The present invention relates to improvements in hot blast cupolas and resides principally in the provision of means for circulating, heating and delivering air under pressure to the tuyères which blast the air into the cupola to effect melting of the products therein used in the production of cast metal objects.

One of the principal objects of the present invention is to provide a relatively long path of circulation of the air subject to the heat created during melting of the metals whereby the air is thoroughly heated before it is delivered to the tuyères.

Another object of the invention resides in a special construction of conduits through which the air is circulated and providing for easy replacement of the conduits when necessary.

A further object of the invention resides in the provision of means for readily determining during operation of the cupola, that is, during a melting operation, whether the respective conduits are intact or whether leaks have occurred therein, and providing for cutting out or making inoperative such of the conduits as may be leaky so that should one or more of the conduits become burned out or develop leaks the air will not be permitted to escape therefrom into the cupola to create a melting zone above the desired melting zone created by the tuyères.

The foregoing and other objects and advantages of the invention will become more apparent and will be pointed out during the course of the following detail description of the drawings, to which

Fig. 1 is a vertical central sectional view through a cupola embodying the present invention and taken on the line 1—1 of Fig. 2;

Fig. 2 is a view taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged fragmentary view of the upper portions of two pairs of conduits and their couplings, one pair being shown in section;

Fig. 4 is an enlarged fragmentary view partly in section through a portion of the upper end of the cupola and showing the manner of hinging the conduits;

Fig. 5 is an enlarged detail view partly in section and partly in elevation showing the lower ends of the conduits, the inlet and outlet pipes with which they communicate and valves for controlling the flow of air through said conduits; and

Fig. 6 is a front view of one of the covers for the blast pipes taken on the line 6—6 of Fig. 5.

In Fig. 1 of the drawings the numeral 1 indicates the lining of the base of the cupola composed of refractory material enclosed within a metal shell 2 resting upon a mantle plate 3.

The usual tuyères 4 communicate with openings 5 through the lining 1 to deliver the blast of air into the cupola to effect the melting of the metal therein. Each of the tuyères communicates with a down pipe 6, the upper end of which pipes are connected to and communicate with the lower blast pipe 7.

The inner or refractory wall 8 of the cupola, above the base, is formed to accommodate conduits or pipes 9 and 10 arranged in pairs with the longer pipes 9 of each pair communicating at their lower ends with the lower blast pipe 7; and with the shorter pipes 10 communicating with the upper blast pipe 11 to which the air under pressure is supplied from any suitable source, not shown. It will be noted that the lower ends of the pipes 9 and 10 extend through openings in the refractory lining 8 and the outer shell 12 of the cupola, and as shown best in Fig. 5, confront respectively valve heads 13 and 14 located respectively in the lower and upper blast pipes 7 and 11. Around the lower ends of each of the pipes 9 and 10 within the said blast pipes is a suitable gasket 15 capable of withstanding the temperatures to which they are subjected, due to the passage of the air therethrough and the heat of the cupola, and adapted to be compressed by gland rings 16 drawn up against the gaskets by means of bolts 17 and nuts 18 to effect a fluid tight joint on each conduit, while permitting movement of the conduits under forces created by expansion and contraction.

The valve heads 13 and 14 are carried on stems 19 each provided at its outer end with a handle 20. The stems extend through gland nuts 21 threaded onto the outer ends of bosses 22 through which and packings 23 the stems also extend. The bosses 22 which receive the stems 19 are provided on plates 24 covering the respective blast pipes. The said cover plates 24 are removably attached to the blast pipes by eye bolts 25, the outer ends of which receive wing nuts 26. Dowel pins 27 are provided to center the cover plates. Packing rings 21 are inserted between the plates 24 and the blast pipes to provide fluid tight joints.

The direction of flow of the air through the blast pipes, conduits 9 and 10 and the tuyères is indicated by the arrows in the drawings, it being noted that the air enters the shorter pipes 10 from the blast pipes 11 and then passes upwardly within the cupola wherein the pipes are directly exposed to the temperatures existing in the cupola, and then down through pipes 9, blast pipe 7, down pipes 8, and through the tuyères 4 into the cupola through the openings 5 to create the melting zone at the bottom of the cupola.

Referring to Figs. 1 and 2 it will be noted that the respective conduits 9 and 10 are alternately arranged around the interior of the cupola, and, of course, the number of conduits used depends...
upon the capacity of the cupola, and the size of the conduits used.

Each pair of conduits 9 and 10 is connected to its top by couplings 28, shown in detail in Figs. 3 and 4; each coupling comprising a hood-like member having a pair of sockets 29 and 30 therein which receive the upper ends of the pipes 9 and 16. Packing rings 31, somewhat similar to piston rings, are seated in grooves in the upper ends of the conduits and contact the inner walls of the sockets 29 and 30, providing fluid tight joints, and yet permitting relative longitudinal movements between the conduits and sockets to take care of expansion and contraction which occurs at various times in the melting process and thereafter.

