March 9, 1954 W. H. MOORE 2,671,658

METAL LINED CUPOLA

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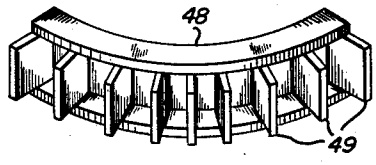


Fig. 2

Fig. 1

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METAL LINED CUPOLA

Filed Feb. 14, 1951 5 Sheets-Sheet 2

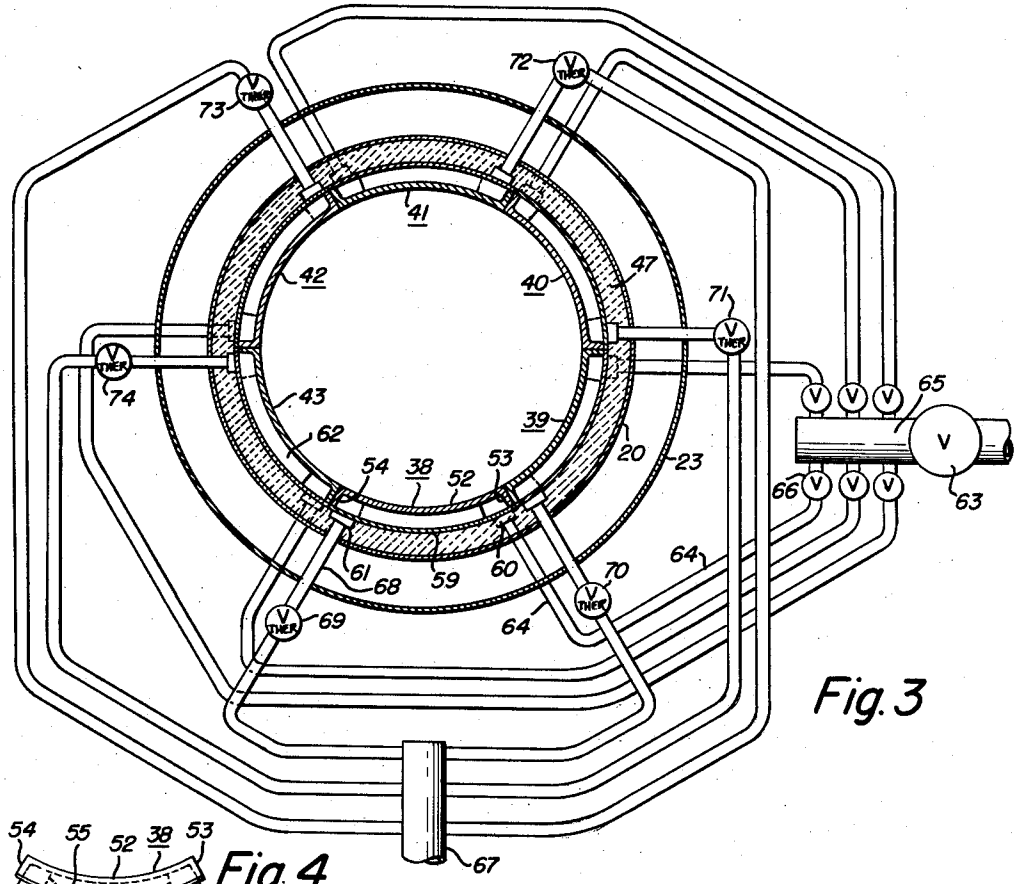


