Oct. 21, 1952 J. B. WAGSTAFF 2,614,585

COMPOSITE PIPE

Filed Jan. 22, 1948

Fig. 1

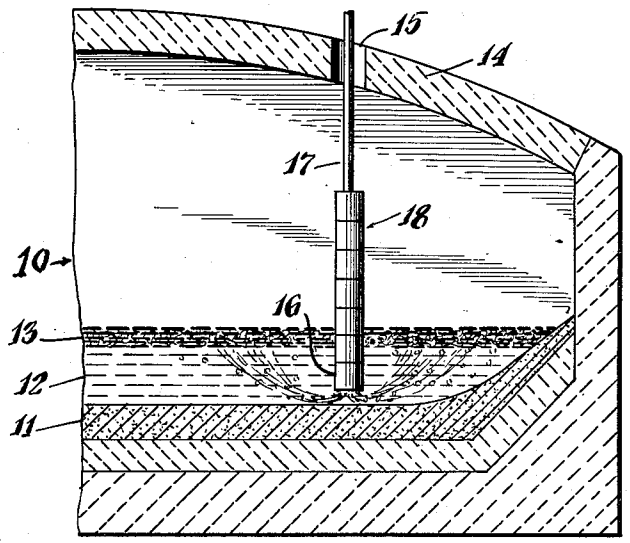


Fig. 2

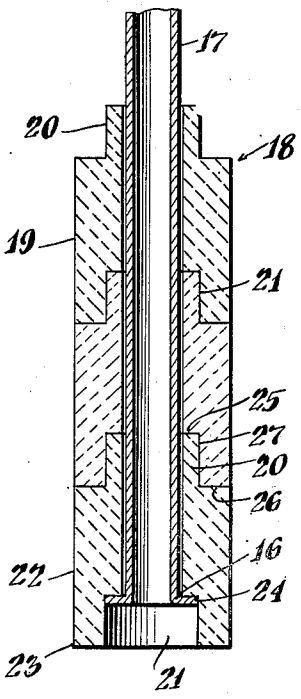


Fig. 3

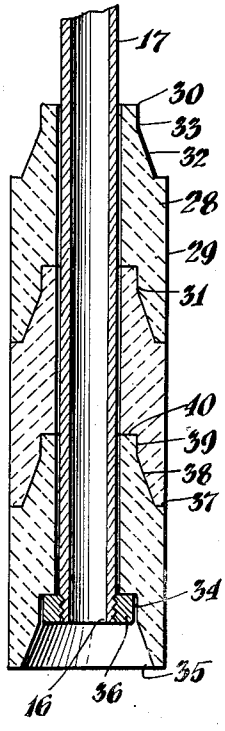
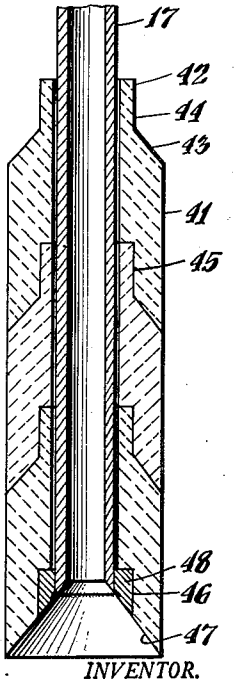


Fig. 4



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COMPOSITE PIPE

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3 Claims. (Cl. 138—64)

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This invention relates to apparatus for introducing a gas, such as oxygen or oxygen-enriched air, into a bath of molten metal.

The introduction of oxygen or oxygen-enriched air into a bath of molten metal, for example, molten iron in an open hearth furnace to accelerate the rate of reduction of the carbon content of the molten iron, has received and is receiving considerable attention by research personnel. In order to obtain satisfactory results it has been found necessary to introduce the oxygen beneath the surface of the bath of molten iron where it will come into intimate contact with the carbon and effect its removal. Obviously the introduction of oxygen through a steel or iron pipe having its exit end disposed beneath the surface of the molten iron results in melting of the pipe at a rate requiring rapid replacement of the pipe. In fact, the suggestion has been made to use a long steel pipe or so-called "lance," say about 20 feet long or longer, mounted on a carriage with one end immersed in the molten metal, the pipe being moved into the molten metal to replace the end portion as the latter melts while feeding oxygen through this pipe into the molten bath. Such equipment has many disadvantages, among which may be mentioned (1) it involves the use of a cumbersome carriage for the long lengths of pipe, which carriage and lengths of pipe occupy the space near the open hearth furnace and therefore obstruct and otherwise interfere with the movement of the operators in the vicinity of the furnace, (2) it entails frequent interruption of the feed of the oxygen into the molten bath necessitated by the placement of new lengths of pipe on to the carriage and the connection of such pipe with the source of oxygen, (3) it involves arduous and time-consuming labor for servicing and operating the carriage which effects feeding of the length of pipe into the molten metal bath, and (4) it necessitates stock piling long lengths of pipe in the vicinity of the molten metal bath.