Each of the couplings 28 is provided with upward standing ears 32 having alined openings to receive pins 33 maintained against longitudinal movement by means of cotter pins 34, or the like. Depending brackets 35 are attached to the annular plate 36 at the top of the cupola as by means of rivets or bolts 37, the said brackets being formed to provide cradles 36 to receive pins 33 to hingedly connect each pair of pipes 9 and 10, and their respective couplings 28, to the top of the cupola.

As is well known hot blast cupolas are charged by dumping the iron, coke, etc., thereinto from the top. In the present case, since the conduits 9 and 10 and couplings 28 especially at their tops are exposed to contact by the iron and coke being dumped into the cupola, we provide guard plates 40 each having at its top a hooked end or flange 41 to engage over the plate 36 whereby the plates 40 are removably supported to protect the upper ends of the conduits and their couplings during charging of the cupola.

From the foregoing it should be obvious that the air under pressure which is supplied to the bustile pipes 11, is forced upwardly through conduits or pipes 9, 16 and downwardly through conduits or pipes 9, into the lower bustiles 9 and down pipes 6 to the tuyères. The travel of the air is over a relatively long course with the conduits in direct exposure to the heat within the cupola, so that the air which is delivered to the tuyères and blasted into the cupola is of a relatively high temperature.

Of course the air entering the bustile 11 is introduced into the lower ends of the pipes 9, while the air delivered from the pipes 9 into the bustile 7 is emitted under pressure toward the valve heads 12. The operator may test from time to time whether or not the pipes 9 and 10 and their couplings are intact or whether they have developed leaks by moving the valve heads 13 toward the confronting ends of the pipes 9. If the valve heads move against their respective pipes with ease, then the operator will know or be warned that there is a leak in one of the pipes 9 or 10 of the pair being tested. In such event he simply closes the valves 13 and 14 against their respective pipes so that the pipes thus closed are cut out and air will be delivered to the tuyères only through the intact pipes thus assuring maintenance of the melting zone at the bottom of the cupola.

When it is necessary to replace any of the pipes after a melting operation and when the cupola has cooled sufficiently to permit a workman to enter it, he removes the guard plates 40 which cover the pipes to be repaired, as well as the refractory cement or filler C from the lower ends of said pipes, swings the said set of pipes on the pivot 33 to the dot and dash line position of Fig. 1, after removing the gland rings 16. The conduits or pipes may be then readily withdrawn from the couplings and new ones inserted therein, after which the couplings are restored to the full line position of Fig. 1. The packings 18 may also be placed around the lower ends of the conduits, the gland rings 16 restored, and a new batch of refractory cement C troweled in to fill the space around and below the ends of the pipes. If the couplings 28 need to be repaired the pipes are simply moved out of the cradles 36 so that a new installation may be made in obvious manner.

We would point out also that access to the interior of the bustiles for removing and replacing the gland rings 16, is had simply by removing the proper plate 24 which carries the valve with it as a unit.

We have shown and described the pipes or conduits 9 and 10 arranged or coupled in pairs with the inlet for the air through the lower bustle pipe so that the air is fed upwardly through the pipes 10 and then downwardly through the pipes 9. We have also shown and described slip joints for the ends of said pipes to facilitate removal and replacement thereof.

What we claim is:

1. In a hot blast cupola having a chamber to receive a charge of materials to be melted therein and tuyères communicating with said chamber adjacent its lower end to deliver blasts of air thereto to create a melting zone at the bottom of the chamber, means to preheat the air delivered by said tuyères to said chamber comprising bustile pipes into which the air is delivered under pressure, conduits leading from said bustile pipes upwardly within the cupola, a second set of conduits leading downwardly in the said cupola, couplings connecting the upper ends of adjacent conduits and hingedly supporting the same at their tops within said cupola, and bustile pipes communicating with said second conduits and said tuyères.

2. In a hot blast cupola having a chamber to receive a charge of materials to be melted therein and tuyères communicating with said chamber adjacent its lower end to deliver blasts of air thereto to create a melting zone at the bottom of the chamber, means to preheat the air delivered by said tuyères comprising conduits on the interior of the cupola and arranged in pairs with couplings at their upper ends, bustile pipes into which the air under pressure is delivered for heating, bustile pipes into which the heated air is delivered, one of the conduits of each pair communicating with said first bustile pipe, and the other of the conduits of each pair communicating with the second bustile pipe, and said tuyères communicating with the second bustile pipes to receive the heated air therefrom and deliver it into said chamber.

3. In a hot blast cupola having a chamber to receive a charge of materials to be melted therein and tuyères communicating with said chamber adjacent its lower end to deliver blasts of air thereto to create a melting zone at the bottom of the chamber, means to preheat the air delivered by said tuyères comprising conduits on the interior of the cupola and arranged in pairs with couplings at their upper ends, bustile pipes into which the air under pressure is delivered for heating, bustile pipes into which the heated air is delivered, one of the conduits of each pair communicating with said first bustile...
pipes, and the other of the conduits of each pair communicating with the second bustle pipes, said tuyères communicating with the second bustle pipes to receive the heated air therefrom and deliver it into said chamber, and a hinged connection for each pair of conduits permitting them to be swung inwardly in the cupola for the purposes specified.