Fig. 3

Fig. 4

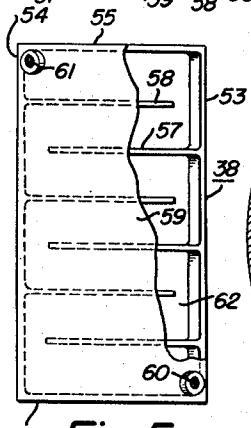


Fig. 5

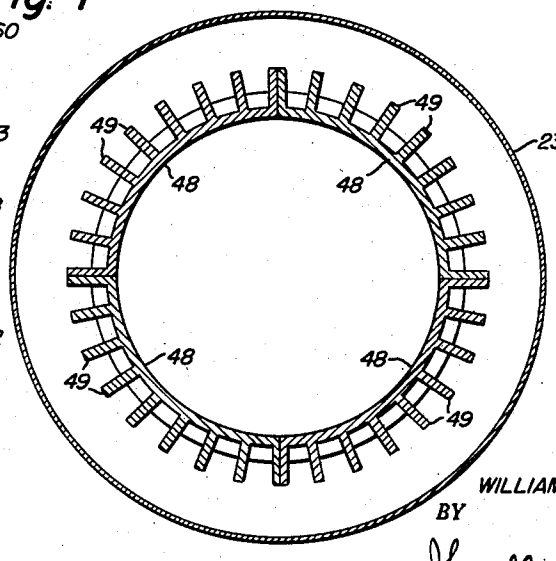


Fig. 6

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METAL LINED CUPOLA

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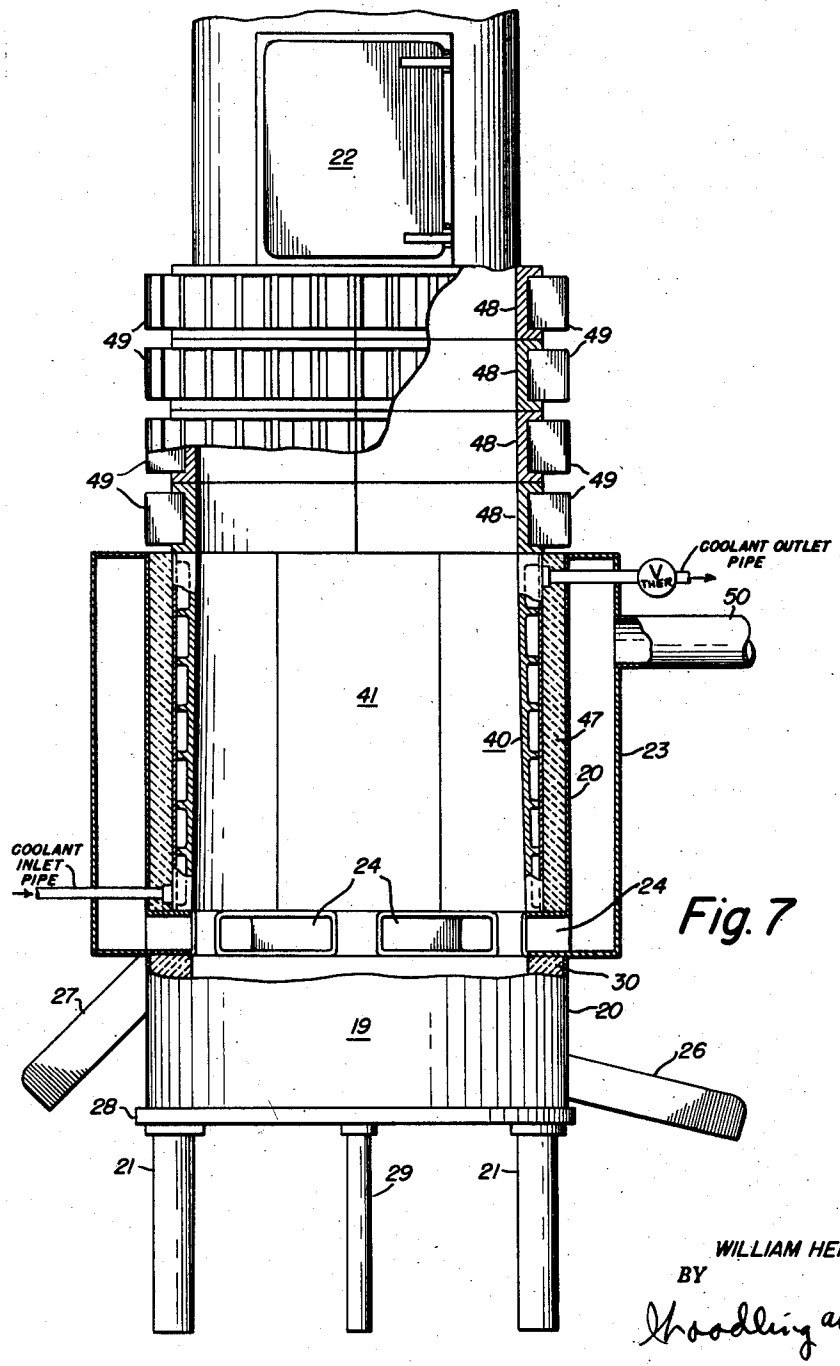


