood, preferably pine. To improve its resistance at high temperature, the surface of the plug is advantageously covered by a layer of refractory material. Two elements 10 porous to a bubbling agent are situated on either side of a tap hole 2 (see Fig. 3). The optimum place where these elements should be sited is preferably determined experimentally for each converter. By positioning them at some 0.5m from
the axis of the tap hole, we have obtained the expected result for our 150 tonnes converter. Porous elements suitable for the implementation of the invention have been described in patents LU 82.552, LU 82.553, LU 82.554. They are constituted by several neighbouring elongated segments, of rectangular section, surrounded by a metallic box. On the cold side of the porous element, a distribution chamber is welded on the walls of the box. Piping link this chamber to a source of bubbling agent. The passage of the bubbling fluid is carried out at the interface of the different segments. It follows that the porous elements create a well spread flow of fluid.

Instead of using a rigid mounting of the lug on the arm, such as shown on Fig. 1, one may advantageously opt for a swivelling mounting (see Fig. 2). In this form of embodiment of the invention, a tube is secured on the arm, the former having a welded base. A bolt screwed into a ball fitted with the plug holding lug ensures, through the spring and the washer, a seal for the ball onto the base. This swivelling mounting of the plug on the arm guarantees an automatic centering of the plug on the mouth of the tap hole the contours of which vary due to wear.

The operation of the device is as follows: During blowing the jack may be held in the pouring position, such as shown in Fig. 1, to guarantee that the plug is held in the mouth of the tap hole. Let us note in passing that the tap hole is preferably always closed, except during the pouring operation. This limits the loss of heat and prevents outbursts of flames and slag during the blow. Before tilting the converter, the jack withdraws the arm up to the thrust. The plug remains stuck in the tap hole. The liquid mass, during the tilting, comes into contact with the plug and destroys it in a few seconds. At this moment the converter is in such a position that slag alone is in the immediate vicinity of the tap hole. Due to the intense and continuous bubbling, caused by the rise of the flow of bubbling gas released from the porous elements, a circular area is created above the tap hole. This area is devoid of slag and practically does not present any vortex, so that the steel may flow without carrying forth notable quantities of slag. A new plug is positioned on the lug of the arm. Towards the end of the pouring, as soon as the first pieces of slag are observed, or detected by means of optical detectors, magnetic detectors, etc., the jack is put under pressure and the plug is thrust into the tap hole. The plug has a reduced mass, closing is therefore rapid. As the plug is relatively soft, it is able to adapt to the contours
of the tap hole. To guarantee an hermetic closure, the position of the cut-off is preferably adjustable on the axis of the tap hole. It is also pointed out that since the plug remains stuck respectively held in the tap hole between two emptying operations, the use of a second plug is superfluous.

The bubbling agent is usefully a neutral gas such as argon, nitrogen or eventually carbon dioxide. During the run, a flow of gas of 2-3 m³/hour ensures the porosity of the refractory elements. At the time of tipping, the output of gas is increased to reach 5-10 m³/hour. Let us note here that higher outputs cause projections, which mix with the slag and which are then carried with the latter towards the tap hole. By adjusting the output of bubbling gas, it has been observed that for re-killled steels, there is an improvement of the output of ferromanganese reaching 3 to 7%, which is equivalent to an average saving of 0.35 kg/t of steel. Similarly, the number of casts presenting a high rephosphorization, of the order of 0.06% P, has decreased by more than half, while those that presented a low rephosphorization, of the order of 0.02% P, has easily doubled.

Although the invention has been described and shows the convincing advantages in relation to a tilting crucible, it may also be used with static metallurgical containers having a tap hole provided in the bottom. Similarly, the number of porous elements must not necessarily be taken as being equal to two and the bubbling gases suitable for the implementation of the invention are not uniquely argon, nitrogen and carbon dioxide.
THE CLAIMS DE

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THE CLAIMS DEFINING THE INVENTION ARE AS follows:

1. A process to empty tilting metallurgical containers, in particular steel converters, provided with a tap hole in the side wall and containing molten metal on which floats a layer of slag, characterised in that the tight closure of the tap hole is ensured at the latest after the end of the metallurgical operations and before the tilting of the container by means of a plug capable of being attacked by the molten mass, in that the container is tilted, in that a bubbling gas is introduced in the vicinity of the tap hole into the container through porous elements, in that the tap hole is closed by means of a new plug as soon as the first elements of slag are detected and in that the container is tilted into the starting position.

2. A process according to claim 1, characterised in that the plug is introduced into the tap hole by means of a pivoting arm, preferably actuated by a hydraulic jack, in that the holding of the plug in the tap hole during the metallurgical operations is ensured by means of the said arm and that the arm is withdrawn just before the emptying operation.

3. A process according to claim 1, characterised in that a set quantity of gas is permanently blown, preferably 1-3 m³/hour, through each porous element and that this flow is increased, preferably to 5-10 m³/hour, during the outpouring of the metal from the container.

4. A device for the implementation of the process according to claims 1 to 3, characterised in that the elements permeable to the gas comprise at least one elongated segment having preferably a rectangular section and are fitted on the cold side with a distribution channel for the gas linked through a pipe to a source of bubbling agent and in that the said plug is fixed transiently on a pivoting arm actuated by a jack.

5. A device according to claim 4, characterised in that the transient securing is constituted by a lug which holds the plug, provided with a suitable recess, by friction.

6. A device according to claim 5, characterised in that the plug-holding lug is mounted in a swivelling manner on the pivoting arm.

7. A device according to one of the claims 4 or 5, characterised in that the plug has the shape of a truncated cone the small base of which is circular and the large base of which is elliptical.
6. A device according to claim 7, characterised in that the plug is made of wood, preferably pine and is partially covered by a layer of refractory material.

7. A device according to claim 4, characterised in that it comprises two porous elements, situated on either side of the top hole, preferably at a distance of some 0.5 m from the axis of the top hole.

8. A device according to claim 4, characterised in that the source of the bubbling agent is an oxygen, nitrogen or carbon dioxide source.

DATED this 16th day of June 1993.

ARGEE S.A.

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