June 23, 1942. F. FARMER ET AL 2,287,094

MUFFLE FURNACE

Filed March 15, 1940 2 Sheets-Sheet 1

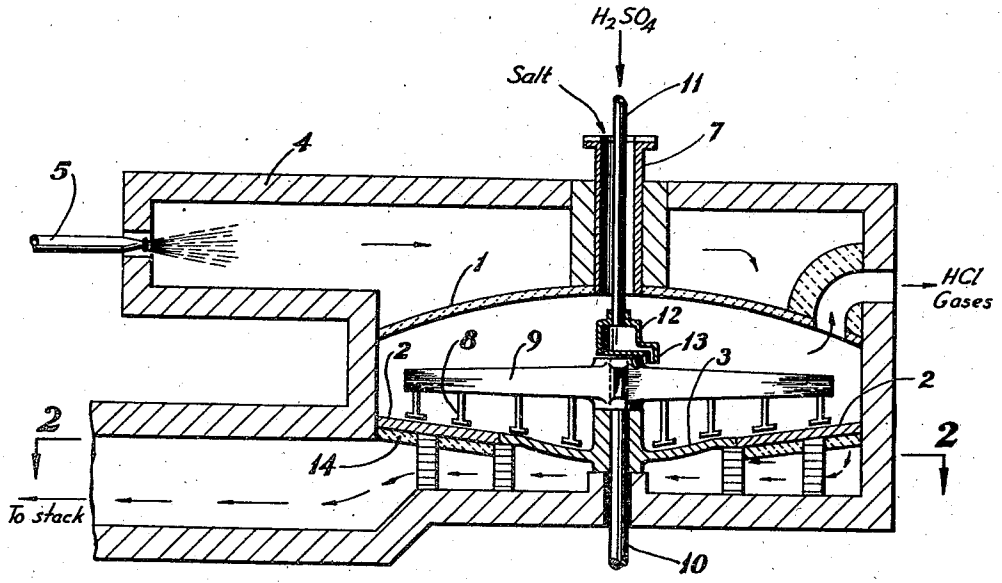


Fig. 1

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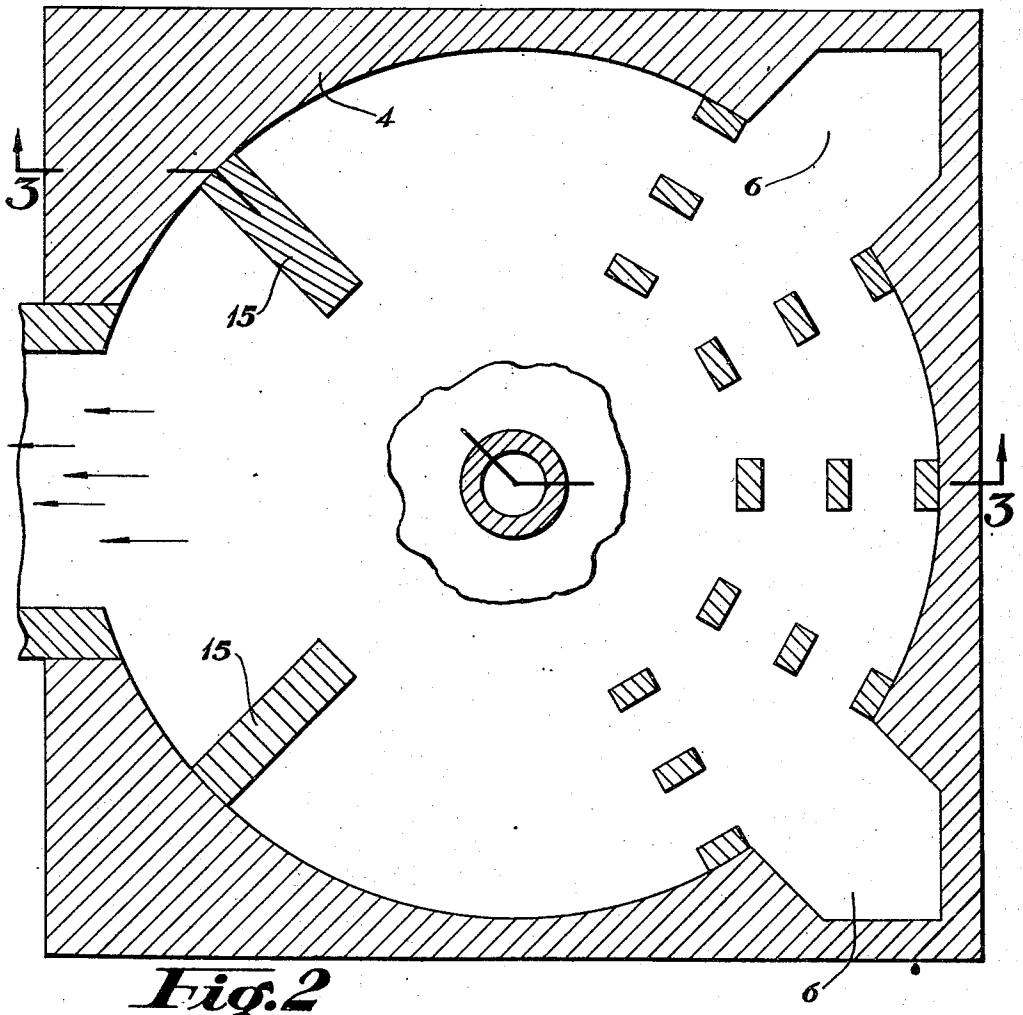