Fig. 7

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METAL LINED CUPOLA

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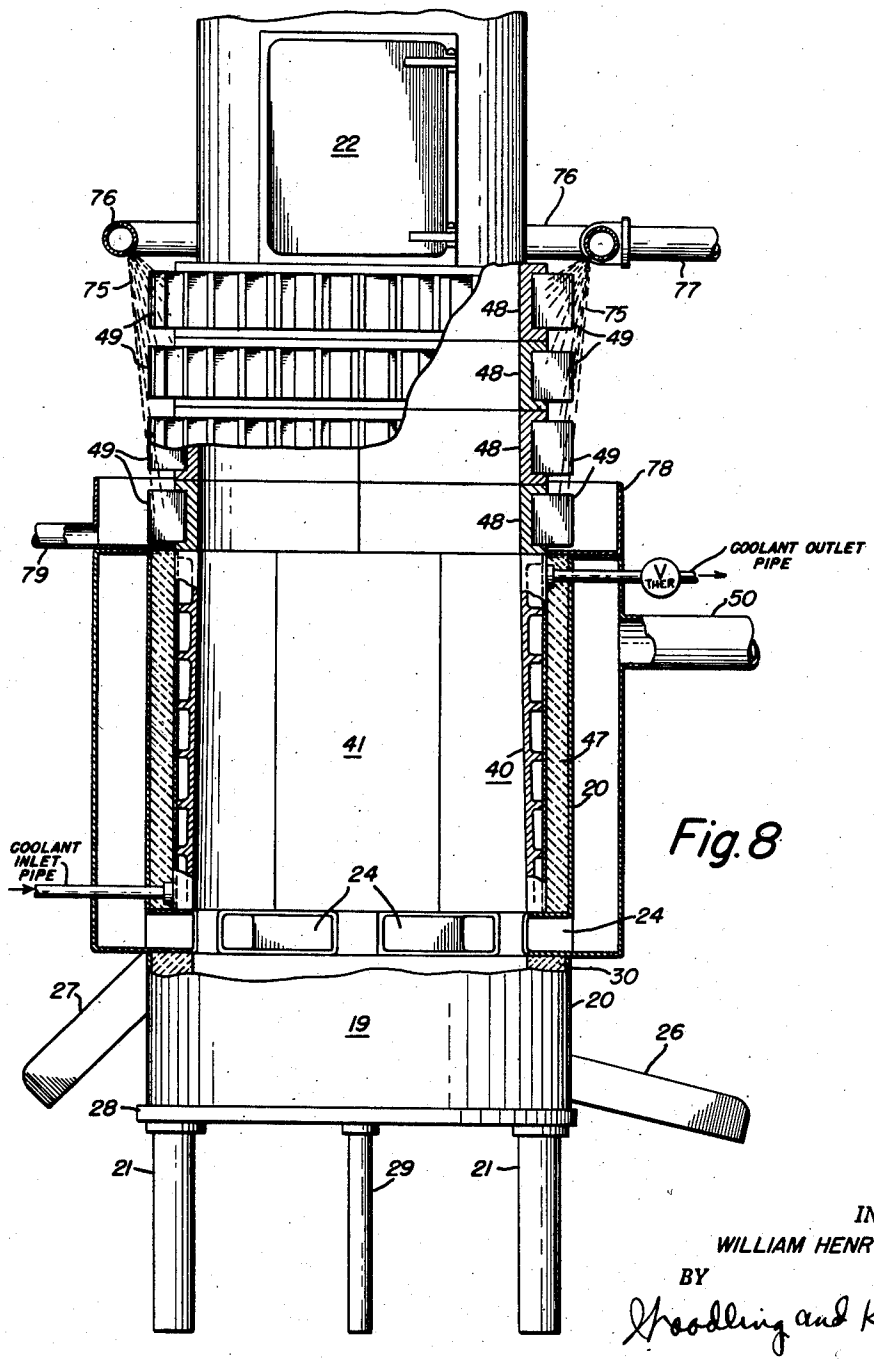