It is an object of this invention to provide apparatus for introducing a gas such, for example, as oxygen or oxygen-enriched air below the surface of a bath of molten metal, e. g., a bath of molten iron in an open hearth furnace, which apparatus is compact, is simple to construct, is efficient in operation, requires little attention by the operator and may be used for relatively long periods of time, its effective life usually being the same or even longer than the life of the refractory lining for the furnace.

Other objects and advantages of this invention

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will be apparent from the following detailed description thereof.

In accordance with this invention a conduit desirably in the form of a cylindrical pipe extends through a wall of an open hearth furnace and has its free end disposed beneath the surface of the bath of molten metal. The end of the conduit disposed exteriorly of the furnace communicates with a source of oxygen or other gas. A high temperature, heat-resistant refractory material completely covers the portion of the pipe disposed within the bath of molten metal extending beyond the end of the pipe disposed within the bath of molten metal and desirably a substantial distance above the level of the bath of molten metal. This refractory covering preferably consists of a plurality of like sections each extending along the length of the conduit with the end of one section abutting against the adjacent end of a contiguous section, the abutting ends being complemental and shaped to provide a joint having a substantial portion thereof disposed at an angle to a plane normal to the longitudinal axis of the conduit. In this way relatively short sections of refractory material may be shaped and assembled to provide a refractory cover in which the joints between sections are so disposed that they do not permit the molten metal to attack the metal conduit through which the gas flows, as will be explained more fully hereinafter.

In the preferred embodiment illustrated on the drawing the invention is shown incorporated in an oxygen feeding device for an open hearth furnace and the description which follows will be confined to the present illustrated embodiment of the invention. It will be understood, however, that the novel features and improvements are susceptible to other applications such, for example, as feeding devices for feeding other gases than oxygen into baths of molten metal, including molten iron and other molten metals in electric, open hearth and other furnaces. Hence, the scope of this invention is not confined to the embodiment herein described.

In the accompanying drawing forming a part of this specification and showing for purposes of exemplification a preferred form of this invention without limiting the claimed invention to such illustrative instance,

Figure 1 is a fragmentary vertical section through an open hearth furnace embodying my invention;

Figure 2 is a fragmentary vertical section through the lower portion of the oxygen feeding device of Figure 1 showing one form of high tem-

perature, heat-resisting refractory casing protecting the metal pipe through which the oxygen is introduced into the molten metal bath;

Figure 3 is a fragmentary vertical section corresponding to Figure 2 but showing a modified form of high temperature, heat-resisting refractory covering; and

Figure 4 is a fragmentary vertical section corresponding to Figure 2 but showing still another modified form of high temperature, heat-resisting refractory covering.

In the drawing 10 indicates an open hearth furnace of well known type having a refractory base 11 on which the bath of molten metal 12 rests, this bath as customary having an upper slag layer 13. The top 14 of this furnace is provided with an opening 15 through which extends the leading end 16 of a metal, desirably steel, conduit 17 which in the embodiment shown in the drawing is a conventional pipe. End 16, as shown in Figure 1, is disposed beneath the surface of the molten metal bath 12. The end of the conduit 17 positioned exteriorly of the furnace 10 is connected with a suitable source of oxygen or other gas supplied through this conduit to the bath of molten metal beneath the surface thereof.

As shown in Figure 2, pipe 17 is protected by a high temperature, heat-resistant refractory cover 18. The refractory cover 18 may be made of any suitable material resistant to the temperatures to which the pipe 17 may be subjected; for example, well known fire brick, chrome refractory, fused alumina, dolomite, magnesite or silica may be used.

