Feb. 25, 1958 H. W. SCHWENGEL 2,824,731

CUPOLAS HAVING THIN WALL PORTIONS

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Fig. 1.

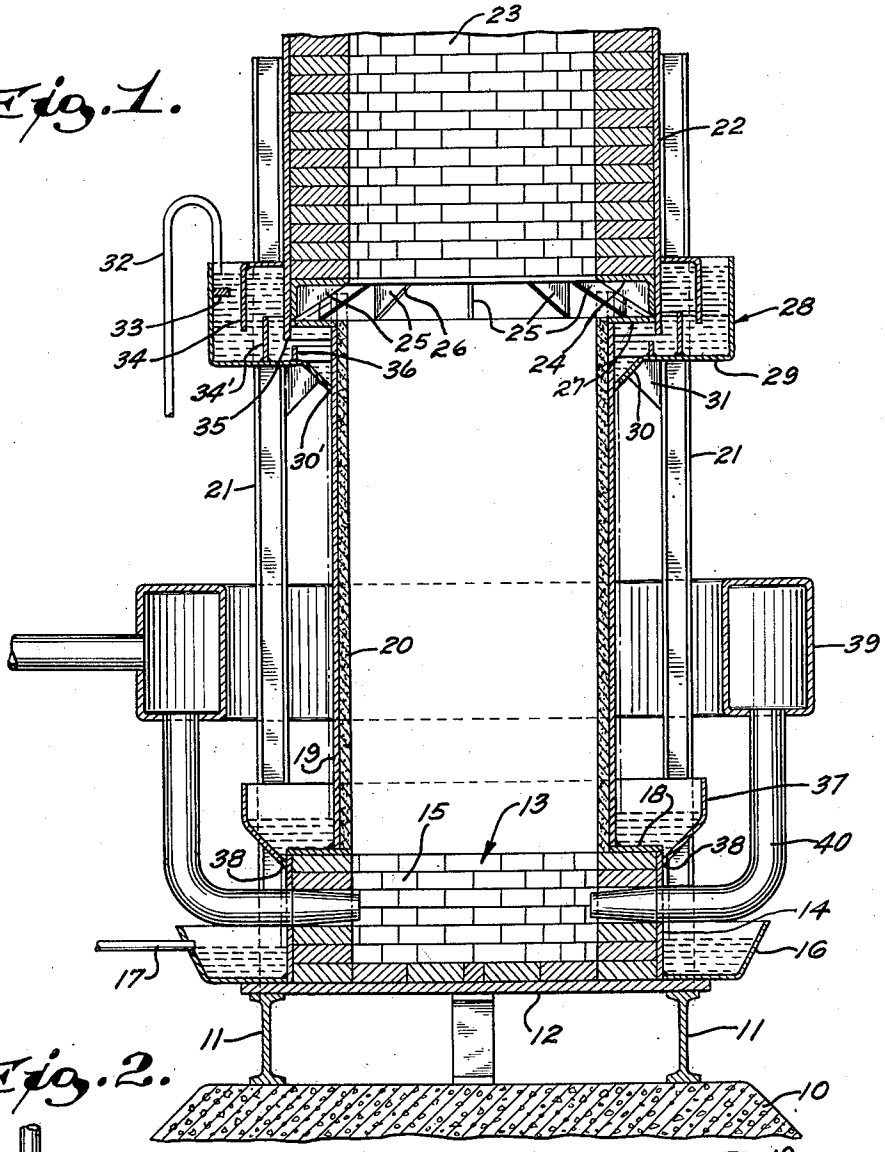
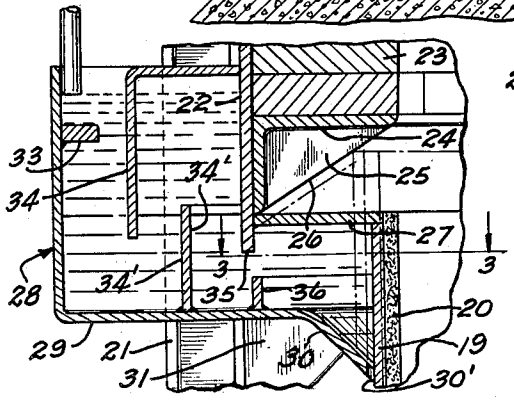


Fig. 2.



