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FLUE FOR COOLING COMBUSTIBLE OR WASTE GASES

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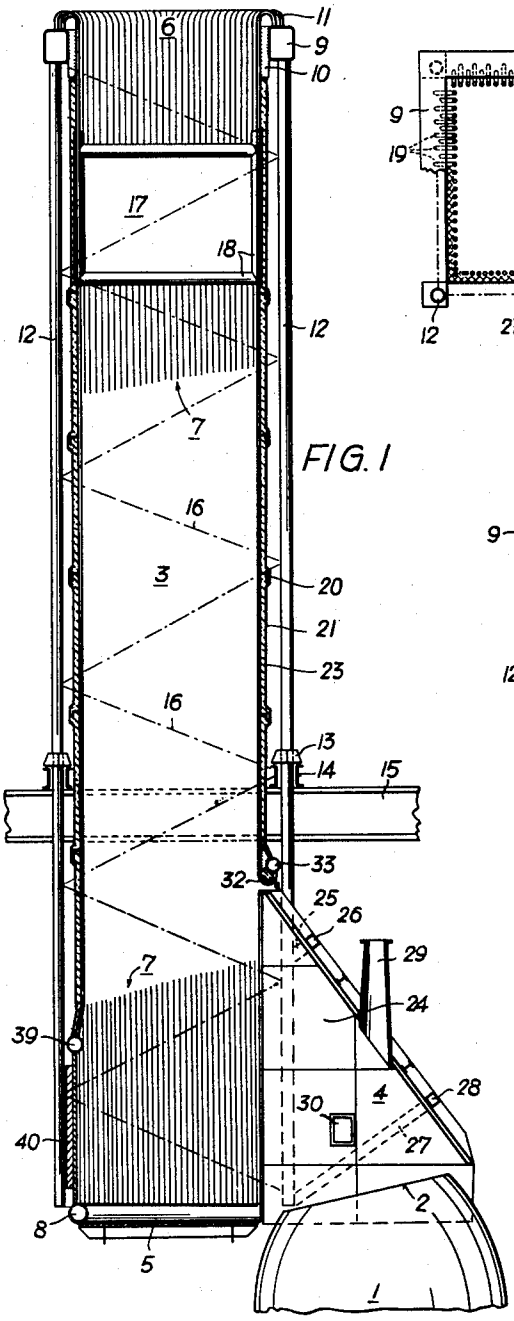

FIG. 1

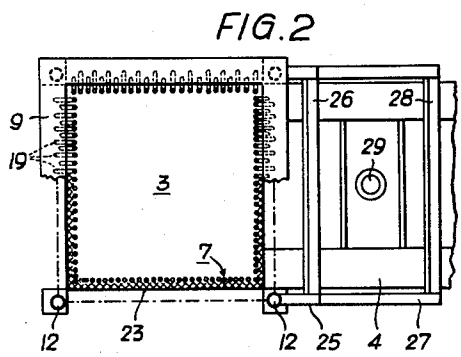

FIG. 2

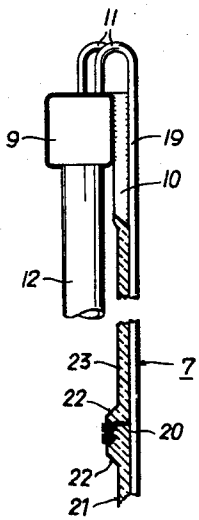

FIG. 3

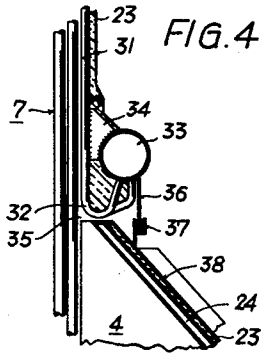

FIG. 4

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It is known to cool gases or waste gases obtained in metallurgical or chemical process by passing them through a cooling flue. In the flue the gases radiate their heat to the walls of the flue which are cooled by a cooling medium. In a special construction the walls of the flue are formed by tubes through which passes a cooling medium. For utilizing the thermical uplift of the gases, such cooling flues are generally arranged vertically.

A lot of constructions of cooling flues have been proposed using coolant tube walls. The cooling tubes as well as their insulation and outer jacket are supported mostly by a separate steel construction. However, embodiments have already been proposed where the cooling tubes themselves are combined to tube plates and thereby form a self-supporting flue construction which needs no separate support. Most of the vertically arranged cooling tubes discharge on top and below into collecting chambers and carry on their outside the insulation and the outer jacket made of sheet metal. It is clear that such self-supporting constructions can be carried out with lower expenses than those where a separate steel construction is supporting the weight of the cooling flue. However, it is a disadvantage that here the cooling tubes, being mostly 20 to 40 m. in length and having a small diameter have to accommodate the total weight of the cooling flue in compression and are loaded in buckling stress on account of their slenderness.