Fig. 8

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METAL LINED CUPOLA

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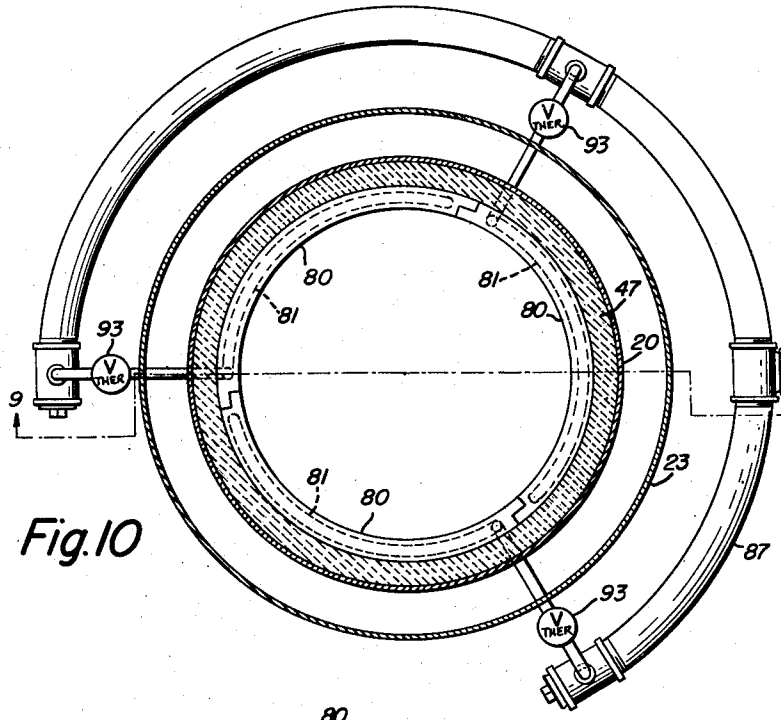