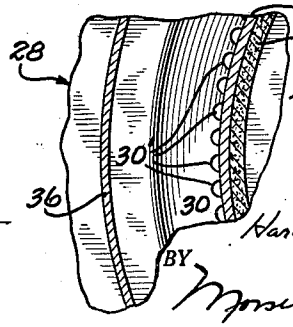


Fig. 3.

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CUPOLAS HAVING THIN WALL PORTIONS

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7 Claims. (Cl. 266—32)

This invention relates to improvements in cupolas having thin wall portions.

In the conventional cupola it is customary to renew the refractory lining every twenty-four hours. This involves considerable time and expense. It has heretofore been proposed to utilize a relatively thin shell around the melting zone so as to permit the use of water cooling and thus delay the burning out of the lining. In these prior devices metal webs have been secured directly to the exterior of the water cooled wall portion. These cupolas, however, have not been satisfactory because the webs interfered with good water circulation, and there were so many opposing stresses that warping and other difficulties were encountered. Furthermore, it was necessary to provide temporary supports for the upper portion of the cupola while repairing the shell around the melting zone.

It is a general object of the present invention to provide in a cupola construction having a relatively thin shell around the melting zone, when considering the metal plus its refractory lining if a lining is used at this location, novel means independent of and spaced outwardly from said thin shell portion for supporting the relatively heavy upper part of the cupola. Thus, said upper portion of the cupola is independently supported so that the thin shell portion may be repaired without providing temporary supports for said upper portion.

A more specific object of the invention is to provide a cupola construction as above described wherein a plurality of metal legs, which are spaced outwardly from the thin shell portion of the cupola, are employed to transfer the load from the upper portion of the cupola to the base.

A further object of the invention is to provide in a cupola of the class described having an expansion joint, means for water cooling the expansion joint as well as the thin shell portion surrounding the melting zone, said cooling being so worked out as to be more uniformly effective.

A still further object of the invention is to provide in a construction as above described, means whereby the thin shell surrounding the melting zone may expand in a vertical direction without causing buckling or other distortion.

Other objects of the invention are to provide an improved cupola construction which is relatively simple and inexpensive, which make it possible to run the cupola for a relatively long time without dropping the bottom, which is easy to repair, and which is otherwise well adapted for the purposes described.

With the above and other objects in view, the invention consists of the improvements in cupolas having thin wall portions, and all of its parts and combinations, as set forth in the claims, and all equivalents thereof.

In the accompanying drawing, in which the same reference numerals designate the same parts in all of the views:

Fig. 1 is a vertical sectional view through a cupola constructed in accordance with the present invention, the upper portion being broken away;

Fig. 2 is an enlarged fragmentary vertical sectional view showing details of the water trough; and

Fig. 3 is a fragmentary sectional view taken on the line 3—3 of Fig. 2.

Referring more particularly to the drawing, the numeral 10 designates a concrete pier or the like, and the numeral 11, I-beams for supporting a base plate 12, which plate may include the usual bottom doors (not shown). Supported on the base plate is a well 13 which includes a cylindrical metal shell 14 and a lining 15 of refractory brick. Surrounding the metal shell is an annular water catching trough 16 having an overflow outlet pipe 17. Welded at its periphery to the upper edge of the cylindrical shell 14 is a metal ring 18. Supported on the ring 18 and welded to it near its inner periphery is the lower end of a cylindrical metal shell 19, this shell being around the melting zone. The present invention makes it possible to employ the metal shell 19 without any lining. However, a thin lining of refractory material, such as the lining 20, may be employed if desired so that the wall is relatively thin when considering the metal 19 and its refractory lining 20 as compared with walls having refractory linings of usual thickness as at 15.