The refractory cover 18 of Figure 2 consists of a plurality of sections each having a bore running the full length thereof of a diameter just slightly greater than that of pipe 17 to receive the pipe with no appreciable clearance between the exterior walls of the pipe and the walls of this bore. Each section comprises a cylindrical body portion 19 having a cylindrical extension 20 projecting from one end thereof, which cylindrical extension is of smaller diameter than that of the body portion 19. At the other end a cylindrical recess 21 is formed having a diameter substantially the same as that of the extension 20. The sections it will be noted are all alike and are assembled on the pipe 17 so that the lowermost section 22 is positioned at the end of the pipe with the walls 23 defining recess 21 projecting beyond the end 16 of pipe 17. End 16 is formed integrally as a flange 24 the outside diameter of which is substantially the same as the diameter of recess 21 so that this flange fits within this recess.

Projection 20 of lowermost section 22 snugly fits within the recess 21 of the section immediately thereabove. In the same manner the projection 20 of each section snugly fits within the recess of a section immediately thereabove, the resulting assembly of sections resting on the flange 24 at the end 16 of the pipe 17. There is thus provided a refractory covering in which the joints between contiguous sections have a substantial portion thereof extending in a plane at an angle to a plane normal to the pipe 17. In the embodiment of the invention shown in Figure 2 the joint between contiguous sections is of stepped configuration and consists of two horizontal portions 25 and 26 connected by a vertical portion 27, which vertical portion extends at right angles to a plane normal to the longitudinal axis of pipe 17. The resultant joint construction minimizes entry of molten metal through the joints between sections into contact with the metal pipe 17, since portion 27 of the joint functions as a barrier to the flow of molten metal towards the pipe walls.

The abutting walls of projection 20 and recess 21 are ground or otherwise formed to provide smooth contacting surfaces; no cement or other bonding material which would be attacked by the molten metal and provide a clearance between contiguous sections is employed.

The modification of Figure 3 differs from that of Figure 2 chiefly in that the refractory covering consists of a plurality of like sections 28 each having a bore running the full length thereof of a diameter to receive pipe 17. Each section comprises a cylindrical body portion 29, a projecting portion 30 at one end and a complemental recess 31 at the opposite end. The projecting portion 30 consists of a truncated conical segment 32 and a contiguous cylindrical segment 33. Recess 31 consists of a cylindrical segment 34 and a truncated conical segment 35. End 16 of the pipe is provided with a collar 36 in the form of a threaded flange fitting within segment 34 of recess 31. The assembly of sections 28 forming the refractory cover rests on collar 36.

In the construction of Figure 3 each joint between contiguous sections consists of a horizontal portion 37, a conical portion 38 forming the major portion of the joint, a vertical portion 39 and a horizontal portion 40. The contacting surfaces forming the joint are shaped to provide intimate contact between the complemental portions of contiguous sections and are free of cement or other bonding material. A joint thus results in which portions 38 and 39 are at an angle to a plane normal to the longitudinal axis of pipe 17; portions 38 and 39 act as a barrier preventing contact of molten metal with the walls of pipe 17.

It will be noted conical segment 35 of recess 31 projects beyond collar 36 at the end 16 of pipe 17. The segment 35 provides a protective covering for the end 16 of pipe 17 and for collar 36 as will be explained more fully hereinafter.

In the modification of Figure 4 the refractory covering consists of a plurality of sections each comprising a cylindrical body portion 41. At one end of the body portion a projection 42 is formed consisting of a truncated conical portion 43 merging into a cylindrical portion 44. At the other end a recess 45 is formed complemental in shape to projection 42, the recess 45 consisting of a cylindrical segment 46 and a truncated conical segment 47. End 16 of the pipe has welded thereto a collar 48 snugly fitting within the segment 46 of recess 45 in the lowermost section. The assembly of sections rests on collar 48. Except as here noted, the construction of Figure 4 is the same as that hereinabove described in connection with Figure 3.

In Figures 2, 3 and 4 of the drawing while the refractory covering has been shown consisting of three sections it will be understood any desired number of sections may be used. Furthermore, other shapes of individual sections than those shown in the drawings may be employed as long as the shapes when assembled in abutting relationship provide joints which have a substantial portion thereof disposed in a plane at an angle to a plane normal to the conduit through which the gas is supplied, which joints are close fitting so that at least a portion of the joint acts

as a barrier preventing penetration of the molten metal therethrough into contact with the walls of the conduit 17.