Fig. 10

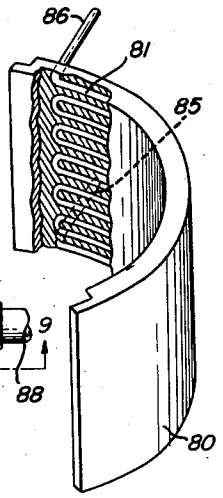


Fig. 11

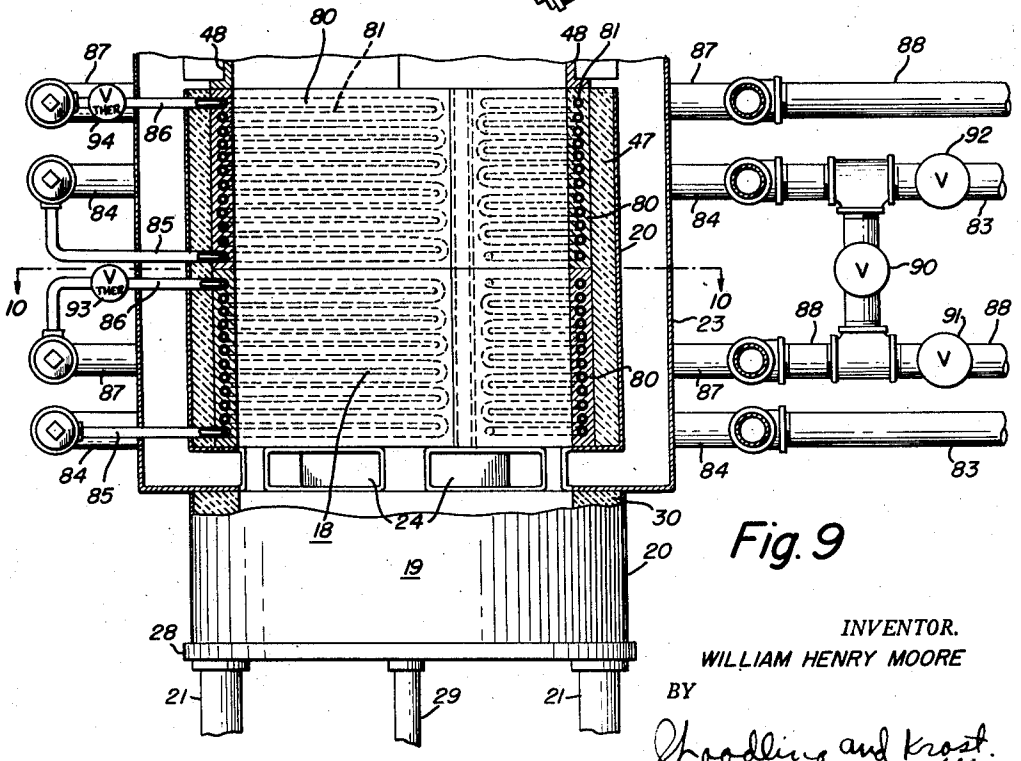


Fig. 9

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Patented Mar. 9, 1954

2,671,658

UNITED STATES PATENT OFFICE

2,671,658

METAL LINED CUPOLA

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Application February 14, 1951, Serial No. 210,831

1 Claim. (Cl. 266—32)

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The invention relates in general to cupolas and more particularly to cupolas for melting cast iron.

An object of the invention is the provision of a cupola having an inner shell or lining above the tuyères which avoids the use of refractory materials.

Another object of the invention is the provision of a cupola having an inner shell or lining above the tuyères constructed of metals having a high melting point, such as iron, steel, or other ferrous metals or alloys, as well as non-ferrous metals which are commonly used in water or other coolant jackets, such as copper or aluminum and their alloys. This class of materials will hereinafter be referred to as heat dissipating metals and may comprise metallic sections or blocks, either cast or fabricated.

Another object of the invention is the provision of a cupola having the inner shell or lining for the melting zone, as well as for the charging zone, constructed of heat dissipating metals in sections or in blocks directly exposed to the melting charge without any refractory lining protecting same.

Another object of the invention is the provision of cooling the metallic sections or blocks.

Another object of the invention is the provision of an inner shell or lining for the melting zone constructed of a plurality of arcuate metallic sections in which each section is provided with fluid passageways whereby a coolant may be passed therethrough to remove heat therefrom.

Another object of the invention is the provision controlling the flow of a coolant through the fluid passageways by thermostatic means.

Another object of the invention is the provision of an inner shell or lining for the melting zone which has a greater diameter at the bottom near the tuyères than at the top.