It is an object of the present invention to avoid this disadvantage by the fact that the vertically arranged wall forming cooling tubes are attached, in freely suspended relation, in a support construction of the cooling flue which construction consists essentially of several suitable rigid downcomer tubes and an upper collecting chamber or header for the cooling medium. By the inventive arrangement, the slender cooling tubes which now have to carry the total weight of the cooling flue together with insulation and outer jacket, too, are no longer loaded in buckling stress but in tension, only, and the rigidly dimensioned downcomer tubes of large diameter can easily accommodate the total compression load of the cooling flue. These downcomer tubes may be rigidly anchored in the existing steel construction of the steel work building in any height between top edge and the bottom edge of the cooling flue, and transmit the load of the cooling flue onto the latter. These downcomer tubes may be combined to a rigid and vibratory tight support for the cooling flue. The cooling tubes attached suspendingly at the upper end of the flue, and forming the walls of the flue, discharge with their lower ends in one or several coolant inlet chambers or headers into which the cooling medium enters. The cooling medium moves up in the cooling tubes and passes into the upper collecting chamber at the upper end from where it is removed by the downcomer tubes arranged as a support. A further special advantage of the inventive construction lies in the free thermal expansion of the cooling tubes suspended at their upper ends. In order not to load the tube connection between the cooling tubes and the upper collecting chamber with the weight of the cooling tubes, these may be attached to the upper collecting chamber, for instance by fishplates, and discharge into

same through tube turns. The cooling tubes themselves may be combined with each other according to the invention to tube plates by welded cross members, to which the outer jacket of the cooling flue is connected. The hollow space between the outer jacket and the cooling tubes may be filled with insulating material. As the cooling tubes exposed in the inner bank to the hot gases have a higher temperature than the outer jacket of the flue being cooled by the outside air, its sheet metal covering is effectively chamfered angularly or Z-like at the connection spots with the cross members as to accommodate the produced thermal expansion by the shanks of the sheet metal being formed thereby.

In the inventive construction of the cooling flue, there is the possibility to let the waste gases blow in the flue directly from below or from the side. At the known steel converter plants and especially at converters being blown with oxygen or oxygen enriched air both types of constructions are usual. The choice of same depends above all on the geometrical conditions within the steelwork building. The last mentioned construction, according to which the gases enter laterally through a suitable suction hood from the converter into the cooling flue, has the advantage that the slag particles being carried along with the converter gases may deposit in the lower part of the cooling flue and may be removed by the lower end being closed by cooled flaps in this case. As a construction of the cooling flue, an embodiment is especially advantageous where a cooled suction hood is attached laterally to the lower end of the flue. Thereby the suction hood is according to the invention supported by a tube construction attached to the supporting downcomer tubes of the cooling flue. The advantage of this construction lies in the fact that the weight of the hood does not load the cooling tube of the flue walls in bending. For the accommodation of the thermal expansion there is, according to the invention, an expansion joint between the hood and the flue, which joint is provided gas tight with respect to the outer air. The lateral hood, too, is connected to the cooling system and is advantageously provided with plate cooling on account of the large slag discharge of the converters and for an easier possibility of cleaning.

Especially at steel converters being blown with oxygen it is not common to discharge the cooled waste gases into the atmosphere uncleaned. For this reason these gases are advantageously guided to a separate dust separating plant before being discharged, which plant is advantageously arranged laterally of the flue. For this purpose the mentioned flue construction has a lateral opening over the whole width of the flue wall adjacent to its upper discharge end. This opening is, according to the invention, formed by a tube frame into which the cooling tubes of the walls discharge on top and below, so that the passage of the cooling water is guaranteed. The thermal expansion between the gas duct leading to the dust separating plant and the cooling flue is likewise accommodated by a corresponding gas tight expansion joint.

For the brick re-lining of the converter, it is necessary to provide a good accessibility for the placing of the lining material in the cooling flue. According to the invention the cooling flue is provided with a corresponding large opening at its lower part in the tube wall opposite to the suction hood, which opening may be formed by a cooled tube frame and closed by cooled wing doors. The upper door girder is formed by a collecting chamber into which, according to the invention, the cooling tubes of the overlying wall discharge; the lower door girder is formed by the lower collecting chamber of the complete cooling system. This door construction has the advantage that it fits in the cooling system of the flue

walls structurally, and that it provides a rigid door frame which may be sealed against penetration of leakage air.