Suitably supported at their lower ends on the base plate 12 are metal I-beams 21, preferably four in number equally spaced. The lower portions of the I-beams may be welded to the sides of the shell portion 14 which surrounds the well. The I-beams extend upwardly in spaced relation from the shell portion 19 and have their upper portions welded to the outside of an upper metal shell 22, the latter being of substantially greater diameter than the shell 19, but preferably although not necessarily of the same diameter as the shell 14 of the well. The shell portion 22 is lined with refractory brick 23 of customary thickness. A metal angle ring 24, has an upright flange welded to the inner side of the upper shell 22 near the bottom thereof and has a top horizontal flange portion which supports the refractory material 23. The flanges of the angle ring 24 are strengthened by spaced fins 25 which are triangular in shape and have diagonally extending lower edges 26.

It is thus apparent that the load of the refractory material 23 is carried by the ring-shaped angle member 24 which is securely connected to the lower portion of the metal shell 22. In addition, the load of the entire upper portion of the cupola is carried by the supporting legs 21 rather than by the thin wall portion 19—20. The legs 21 transmit this load to the metal lower shell 14 surrounding the well portion of the cupola and to the base plate 12, but it is to be understood that the legs may transmit the load directly to the base 12 without being connected to the sides of the well. This load is then transmitted by the I-beams 11 to the concrete pier. Thus, the heavy upper portion of the cupola with its thick lining is permanently supported from the bottom by the legs 21, and, inasmuch as the latter are spaced outwardly from the thin shell portion 19 they are relatively unaffected by the heat in the melting zone. Furthermore, repairs can be made in the metal shell portion 19 without the necessity of furnishing any temporary supports for the upper portion of the cupola because the legs 21 always furnish suitable support.

The upper end of the metal shell 19 is connected to the inner periphery of a flat metal band 27 and the latter has its outer periphery welded to the lower edge of the metal shell 22. With this arrangement, if the metal shell 19 and its lining 20 expand in a vertical direction there is an open space below the diagonal edges 26 of the fins 25

for said expansion to take place, and there is room for said expansion up to a maximum as indicated by the dot and dash lines in Figs. 1 and 2, but expansion to this extent does not take place in practice. The fins, in addition to their supporting function, serve to conduct heat from the angle portion 24 to the water in the trough 28.

Surrounding the upper portion of the intermediate metal shell 19 and the lower portion of the upper shell 22 is a metal trough 28 for cooling water, said trough having an horizontal bottom portion 29 leading to an inner frusto-conical bottom portion 30 which extends close to the outside of the metal shell 19. The inner periphery of the portion 30 is serrated to provide a plurality of holes 30' from which water may fall along the outside of the metal shell 19. The trough may be suitably supported on gusset members 31 carried by the legs 21. Water which enters from an inlet pipe 32 may be directed against a bar 33. This water will fill the outer trough portion and then flow under a circular baffle 34 over a circular baffle 34', and under a downwardly projecting lower edge 35 of the shell 22, and then over another circular baffle 36 to the frusto-conical center portion 30. This water will then pass out of the holes 30' and shower down the sides of the metal shell 19 to uniformly cover the shell throughout its periphery. This water will then fall into a circular trough 37 which is welded around the upper portion of the lower metal cylindrical wall 14. Water in the trough will flow out of holes 38, like the holes 30' of Fig. 3, and will fall down the sides of the lower shell 14 into the lowermost trough 15.

The cupola is equipped with the usual wind drum 39 having tuyeres 40 leading into the lower portion of the cupola.

In use of a cupola constructed in accordance with the present invention, the relatively thin lining portion 19, which surrounds the melting zone, gets very hot. However, the continuous shower of water from the trough 28, which uniformly and continuously covers its outer surface, keeps the temperature of this shell portion down and delays the frequency with which the bottom of the cupola has to be dropped for repairs. During such repairs the legs 21 furnish permanent support for the upper portion 22—23 of the cupola and these legs are relatively unaffected by the temperature in the melting zone because they are spaced so far outwardly from the shell portion 19. Furthermore, there is a curtain of cool water between the shell and the legs. In addition to the above, the water in the trough 28 is in constant contact with the lower portion of the shell 22 and band 27 to keep these parts from getting too hot. The metal shell 14 around the well is kept cool by the shower of water from the holes 38 in the trough 37.