Another object of the invention is the provision of a cupola having a charging zone with an inner shell or lining constructed of heat dissipating metallic sections or blocks wherein the sections or blocks may be cooled, by presenting a cooling surface to atmosphere, by presenting a cooling surface to an incoming air blast used for cupola combustion, or by presenting a cooling surface to water spray with a trough to collect the water and remove it continuously.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claim taken in conjunction with the accompanying drawings, in which:

Figure 1 is a side elevational view of a cupola embodying the invention, the major part being shown in section to particularly illustrate the arrangement of the internal construction, the external piping arrangement for the coolant being omitted;

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Figure 2 is a perspective view of one of the metallic sections or blocks constituting the inner shell or lining for the charging zone;

Figure 3 is a cross-sectional view taken along the line 3—3 of Figure 1, showing principally the external piping arrangement for the flow of the coolant through the arcuate sections constituting the inner shell or lining for the melting zone;

Figure 4 is a plan or top view of one of the arcuate sections of the melting zone of the cupola;

Figure 5 is a view of the back side of the arcuate section shown in Figure 4 with a portion of the back side removed to illustrate the circuitous coolant passageways provided therein;

Figure 6 is a cross-sectional view, taken along the line 6—6 of Figure 1, showing principally the cooling vanes for the metallic sections or blocks constituting the inner shell or lining for the charging zone;

Figure 7 is a view similar to Figure 1, but shows the external cooling surface of the metallic sections or blocks of the charging zone exposed for atmospheric cooling.

Figure 8 is a view similar to Figure 1, but shows the external cooling surface of the metallic sections or blocks of the charging zone exposed for water spray cooling;

Figure 9 is a fragmentary view of a modified form of the inner shell or lining for the melting zone, the Figure 9 being taken along the line 9—9 of Figure 10 and also showing the external pipe arrangement.

Figure 10 is a cross-sectional view of Figure 9 taken along the line 10—10 thereof and shows the external arrangement of the pipes encompassing the cupola for the coolant; and

Figure 11 is a perspective view of one of the arcuate sections which define the inner shell or lining for the melting zone in Figure 9, the Figure 9 showing a melting zone two sections high.

With reference to Figure 1, I show a cupola which comprises an inner coolant shell or lining for the melting zone. The cupola comprises in general an outer metal wall 20 supported on suitable legs 21. The outer metal wall 20 surrounds the melting zone 18 and the well 19. The cupola may be charged through a door 22 in the side wall of the upper portion thereof. The enlarged intermediate portion 23 comprises a wind box having tuyères 24 through which air may be introduced into the melting zone which is immediately above the tuyères and which is the hot-

test part of the cupola. Below the melting zone 18 and the tuyères 24 is the well 19 into which the molten metal drops and collects before being tapped off through a tap hole into a cupola spout 26. On the side opposite from the cupola spout 26 is a slag spout 27 which is located a short distance below the tuyères. The bottom of well 19 is supported by an outer support ring 28 in the middle of which are the conventional drop doors supported by a support member or prop 29. The inner casing of the well is lined with refractory material 30 which retains the molten metal after it drops from the melting zone.

In the construction of the cupola, the inner shell or lining for the melting zone 18 comprises a plurality of metallic arcuate sections, being six shown on the drawing, although any number may be used. The six metallic arcuate sections are identified by the reference characters 38, 39, 40, 41, 42 and 43, see Figure 3. The sections are preferably made of cast iron or steel but may be made of any other heat dissipating metal having a sufficiently high melting point. The arcuate section 38 is shown in Figures 4 and 5 of the drawings, the Figure 4 being a top plan view and the Figure 5 being a view of the back of the section with a portion of the back being broken away to illustrate the circuitous coolant passage means therethrough. The individual arcuate sections are identical and the section 38 as shown in Figures 4 and 5 comprises preferably a cast metal casing having inner wall 52 provided with vertically extending sides 53 and 54 and a top 55 and a bottom 56. Secured to the back of the arcuate section is a boiler plate 59 which may be welded or otherwise secured thereto to provide a leak-proof assembly. In order to provide a circuitous coolant passage means in each section, there are a plurality of webs 57 extending from the side 53 and a plurality of webs 58 extending from the side 54. The webs are preferably cast integrally with the arcuate wall 52 and laterally extend to a point short of reaching the opposite side wall. As illustrated in Figure 5, this staggered web arrangement provides a circuitous passage means for the coolant to keep the temperature below the melting point of the cast metal sections. The inlet for each section is located at the bottom and is indicated by the reference character 60, and the outlet is at the top and indicated by the reference character 61. As shown in Figure 1, the circuitous coolant passage means is illustrated by the reference character 62. Preferably, the cross-sectional areas of the circuitous coolant passage means 62 becomes larger as the coolant approaches the top so that the flow of the coolant therethrough is reduced as it approaches the top. As shown in Figure 1, the flow of the coolant through the circuitous passage means 62 is regulated by a thermostatic valve which is mounted in the pipe connected to the outlet 61 at the top of each arcuate section. Also, it is to be observed in Figure 1 that the inner wall of the plurality of cast metal arcuate sections slopes slightly outwardly as the melting charge approaches the tuyères with the result that the diameter of the melting zone immediately above the tuyères is greater than that of the top of the melting zone. The height of the arcuate sections may range from three to six feet above the tuyères. After the plurality of cast metal arcuate sections 38 to 43 are installed forming a complete circle for the melting zone, I preferably pack a suitable refractory motar 47 between the plurality of arcuate sections and the outer metal wall 20.