4. In a hot blast cupola having a chamber to receive a charge of materials to be melted therein and tuyères communicating with said chamber adjacent its lower end to deliver blasts of air thereto to create a melting zone at the bottom of the chamber, means to preheat the air delivered by said tuyères comprising bustle pipes into which the air is delivered under pressure, conduits leading from said bustle pipes upwardly within the cupola, a second set of conduits leading downwardly in said cupola, couplings connecting the upper ends of said conduits and said tuyères, and conduits communicating with said second conduits and said tuyères.

5. The structure of claim 4 wherein the bustle pipes are arranged externally around the cupola, with the lower ends of all conduits extending through the cupola wall in communication with the bustle pipes, and fluid tight joints are provided between said lower ends of the conduits and said bustle pipes.

6. In a hot blast cupola having a chamber to receive a charge of materials to be melted therein and tuyères communicating with said chamber adjacent its lower end to deliver blasts of air thereto to create a melting zone at the bottom of the chamber, means to preheat the air delivered by said tuyères comprising bustle pipes into which the air is delivered under pressure, conduits leading from said bustle pipes upwardly within the cupola, conduits leading downwardly in said cupola, couplings connecting the upper ends of said conduits and said tuyères, and valves within said bustle pipes confronting the open ends of said conduits and operable to permit circulation of air through said pairs of conduits and to cut off said circulation.

7. In a hot blast cupola having a chamber to receive a charge of materials to be melted therein and tuyères communicating with said chamber adjacent its lower end to deliver blasts of air thereto to create a melting zone at the bottom of the chamber, means to preheat the air delivered by said tuyères comprising bustle pipes into which the air is delivered under pressure, conduits leading from said bustle pipes upwardly within the cupola, conduits leading downwardly in said cupola, couplings connecting the upper ends of said conduits and said tuyères, and manually controlled means to determine the continuity of the passage of the air through said conduits and couplings and capable of closing said conduits in the event of leakage to prevent delivery of air thereto.

8. In a hot blast cupola having a chamber to receive a charge of materials to be melted therein and tuyères communicating with said chamber adjacent its lower end to deliver blasts of air thereto to create a melting zone at the bottom of the chamber, means to preheat the air delivered by said tuyères comprising bustle pipes into which the air is delivered under pressure, conduits leading from said bustle pipes upwardly within the cupola, conduits leading downwardly in said cupola, couplings connecting the upper ends of said conduits in pairs and hinged supporting the same within said cupola, bustle pipes communicating with said second conduits and said tuyères, removable closures on said bustle pipes and affording access to the interior thereof of, removable packings around said conduits within said bustle pipes forming fluid tight joints between said bustle pipes and said conduits, and valves carried by said removable closures operable to close said conduits.

9. In a hot blast cupola having a chamber to receive a charge of materials to be melted therein and tuyères communicating with said chamber adjacent its lower end to deliver blasts of air thereto to create a melting zone at the bottom of the chamber, means to preheat the air delivered by said tuyères comprising bustle pipes into which the air is delivered under pressure, conduits leading from said bustle pipes upwardly within the cupola, conduits leading downwardly in said cupola, bustle pipes into which the heated air is delivered, couplings connecting the upper ends of said conduits in pairs and hinged supporting the same within said cupola, the lower ends of said conduits being curved and extending through the wall of the cupola into the said bustle pipes, removable packings forming a fluid tight joint between said lower ends of the conduits and the bustle pipes, and removable closures on the bustle pipes affording access to the interior thereof for removal and replacement of said packings to permit said pairs of conduits to be swung on their hinges and to be clamped in place.

10. In a hot blast cupola having a chamber to receive a charge of materials to be melted therein and tuyères communicating with said chamber adjacent its lower end to deliver blasts of air thereto to create a melting zone at the bottom of the chamber, means to preheat the air delivered by said tuyères comprising bustle pipes into which the air is delivered under pressure, conduits leading from said bustle pipes upwardly within the cupola, conduits leading downwardly in said cupola, bustle pipes into which the heated air is delivered, couplings connecting the upper ends of said conduits in pairs and hinged supporting the same within said cupola, the lower ends of said conduits being curved and extending through the wall of the cupola into the said bustle pipes, removable packings forming a fluid tight joint between said lower ends of the conduits and the bustle pipes, and removable closures on the bustle pipes affording access to the interior thereof for removal and replacement of said packings to permit said pairs of conduits to be swung on their hinges and to be clamped in place, and means between said removable closures and said bustle pipes to form a fluid tight joint when the closures are clamped onto said bustle pipes.

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