Fig. 2

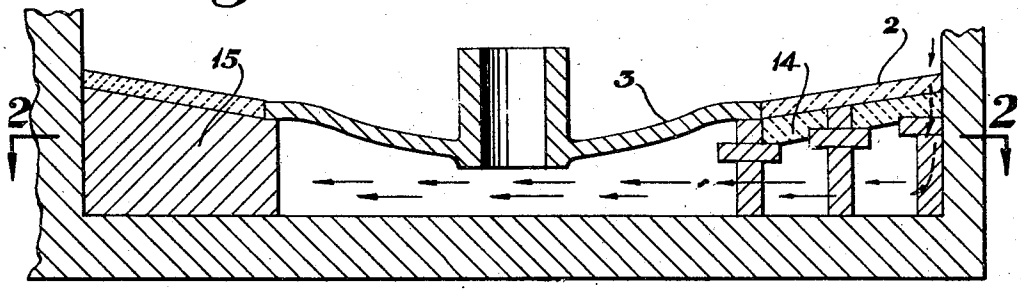


Fig. 3

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MUFFLE FURNACE

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Application March 15, 1940, Serial No. 324,116

1 Claim. (Cl. 23—277)

This invention relates to the manufacture of hydrochloric acid and sodium sulfate in mechanical furnaces of the Mannheim type, and has for its object the elimination of scale formation on the hearth of such furnaces.

The principles and operation of the invention may best be understood by reference to the accompanying drawings in which Figure 1 is a side elevation in section of one type of Mannheim furnace, Figure 2 is a section taken along line 2 of Figure 1 with parts broken away to show detail, and Figure 3 is a section in elevation taken along line 3 of Figure 2.

Figure 1 illustrates a typical Mannheim furnace which has been modified, as will presently be pointed out, according to this invention. Mannheim furnaces are in general indirect fired or muffle furnaces in which the muffle is in the nature of a vertical cylinder topped by a convex refractory arch 1. In some Mannheim furnaces, as illustrated in Figure 1, the bottom of the muffle is composed of an annular hearth 2 of suitable refractory tile surrounding a pot 3 constructed of cast iron or any suitable material. In others the bottom is entirely tile without special configuration describing a pot. The muffle is built in appropriate brick-work structure, as illustrated generally at 4, adapted to direct burner gases from a suitable burner 5 over and in contact with the top of the muffle, down thru suitable flue 6 and back under the bottom of the muffle, and thence to stack.