The inventive cooling flue is shown by way of example in the FIGS. 1 to 4. FIG. 1 shows a longitudinal section of such a cooling flue with all necessary details. FIG. 2 is a cross section of a cooling flue according to FIG. 1. FIGS. 3 and 4 show details of the tube walls of the tube connections to the collecting chambers and of the outer covering.

According to FIG. 1 the steel converter 1 being tiltable about a not shown horizontal axis blows its gases from the mouth 2 into the suction hood 4 arranged laterally of the cooling flue 3. The cooling flue 3 is closed at its lower end by a flap 5 and discharges at its upper end 6 into the free atmosphere. According to the invention the cooling flue 3 consists of tube walls 7 through which passes a cooling medium, for instance water. The single tubes of the tube walls 7 discharge at the lower end of the cooling flue into a collecting chamber, or coolant inlet means, 8 and at the upper end into a collecting chamber 9. The tubes are arranged vertically and are fixed by way of fish plates 10 to the collecting chamber 9. On top the cooling tubes end in tube turns 11 which discharge into the collecting chamber 9. In this construction the collecting chamber 9 is supported by four rigid tubes 12 arranged at the corners of the collection chamber. These tubes serve simultaneously as downcomer tubes for the cooling medium and to accommodate the total weight of the suspended cooling flue in compression. The tubes are based with brackets 13 on supports 14 belonging to the steel construction 15 of the steel work plant. By means of truss girders 16 the downcomer tubes 12 are combined so that a rigid and vibration free support is provided for the cooling flue 3. The downcomer tubes 12 are continued even below the brackets 13 and run along the length of the complete cooling flue 3.

For cleaning the gases discharged from the converter mouth from solid slag particles these pass normally through a not shown dust separating plant. For this purpose an opening 17 is provided in one side wall of the cooling flue which opening is formed by a strong tube frame 18. The individual cooling tubes of the tube wall 7 discharge from the top and from below into this tube frame 18 so that the passage of the cooling medium is not interrupted. A horizontal gas conduit, not shown in FIG. 1, is connected to the tube frame 18, which conduit is connected by way of a corresponding expansion joint to the same with respect to the thermal expansion of the cooling flue 3. As the tube walls 7 of the cooling flue 3 are exclusively fixed by fish plates 10 to the upper collecting chamber 9 the whole cooling flue may expand unhindered in a downward direction.

To the exterior the cooling flue has to be correspondingly insulated and to be sealed against the escape of the gases. FIG. 3 shows the details of the inventive suspension of the cooling tubes as well as the fastening of insulation and outer jacket. The cooling tubes 19 discharge with their upper tube turns 11 into the upper collecting chamber 9 which is supported by way of downcomer tubes 12 at any place along the steel construction of the steelwork building. The cooling tubes 19 are fixed to the collection chamber 9 by way of fish plates 10. The cooling tubes 19 are further on combined in certain distances by angle plates 20 to tube plates. These angle-plates 20 lie at the outside of the cooling flue and the covering sheets 21 are attached to them. These covering sheets have angular or Z-like edges 22 directly adjacent to the connection to the angle plates 20 which edges allow a free thermal expansion of the covering sheets 21 with respect to the cooling tubes 19. The insulation 23 is provided between the cooling tubes 19 and the covering sheets 21 and prevented by angle plates 20 from sliding downwards on account of its own weight.

The arrangement of the suction hood 4 with respect to the cooling flue 3 can be seen from FIG. 1. In the example shown, the suction hood 4 consists of single hollow plates 24 through which the cooling medium passes, too. At its smooth surfaces the slag incrustation is reduced to a minimum and the same may be easily cleaned at any time. The total weight of the hood 4 is likewise supported by the downcomer tubes 12. For this purpose, special tube constructions 25, 26, 27 and 28 are provided, and through which the cooling medium passes, too. In steel converters blow from the top with oxygen, the lance is inserted into the hood 4 and the converter 1 by a cooled connection. The opening 30 in the side wall of the hood 4 allows the insertion of additions during the blow process.