The relatively heavy refractory lining for the upper portion of the cupola is supported by the circular angle 24 which in turn is secured to the lower inner side of the metal shell 22. Therefore, this weight is transferred directly to the legs 21 and thence to the base portion of the structure, so that there is no substantial weight carried by the relatively thin shell portion 19.

There is plenty of room for vertical expansion of the shell 19 into the space beneath the diagonal edges 26 of the strengthening fins 25 as is clearly indicated by the dot and dash lines in Figs. 1 and 2.

The legs 21 provide a self-contained unit, as distinguished from those cupola constructions where the upper portion such as the portion 22—23 must be independently supported by suspension or other means.

Should the water stop or diminish during operation, the thin wall 19—20 still has no stresses from any overhead load to cause deformation, because the load of the upper portion 22—23 is carried by the legs 21 to the base.

Various changes and modifications may be made without departing from the spirit of the invention, and all of such changes are contemplated, as may come within the scope of the claims.

What I claim is:

1. In a cupola having a bottom well portion, a relatively thin intermediate wall portion of greater height than the height of said well portion projection upwardly from said well portion and adapted to surround the melting zone, an upper cupola portion including a metal shell, means independent of the intermediate wall portion for supporting said upper cupola portion, a shelf secured to the shell of the upper cupola portion and projecting inwardly therefrom, the major portion of said shelf being outwardly of the exterior of said intermediate wall portion, a refractory lining for the upper portion of the cupola supported on said shelf, an expansion joint between the upper end of the intermediate wall portion and the lower part of the upper cupola portion and below said shelf and outwardly of the exterior of the intermediate wall portion to provide for relative vertical movement between said intermediate wall portion and said upper cupola portion, and means for maintaining a body of water around and below said expansion joint and in contact with the exterior of the lower part of the upper cupola portion and with the exterior of the upper end of the intermediate wall portion.

2. In a cupola having a bottom well portion, a relatively thin intermediate wall portion of greater height than the height of said well portion projecting upwardly from said well portion and adapted to surround the melting zone, an upper cupola portion including a metal shell, means independent of the intermediate wall portion for supporting said upper cupola portion, a metal shelf secured to the shell of the upper cupola portion and projecting inwardly therefrom, a refractory lining for the upper portion of the cupola supported on said shelf, the upper end of the intermediate wall portion being of less exterior diameter than the exterior diameter of the shell for the upper cupola portion and being spaced below the refractory lining thereof and below an inner portion of said shelf to provide an expansion space above and outwardly of the upper end of said intermediate wall portion, and means flexibly connecting the metal shell of the upper cupola portion to said upper end of the intermediate wall portion whereby expansible movement of the latter within the lower end of the metal shell of the upper cupola portion and into said expansion space is permitted.

3. In a cupola having a bottom well portion, a relatively thin intermediate wall portion projecting upwardly from said well portion and adapted to surround the melting zone, an upper cupola portion including a metal shell, means independent of the intermediate wall portion for supporting said upper cupola portion, a metal shelf secured to the shell of the upper cupola portion and projecting inwardly therefrom, the major portion of said shelf being outwardly of the exterior of said intermediate wall portion, a refractory lining for the upper portion of the cupola supported on said shelf, the upper end of the intermediate wall portion being of less exterior diameter than the exterior diameter of the shell for the upper cupola portion and being spaced below the refractory lining thereof and below said shelf to provide an expansion space above the upper end of said intermediate wall portion, and a horizontal ring spaced below said shelf and projecting outwardly of the exterior of said intermediate wall portion flexibly connecting the metal shell of the upper cupola portion to said upper end of the intermediate wall portion whereby expansible movement of the latter into said expansion space is permitted while said ring tilts into said space with the connection between the exterior of said ring and the metal shell of the upper cupola portion serving as a pivot.

