Sept. 9, 1958 O. CUSCOLECA ET AL 2,851,351

PROCESS FOR BLOWING PIG IRON TO STEEL

Filed June 29, 1954

Fig. 1

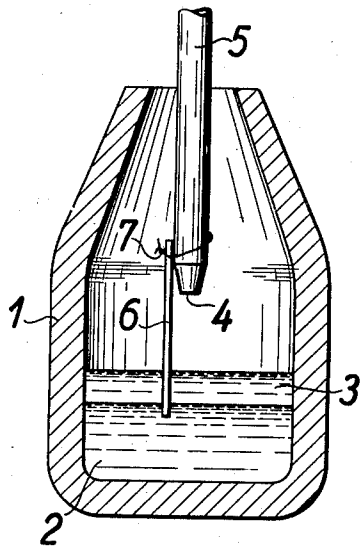


Fig. 2

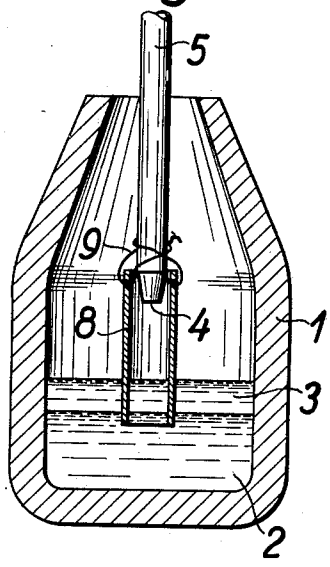
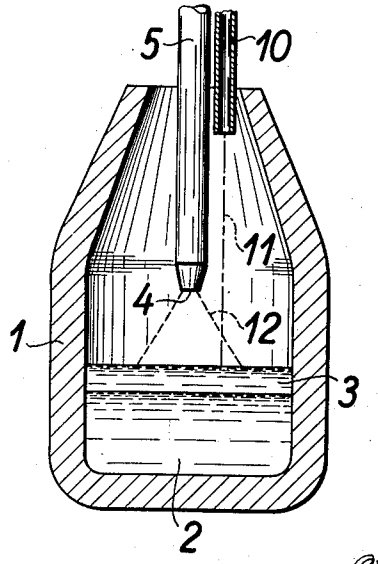


Fig. 3



INVENTORS
Otto Cuscoleca,
Felix Grohs, Kurt Rösner
BY and Wolfgang Kühnelt

Campbell Bumbaugh Elliott & Evans
ATTORNEYS

United States Patent Office 2,851,351 Patented Sept. 9, 1958

2,851,351

PROCESS FOR BLOWING PIG IRON TO STEEL

Otwin Cuscoleca, Velden, Worthersee, Felix Grohs, Leoben, Kurt Rösner, Leoben-Donawitz, and Wolfgang Kühnelt, Judenburg, Austria, assignors to Oesterreichisch-Alpine Montangesellschaft, Vienna, Austria

Application June 29, 1954, Serial No. 440,162

13 Claims. (Cl. 75—60)

This invention relates to a process for refining pig iron to steel by blowing oxidizing gases or gas mixtures, particularly oxygen onto the bath surface from above and producing the heat quantities required for the process by the reaction of the gases with the metal bath. Such processes, in which pig iron is blown to steel in a converter with the aid of a jet directed against the bath surface are known per se and afford several advantages over those processes in which the blast is supplied to the bath through a tuyère bottom. It has been suggested already in connection with these processes, in which the blast jet is directed from above against the bath surface, to reduce the energy of the blast jet considerably in order to avoid overoxidation of the bath. The measure of directing the blast jet against the bath surface with small energy has proved advantageous but involves the difficulty that the small energy of the blast jet may not be sufficient to displace the slag layer floating on the metal bath unless that slag is liquid. That undesired condition occurs mostly if the flux materials added to control the formation of slag in the subsequent process are placed on the slag before the blowing operation begins; this is the usual practice. That slag layer may considerably retard or even prevent the beginning of the reaction. Only when the blast jet has contacted the metal bath at the beginning of the process does the reaction begin, which then proceeds so violently that as the process continues the contact of the blast jet with the metal bath is ensured by the agitation of the bath. It has been found that after the blowing operation has begun the initiation of the reaction is often delayed until the first contact of the blast jet with the metal bath has been made to effect what may be called an ignition. This delay prolongs the process and involves a lack of oxygen; on the other hand it sets a lower limit for the reduction of the energy of the blast jet.

It is known already to add before the blowing operation begins a readily ignitable substance having a high combustion temperature, preferably aluminum or titanium, to the liquid charge in small acid converters, in order to obtain a more rapid ignition. That process is expensive and complicated, at least where the oxygen-containing gas is blown onto a limited impact area, because in that case additional measures are required to bring the readily ignitable substance of high combustion temperature to the impact area of the jet.