Above the melting zone which terminates at the top of the plurality of cast metal sections is the charging zone which extends up into the charging door 22. In constructing the charging zone, I preferably employ several layers, four being shown in the drawings although any number may be used, of arcuate sections or blocks 48. These blocks extend up to the charging door and are preferably made of cast iron or any other suitable ferrous material. Therefore, it is to be noted that the entire inner shell surface of the charging zone and the melting zone comprises heat dissipating metal without any refractory lining protecting same. The arcuate sections or blocks 48 are preferably made of four segments to make the complete circle, although any number of segments may be used and they may be mounted and held together in any suitable manner. The outside of the arcuate sections is provided with cooling vanes 49 which extend thereabout to present a large cooling area. The air blast entering the wind box 23 through an inlet duct 50 circulates past these cooling vanes to keep the arcuate sections cool. Thus, the segments are air cooled and, of course, the blast itself becomes heated, which offers very distinct advantages in the operation of the cupola. By utilizing this heat taken from the upper region of the cupola, I am able, not only to maintain the thermal efficiency of the cupola, but also to increase the thermal efficiency. Thus, it is to be observed that the construction of the charging zone is such that I am able to eliminate refractory materials as a lining, as well as to utilize some of the heat dissipated in cooling the upper charging zone to preserve the thermal balance of the cupola at a value which will insure efficient operation.

With particular reference to Figure 3, I illustrate the pipe connections for controlling the flow of the coolant to and from the plurality of metal arcuate sections 38 to 43. For the purpose of brevity, the pipes for the section 38 only will be described since the pipes for the other sections are substantially the same. With reference to the arcuate section 38, the coolant is delivered from a coolant feed manifold 65 through a feed pipe 64 that leads to the inlet 60 at the bottom of the arcuate section 38. A main feed valve 63 controls the coolant feed manifold 65. The flow of fluid through the inlet pipe 64 may be controlled by a valve 66.

The coolant upon leaving the section 38 flows out of the outlet 61 through an outlet pipe 68 which is connected to a coolant outlet manifold 67. The quantity or rate of flow of the coolant through the outlet pipe 68 is controlled by a thermostatic valve indicated by the reference character 69 which determines the temperature at which the coolant leaves the top of the arcuate section 38. It is to be observed that each of the other cast metal arcuate sections, namely, 39, 40, 41, 42 and 43, have thermostatic valves 70, 71, 72, 73 and 74 to control the temperature at which the coolant leaves the top of these sections. The thermostats are preferably set so that the heat removed from the metallic arcuate sections maintains the temperature of the metallic sections at a point below the melting point thereof so that at no time during the operation of the cupola is there any damage done to the inner shell or wall of the plurality of metallic sections of the melting zone.