In the operation of such furnaces sulfuric acid and salt are charged into the muffle thru the thimble 7 in proper portions to yield hydrochloric acid and sodium sulfate. The charge is agitated and progressively moved towards the periphery of the muffle by the plows 8 carried by the arms 9 mounted on the vertical shaft 10, the plows 8 being so shaped and positioned as gradually to push the reaction mass out towards the periphery of the muffle. To prevent corrosion of the arms 9 the sulfuric acid is fed by means of the pipe 11 to the pot 12 which rotates with the arms and has a spout 13 adapted to pass the acid to the pot 3 without contacting the arms 9.

In the past it has been customary to heat the muffle both from the top and the bottom or, in other words, to heat the charge both by radiation from the top of the muffle and by conduction thru the hearth 2 and the pot 3. It has been considered necessary heretofore to apply heat to the charge in all ways available in order effectively to carry the reaction to completion. We have now found, however, that indiscriminate application of the heat to the various parts of the muffle lead to deleterious results. We have traced one of the outstanding difficulties encountered in operation of Mannheim furnaces to this indiscriminate application of heat.

This disadvantage of which we speak arises from scaling or caking of the saltcake (sodium sulfate) on the hearth, where it interferes with effective operation of the plows and has to be periodically removed. In the past it has been necessary to shut down these furnaces to remove the scale formed on the hearth at intervals of about three weeks and sometimes less. According to our present invention we are able to operate under the same conditions over an interval of two to four times as long without having to shut down for removal of scale formation. Even then bottom scale is practically negligible and the shut-downs are required primarily for removal of scale formations from the side walls only. By eliminating more than one-half of the shut-downs required per year we obtain substantial advantages in cost of operation, both in respect to the actual cost of the scaling operation and in respect to increased productivity, due to longer periods of uninterrupted operation. We also obain advantages in that damage to the furnace brickwork as a result of frequent cooling and heating is lessened. Likewise we obtain advantages in that the life of the tile bottom of the muffle, that is, the life of the hearth, is greatly prolonged.

We obtain these advantages by so directing the combustion gases that heat is not applied to the reaction mass thru the hearth. Thus we have provided beneath the hearth 2 a layer of insulation 14 of any suitable refractory insulating material and thereby prevent transfer of heat from the hot gases thru the hearth 2. In this manner the formation of scale on the bottom of the muffle is prevented and the capacity of the furnace surprisingly is not decreased as might be expected. Apparently the scale which rapidly formed on the surface of the hearth when heat was applied thereto acted effectively to prevent any practical utilization of heat from the combustion gases in that manner.

According to the preferred form of our invention we do not insulate the pot, but to the contrary we have found it desirable to concentrate the hot combustion gases at this point in the bottom of the muffle. When sulfuric acid and common salt are charged into the furnace the mass is quite fluid, due not only to the sulfuric acid but also to the formation of the low melting

bisulfate. We have found that when the reaction mixture is in this fluid state it can be strongly heated without scale formation. It is only after the bisulfate stage is passed and calcination of the reaction mass to the normal sodium sulfate is taking place that scale formation is a problem. Thus, by concentrating the hot combustion gases upon the pot and excluding them from the hearth we obtain advantages, not only in eliminating the scaling but also in increased fuel efficiency, which have not been possible heretofore.

As illustrated in Figures 2 and 3 at 15 we provide suitable baffles underneath the hearth whereby the hot combustion gases discharged from the flues 6 are concentrated under the pot. In this manner maximum heat efficiency is obtained without the disadvantages of scaling on the hearth.

While we have illustrated our invention applied to Mannheim furnaces in which the bottom muffle is made up of a pot and a hearth, it is to be understood that it is equally applicable to other types of Mannheim furnaces. Also, it will be apparent that there is other means which may be adopted for insulating the hearth from the hot combustion gases. These and numerous other modifications may be made without departing from our invention, and such variations as may be made without departing from the spirit and scope thereof are intended to be included in the appended claim.

We claim:

In a hydrochloric acid furnace of the Mannheim type the combination comprising a muffle having a circular bottom composed of a circular pot and an annular calcining hearth, means for directing hot combustion gases over the top of the muffle and under the bottom thereof, means for insulating the hearth from said hot combustion gases and means for concentrating said hot combustion gases under said pot.

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