In operation the refractory covered conduit or pipe is introduced into the furnace and before the end 16 is brought into contact with the bath of molten metal the supply of oxygen is turned on. The conduit is then lowered so that it is immersed into the bath of molten metal, for example, into the position shown in Figure 1. The existing oxygen prevents the molten metal from coming into contact with the end 16 of the metal pipe or with flange 24 of Figure 2, or collars 36 and 48 of Figures 3 and 4, the portions of the lowermost section of the refractory cover projecting beyond the flange and collars shielding same and the oxygen exiting from these projecting portions under sufficient pressure to prevent the molten metal from flowing into contact therewith. The exothermic reaction of the oxygen with the contents of the metal bath takes place in the locality of the end of the lowermost refractory section which, it will be noted, is spaced from the end 16 of pipe 17 and from the flange 24 or collars 36 and 48. The extending recessed end of the refractory covering therefore protects the end of the pipe, the flange 24 and the collars 36 and 48.

It will be noted this invention provides an improved construction for feeding a gas beneath the surface of a bath of molten metal, which construction is compact, simple in design, efficient and durable in operation. Since the refractory cover is made from refractory shapes all of which are the same, it is relatively inexpensive to assemble and maintain. Should any of the sections of the refractory covering for any reason become defective, it is not necessary to replace the entire covering but only such defective section. The protective cover for the metal pipe may be of the same refractory material as the base 11. Since the refractory cover does not support the weight of the molten metal bath, in general, it will outlast the base 11.

It is well to observe that the bore running through the sections of the refractory covering be of a little larger size than the overall size of the pipe which is to pass therethrough so as to avoid cracking or injury of the refractory covering because of the greater thermal expansion of the pipe when the pipe with the covering theron is introduced into the hot furnace. Even though the refractory covering does not fit snugly around the pipe, molten metal is kept from flowing up into the clearance between the covering and the pipe by the pressurized gas discharging from the end of the pipe which is immersed into the molten metal bath.

Since different embodiments of the invention can be made without departing from the scope of this invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense. Thus while a cylindrical pipe has been shown in the drawing, the invention comprehends pipe of other shapes. Accordingly, the terms "pipe" and "conduit" are used in the claims in a broad sense to include pipe or conduit of any desired cross sectional configuration.

What is claimed is:

1. Apparatus for feeding gas into a bath of molten metal beneath the surface thereof, comprising a metal conduit through which the gas flows and discharges from the free end thereof into the molten metal, a high-temperature, heat-resistant refractory covering protecting the portion of said conduit in the vicinity of said free end, said covering consisting of a plurality of identical sections positioned in abutting relationship on said conduit, each of said sections having a bore running the full length thereof through which said conduit passes, each section having at one end thereof a projecting portion of reduced cross-sectional area as compared with the cross-sectional area of the body portion of said section and a recess complemental in shape to the projecting portion at the other end thereof, the length of said projecting portion and of said recess being at least about as great as the thickness of said body portion of said section, the recess of the terminal section disposed at said free end extending beyond said free end and the projecting portion of said terminal section being positioned within the recess of the contiguous abutting section, and means on said free end for maintaining the sections of said covering on said conduit, said means being of a configuration that fits well within said recess of said terminal section.

2. Apparatus as defined in claim 1 wherein the metal conduit is cylindrical, each section of said covering is cylindrical, the projecting portion of each section comprises a cylindrical part, and the means for maintaining the sections of said covering on said conduit is a flange on the free end of said conduit.

3. Apparatus as defined in claim 1 wherein the metal conduit is cylindrical, each section of said covering is cylindrical, the projecting portion of each section comprises a frusto-conical part, and the means for maintaining the sections of said covering on said conduit is a flange on the free end of said conduit.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
905,948	Stromborg	Dec. 8, 1908
1,330,310	Du Mazuel	Feb. 10, 1920
1,949,731	Soldatoff	Mar. 6, 1934

FOREIGN PATENTS

Number	Country	Date
82,103	Sweden	Nov. 27, 1934