It is an object of the invention to avoid said disadvantages in such process, in which the blast jet is directed against the bath surface with an energy insufficient to ensure the immediate penetration of the slag layer. The invention essentially resides in piercing the slag layer with the aid of a solid body adjacent to the impact area of the blast jet at the beginning of the blowing operation. By the mechanical piercing of the slag layer at least for an instant the contact between the blast and the metal bath is established; this is sufficient to initiate the process, whereafter the continuation of the process is promoted by the ebullition of the bath.

In the most primitive mode of carrying out the process, e. g., a solid body, if desired a piece of scrap or metal of suitable weight, may be thrown on the bath surface or into the converter to pierce the slag layer for an instant adjacent to the impact area of the blast jet. According to the invention, however, the solid body is suitably brought to the slag layer with the aid of the holder of the blast nozzle. In a preferred mode of carrying out the invention the solid body is fixed to the holder of the blast nozzle by a fixing means separating under the influence of the temperature prevailing above the slag layer. To this end the solid body may be tied to the nozzle holder by means of a hemp cord which is burnt up within a few seconds after the holder has been introduced into the converter mouth. Similarly a wire fusing under the action of temperature may be used as a fixing means. Depending on the temperature prevailing there, a wire of readily fusing metal, such as lead, may be used. A primer may be used which destroys the fixation, or a wire consisting of a magnesium alloy which burns up quickly once it has been ignited.

According to the invention a rod of iron or another metal may be fixed, e. g., to the nozzle. Such rod is burnt down quickly as it contacts the bath or slag and if the fixation is of such nature as to separate under the action of temperature, as has been explained, excessive heat transfer through the rod to the nozzle is eliminated. Suitably the rod is of such length as to extend into the metal bath through the slag layer. The piercing of the slag layer may be facilitated by moving said rod.

Instead of the rod a tube may be used, which surrounds the nozzle outlet and is connected to the nozzle holder by a fixing means separating under the action of temperature. As the blowing operation begins, the blast is directed, e. g., for a few seconds, through the tube, whereby the energy of the blast impinging on the bath surface is increased. If the length of the tube is chosen so that the tube penetrates through the slag layer into the metal bath, the blast is introduced below the bath surface at the beginning of the blowing operation, as where a blowing lance is employed, and the reaction is initiated with high energy. When thereafter the fixing means separates under the action of temperature, which may be the case after only a few seconds, the reaction is in progress already.

Illustrative embodiments of the invention are shown in the accompanying drawings.

Figs. 1 and 2 show different embodiments, in which the solid body is fixed to the holder of the blast nozzle, which is movable into the converter.

Fig. 3 shows an embodiment in which the solid body is thrown into the converter.

In the embodiment shown in Fig. 1, 1 designates the converter, 2 the metal bath, and 3 the slag layer. The nozzle is designated with 4, the nozzle holder with 5. The nozzle holder has fixed thereto by means of a hemp cord or a readily fusing wire 7 an iron rod 6, which extends through the slag layer 3 into the metal bath 2. After a few seconds the fixing means 7 is burnt or fused up but the rod 6 has pierced the slag layer 3 already as the nozzle holder 5 was moved into the converter. Thus the reaction has been initiated. Unless the reaction is initated instantaneously, its initiation may be promoted by moving the nozzle holder 5. When the rod 6 drops into the bath the slag layer is pierced vigorously once more.

In the arrangement shown in Fig. 2 a tube 8 is suspended from the nozzle holder 5 with the aid of a wire or a hemp cord 9. That tube serves at the same time as a guide for the blast jet emerging from nozzle 4 and acts like a lance to introduce the blast jet into the metal bath 2 below the bath surface. Thus the reaction of the

blast with the metal bath is initiated vigorously. That tube 8 also separates within a short time from the nozzle holder 5 because the fixing means burns or fuses, whereafter the tube drops into the bath.

Fig. 3 shows an embodiment in which simply a solid body, such as a lump of scrap or metal, is thrown into the converter 1 onto the slag layer 3. To this end a chute or guide 10 is provided, through which the lump of scrap or the like may be thrown. That chute or guide is suitably arranged so that the lump of scrap falls down vertically beside the nozzle 5 and drops on the surface of the slag layer 3 approximately in the central part of the impact area of the blast jet, indicated by the dotted cone 12.