As the hood is connected to the downcomer tubes 12, its connection to the cooling flue 3 has to be effected by way of a corresponding expansion joint. FIG. 4 shows, for instance, the upper connection of the hood 4 to the cooling flue in section. The cooling tubes 31 of the side wall of the flue 3 to which the hood is adjacent, end already with tube turns 32 directly above the hood 4 and discharge with these tube turns into a collecting chamber or header 33 fixed to the cooling tubes 31 by fish plates 34. There is an expansion space 35 between the cooling flue 3 and each tube turn 32. For the gas tight seal serves for instance a sheet metal tongue 36 on the collecting chamber 33 engaging moveably into a corresponding groove 37 on the hood 4. The sealing of the cooling flue is again effected by way of a covering 21; the sealing of the hood by way of a covering 38. There is a heat insulation 23 between the cooling tubes 31, the covering 21, the sealing parts 36 and 37 on the one hand and between the hollow cooling plates 24 of the hood 4 and the covering on the other hand.

To provide access for brick re-lining of the converter 1, there is an opening in the tube wall of the cooling flue 3 opposite to the suction hood 4 which opening may be formed by the tube frame 39 and may be closed gas tight by wing doors 40. The cooling tubes of this tube wall discharge not into the lower collecting chamber 8 but into the tube frame 39 so that the cooling medium passes from the lower collecting chamber or header 8 through the tube frame 39 into the cooling tubes of the overlying tube wall.

FIG. 2 shows a section through the cooling flue 3 with the suction hood 4 fixed thereto. In the upper half of FIG. 2 one can see further on the upper collecting chamber or header 9 with the cooling tubes 19 discharging into same. Besides the same references as used in the other figures are inserted.

The coolant flow is as follows: Coolant flows into lower collecting chambers or headers 8 and 33 in a cold condition, flows upwardly through the riser tubes, enters headers 9, and flows downwardly through downcomer tubes 12. From these it flows either directly into other system components, or through the hollow plates 24 of hood 4, through connections 25, 26, 27 and 28, and thence to such other system components. The invention is not restricted to the embodiments explained and to the examples shown in the drawings.

We claim:

1. A cooling flue for hot gases, such as converter discharge gases, comprising, in combination, a plurality of individual relatively small diameter riser tubes arranged in juxtaposed substantially parallel and upwardly extending relation to form walls defining a gas flow passage; plural relatively large diameter upwardly extending downcomer tubes arranged at spaced locations exteriorly adjacent said walls; an upper header extending around the upper end of said passage laterally exterior to said walls, and communicating directly with and supported solely and directly on the upper ends of said downcomer tubes; said riser tubes having their upper ends communicating with and connected to said upper header; said upper header constituting the sole support suspending said riser tubes for downward expansion; and coolant inlet means connected to and supported by the lower ends of said riser tubes.

2. A cooling flue for hot gases, as claimed in claim 1, in which said gas flow passage has a substantially rectangular cross section; there being four of said downcomer tubes each arranged adjacent a corner of said gas flow passage.

3. A cooling flue for hot gases, as claimed in claim 1, including a supporting structural steel framework; said downcomer tubes being rigidly supported on said framework.

4. A cooling flue for hot gases, as claimed in claim 1, each of said riser tubes having a reverse bend at its upper end connecting the respective riser tube to said upper header.

5. A cooling flue for hot gases, as claimed in claim 1, including laterally extending cross members connected to and interconnecting said riser tubes at spaced intervals along their length.

6. A cooling flue for hot gases, as claimed in claim 5, in which said cross members have an angular cross section; and a casing for said flue secured to flanges of said cross members.

7. A cooling flue for hot gases, as claimed in claim 6, in which said casing is angularly offset at its points of attachment to said cross members to accommodate thermal expansion.

8. A cooling flue for hot gases, as claimed in claim 1, including a laterally projecting suction hood, for entry of hot gases, communicating with said gas flow passage adjacent the lower end thereof; said hood having walls formed by hollow plate-like members communicating with said downcomer tubes for circulation of coolant through said hollow plate-like members.

9. A cooling flue for hot gases, as claimed in claim 1, including a gas outlet in one of said gas flow passage walls adjacent the upper end of said gas flow passage; said gas outlet being defined by a tubular frame in communication with said riser tubes for flow of coolant therethrough between said coolant inlet means and said upper header.

10. A cooling flue for hot gases, as claimed in claim 1, in which said coolant inlet means comprises a lower header extending around the lower end of said passage; and an access opening formed in one of said gas flow passage walls adjacent the lower end thereof and defined by a tubular frame including a portion of said lower header; said tubular frame being connected to said riser tubes and in communication therewith.

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