4. In a cupola having a bottom well portion, a relatively thin intermediate wall portion projecting upwardly from said well portion and adapted to surround the melting zone, an upper cupola portion including a metal

shell, means independent of the intermediate wall portion for supporting said upper cupola portion, a shelf secured to the shell of the upper cupola portion and projecting inwardly therefrom, the major portion of said shelf being outwardly of the exterior of said intermediate wall portion, a refractory lining for the upper portion of the cupola supported on said shelf, an expansion joint between the upper end of the intermediate wall portion and the lower part of the upper cupola portion and below said shelf and projecting outwardly of the exterior of said intermediate wall portion to provide for relative vertical movement between said intermediate wall portion and said upper cupola portion, and a water trough surrounding the upper part of the intermediate wall portion and overlapping the lower part of the upper cupola portion around and beneath the expansion joint and positioned to maintain a body of water in constant contact with said parts to cool the walls in the vicinity of the expansion joint.

5. In a cupola having a bottom well portion, a relatively thin intermediate wall portion projecting upwardly from said well portion and adapted to surround the melting zone, an upper cupola portion including a metal shell, means independent of the intermediate wall porton for supporting said upper cupola portion, a metal shelf secured to the shell of the upper cupola portion and projecting inwardly therefrom, the major portion of said shelf being outwardly of the exterior of said intermediate wall portion, a refractory lining for the upper portion of the cupola supported on said shelf, the upper end of the intermediate wall portion being of less exterior diameter than the exterior diameter of the shell for the upper cupola portion and being spaced below the refractory lining thereof and below said shelf to provide an expansion space above and outwardly of the upper end of said intermediate wall portion, means projecting outwardly with respect to the exterior of the intermediate wall portion flexibly connecting the metal shell of the upper cupola portion to said upper end of the intermediate wall portion whereby expansible movement of the latter into said expansion space is permitted, and a water trough surrounding the upper part of the intermediate wall portion and overlapping the lower part of the upper cupola portion positioned to maintain a body of water in contact with said cupola wall parts and around and beneath the expansion space.

6. In a cupola having a bottom well portion, a relatively thin intermediate wall portion projecting upwardly from said well portion and adapted to surround the melting zone, an upper cupola portion including a metal

shell, means independent of the intermediate wall portion for supporting said upper cupola portion, a metal angle member having a depending flange secured to the interior of shell of the upper cupola portion and having an inwardly directed horizontal flange forming a shelf, a refractory lining for the upper portion of the cupola supported on said shelf, the upper end of the intermediate wall portion being of less exterior diameter than the exterior diameter of a shell for the upper cupola portion and being spaced below said shelf to provide an expansion space above the upper end of said intermediate wall portion and below said shelf and outwardly of the exterior of the intermediate wall portion, and means connected to the upper end of the intermediate wall portion and projecting outwardly therefrom and to the upper cupola portion adjacent the lower edge of the depending flange of said shelf whereby vertical expansible movement of the intermediate wall portion is permitted.

7. In a cupola having a bottom well portion, a relatively thin intermediate wall portion projecting upwardly from said well portion and adapted to surround the melting zone, an upper cupola portion including a metal shell, means independent of the intermediate wall portion for supporting said upper cupola portion, a metal angle member having a depending flange secured to the interior of said shell of the upper cupola portion and having an inwardly directed horizontal flange forming a shelf, laterally spaced triangular upright fins connecting the flange of said angle member and having diagonally extending lower edges, a refractory lining for the upper portion of the cupola supported on said shelf, the upper end of the intermediate wall portion being of less exterior diameter than the exterior diameter of the shell for the upper cupola portion and being spaced below the lower edges of said fins to provide an expansion space, and means flexibly connecting the metal shell of the upper cupola portion to said upper end of the intermediate wall portion whereby expansible movement of the latter toward the diagonal lower edges of said fins is permitted.

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