In Figure 7 I show a modified form of the cupola, in that the cooling vanes 49 present a cooling surface to atmosphere instead of being cooled by an incoming blast of air through the wind box, which in Figure 7 encompasses only the metallic arcuate sections comprising the melting zone. Otherwise, the operation of the furnace in Figure 7 is substantially the same as that shown in Figure 1. In Figure 8 I show a second modified form of the cupola, in that the cooling vanes 49 present cooling surfaces which are adapted to be cooled by a water spray 75 emanating from a circular pipe 76 connected to a suitable water supply source through a pipe 77. The sprayed water upon striking the cooling vanes 49 eventually collects in a circular basin 78 from which the collected water flows therefrom through a discharge pipe 79. The temperature of the charging zone may be regulated by varying the amount of the spray in order to keep the cupola operating at its highest point of efficiency.

In Figures 9, 10 and 11 I show a modified construction of the acuate sections which define the melting zone, in that I employ cast metal arcuate sections 80 having the circuitous fluid passage means cast directly in the sections to provide fluid passageways 81 therein. In Figures 9, 10 and 11, I illustrate three arcuate sections, although it is to be understood that any number may be employed. As shown in Figure 9, the acuate sections are two courses high, and after they are installed to form a complete circle defining the melting zone, a packing mortar 47 is filled in between the arcuate sections and the outside metal wall 20. The bottom of each section is provided with a feed pipe 85 and the top of each section is provided with an outlet pipe 86. The feed pipes 85 for each section communicate with an inlet manifold 84 and the outlet pipes 86 communicate with an outlet manifold 87. The pipe arrangement as shown in Figure 9 is such that the coolant through the two courses may be in parallel or in series. When the two courses of the cast metal arcuate sections are connected in series, the valves 91 and 92 are closed and the valve 90 is open. Incoming fluid or coolant flows through the lower feed pipe 83, the manifold pipe 84, the passageways 81 of the cast metal sections of the lower course, the outlet pipes 86, the outlet manifold pipe 87, the valve 88, and back into the inlet manifold 84 of the top course. The coolant, after flowing through the top course, is discharged from the outlet manifold 87 into a discharge pipe 88. When the coolant pipes are arranged in parallel for the two courses of the arcuate sections, the valves 91 and 92 are opened and the valve 90 is closed. In this event, the coolant enters the two feed supply pipes 83, and after flowing through the respective sections, leaves through the two discharge conduits 88. The outlets for the two courses may be provided with thermostatic valves 93 and 94 to control the temperature in which the fluid leaves each course. The operation of the cupola shown in Figures 9, 10 and 11 is substantially the same as that shown and described in preferred figures and the object is to provide a heat dissipating naked metal shell or lining for the melting zone whereby heat may be removed from the shell by a coolant.

The embodiment of the cast iron section 80 as shown in Figures 9, 10 and 11 for the melting zone may be provided either with the charging zone having cooling vanes presenting a cooling surface for an incoming air blast as shown in Figure 1, or a cooling surface to atmosphere as shown in Figure 7, or a cooling surface to a water spray as shown in Figure 8.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

I claim as my invention:

In a shaft furnace cupola for melting cast iron, said cupola including a charge receiving chamber to receive charging material, a melting chamber supporting the same and having tuyères, a wind box for said tuyères enclosing said two chambers, said charge receiving chamber comprising an inner metallic shell directly contactable by said charging materials and having external radiating vanes disposed in said wind box, said melting chamber comprising an inner metallic shell directly contactable by a meltable charge and composed of a plurality of individual fluid conducting wall segments, a fluid inlet conduit communicating with the bottom of each segment, a fluid outlet conduit communicating with the top of each segment, thermostatic valve means associated with said outlet conduit of each segment and located in close proximity to said segments to control the flow of fluid from the segment into said outlet conduit depending upon the fluid temperature and the heat dissipating requirements of the individual segment as responded to by said thermostatic valve means, each segment thereby operating independently of all others in control and extraction of heat from the particular portion of the melting chamber defined by said segment to maintain the particular segment at a temperature level substantially equal to all other segments.

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