When pig iron is refined to steel by a jet of oxidizing gas directed from above onto the bath surface it has been found suitable, e. g., to control the blast jet to have a mean pressure not exceeding 0.75 kg./sq. cm. or 0.5 kg./sq. cm. on the bath surface. That practice offords certain advantages in avoiding an overoxidation of the bath. Special advantages have been obtained with even lower pressures per unit area of the blast jet on the bath surface, e. g., if that mean pressure is less than 0.1 kg./sq. cm. or even less than 0.02 kg./sq. cm. In all these cases, in which the blast jet impinges on the bath surface with very small energy, the mechanical piercing of the slag layer according to the invention, in order to initiate the process, affords essential advantages.

A practical mode of carrying out the process may be described by way of the following example:

In a converter, in which a pig iron charge of 30 tons is refined to steel by a jet of commercially pure oxygen directed from above against the bath surface, the blast nozzle having an internal diameter of 30 mm. is spaced 1 metre from the static surface of the metal bath. The pressure behind the blast nozzle is 7 kg./sq. cm. (gauge pressure) and the blast jet impinges on the bath surface with relatively small energy. If the slag layer floating on the pig iron has solidified when the cold lime and the cold fluxes were added thereto, that solid slag layer will prevent the access of the oxygen to the pig iron bath. Before the blowing operation begins, a piece of iron is fixed by means of a thin iron wire to the nozzle tube disposed in an elevated position above the converter, as is shown in Fig. 1. Such piece of iron may consist of a waste part of a billet, having a square cross section of 50 mm. side length and a length of about 2 metres.

The nozzle tube with the blast nozzle is then lowered until the nozzle is 1 metre above the static surface of the pig iron bath. At the same time the oxygen valve is opened so that the oxygen is blown against the bath surface. As the nozzle pipe is being lowered, the billet waste part tied to the nozzle tube pierces the solid slag cover so that the oxygen can now react with the pig iron bath at that point. After a short time the wire with which the billet waste part is fixed to the nozzle pipe is fused under the action of heat and the rest of the part, not molten before, drops into the metal bath. Thus the slag is pierced once more. After the contact of the oxygen with the pig iron bath has thus been established and the reaction has been initiated, the slag is liquefied by the heat of reaction and the reaction proceeds in the usual manner.

What we claim is:

1. A process for refining a pig iron bath having a surface which is covered by a layer of slag to convert the iron to steel, comprising directing a jet of oxidizing gas from above against said layer of slag with energy insufficient to penetrate said slag layer and initiate the reaction between the oxidizing gas and the iron bath by piercing said slag layer within the impact area of said jet by means of a solid body during a short interval at the beginning of the process to bring the oxidizing gas into contact with surface area of the pig iron bath.

2. A process as set forth in claim 1 in which said solid body is thrown into said slag.

3. A process as set forth in claim 1 in which said solid body consists of a piece of iron.

4. A process as set forth in claim 1 in which said solid body consists of a piece of scrap.

5. A converter for refining pig iron to steel by a blowing operation comprising a receptacle for receiving a pig iron bath having a surface and a layer of slag thereon, a nozzle for blowing a jet of oxidizing gas against said surface, a holder for said nozzle, said holder being mounted movably in order to be introduced into the receptacle from above to position the nozzle in a blowing position above said layer of slag, a solid body fastened to the said holder and extending downwardly below said nozzle, and means for fastening the said solid body to the said holder, said fastening means consisting of a material which is weakened by the heat prevailing in the said receptacle to release said solid body from the holder.

6. A converter as set forth in claim 5 in which said fastening means consists of a hemp cord.

7. A converter as set forth in claim 5 in which said fastening means consists of a wire having a fusing temperature lower than the temperature prevailing in the said receptacle above the said layer of slag.

8. A converter as set forth in claim 5 in which said solid body consists of an iron tube surrounding said nozzle.

9. A converter as set forth in claim 5 in which said solid body consists of an iron tube having a length sufficient to extend through said slag layer into said iron bath when the nozzle is in said blowing position.

10. A converter as set forth in claim 5 in which said solid body consists of an iron rod.

11. A converter as set forth in claim 5 in which said solid body consists of an iron rod having a length sufficient to extend through the said slag layer into the said iron bath when the nozzle is in said blowing position.

12. A converter for refining pig iron to steel by a blowing operation comprising a receptacle having a top opening for receiving a pig iron bath having a layer of slag upon its surface, a nozzle extending through said top opening and into said receptacle and movable toward and away from said bath for blowing a jet of oxidizing gas against said surface and means adjacent to said nozzle for introducing a solid body into the converter at a spot within the impact area of said jet on said slag layer.

13. In the converter set forth in claim 12 in which the means for introducing the solid body into the converter comprises a chute aimed at a spot within the impact area of said jet on said slag layer.

References Cited in the file of this patent

UNITED STATES PATENTS

411,417	Bookwalter	Sept. 24, 1889
2,668,759	Tenenbaum	Feb. 9, 1954