CONDENSATION DEVICE FOR RETORTS

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Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

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This invention relates to retort tube furnaces; and, more particularly, to a condenser to be used in connection with these furnaces.

This invention comprises a device to be inserted in the ends of a tube or retort for the condensation and collection of the products resulting from the chemical reaction taking place in the retort. Furnaces of this type, which comprise an externally heated tube containing a charge which undergoes chemical decomposition with formation of certain gaseous products which are thereafter condensed to solid form, are used in the reduction of magnesium ore to obtain metallic magnesium as well as in the smelting of other metals under similar conditions. The retort consists essentially of metal tube supported in a heating chamber (in the present instance, the chamber contains a liquid heating medium as described in copending application Serial No. 454,830) having a portion extending from the chamber which is at a lower temperature and serves as the condensing portion of the retort. In the smelting of magnesium, magnesium-bearing dolomite ore and ferrosilicon briquettes are charged into the chamber portion of the tube; the tube is closed and evacuated, and the charge is brought to the reaction temperature. Gaseous magnesium is formed as the result of the chemical reaction which ensues and this is drawn toward the condensing portion of the tube through the flow established by the vacuum pump. Since this portion is maintained below the condensation temperature of the gaseous magnesium, regulite magnesium metal is deposited in the condensation portion. When the reaction is completed, the tube is opened and the metal will be found localized in the condensation portion, the condensed charge remaining in the chamber portion of the retort tube. These are then removed and the process repeated. It will be apparent that this process is adapted to any metal which may be formed in the gaseous state during smelting.

It has long been the practice in furnaces of this type to insert a removable sleeve in the condensation portion of the retort tube so that after the reaction is completed, the sleeve, together with the adherent metallic magnesium, can be removed as a unit as the magnesium displays a considerable tendency to adhere to the surface on which it condenses. However, a considerable amount of metallic magnesium is formed during successful operation of a furnace of this type and it is difficult to provide adequate circulation through the condensing chamber sleeve since the metal condensate may block the egress from it, with consequent reduction of operating efficiency. Another difficulty is that to obtain complete condensation a condensation chamber of considerable length must be provided and this presents structural difficulties which are to be avoided, if possible. The present invention, therefore, contemplates the provision of a shortened but highly efficient condensation chamber together with a removable sleeve construction in which positive exhaust means are maintained at all times. The advantage of this is that a maximum amount of magnesium condensate is obtained in a shortened condensation chamber which at once reduces the expense of the installation and the difficulty of sleeve removal. A further advantage is that clogging of the gas circuit is entirely obviated and a gaseous counterflow effect is achieved which scour the exhaust port and keeps it free at all times.

Yet another advantage, particularly important in the reduction of magnesium, is the separation from the condensed magnesium metal of the condensed sodium which is usually formed concomitantly therewith. The charge used contains some sodium-bearing material and this too is reduced during the reduction process. It passes in the form a gas into the condensation chamber but is distinguished from the magnesium in that it condenses at a somewhat lower temperature. In conventional condensation practice, where but one chamber is provided, the magnesium and sodium necessarily are deposited together. When the chamber is opened the sodium ignites on contact with the air and in some cases will ignite the magnesium metal with serious results. Therefore, it is advantageous to provide separate condensation areas for these two metals, if possible. The construction shown in this application effectively segregates the magnesium and the sodium, providing different condensation areas for each metal and that, on opening the tube, the combustion of the sodium will not affect the magnesium.

With these and other objects in view, the invention consists in the arrangement, construction and combination of the various parts of the improved device as described in the specification, claimed in the claims and illustrated in the accompanying drawings in which:

Figure 1 is a side view of the exterior portion of a retort tube taken on the line 1—1 of Figure 2.

Figure 2 is an elevation of a portion of the face of a retort furnace, showing a multiple-tube arrangement.

Figure 3 is a longitudinal section through the condensation portion of a retort tube.
Figures 4 and 6 are transverse sections taken as shown by the lines 4—4 and 6—6, respectively, of Figure 3.

Figure 5 is a transverse section through the retort (omitting the water jacket) as indicated by the line 5—5 of Figure 3.

Figure 7 is a fragmentary sectional view, on an enlarged scale, showing the sealing means employed.

Referring to Figures 1 and 2, the furnace is indicated generally at 10. This, it will be understood, comprises a heated chamber containing a liquid heat-transfer medium although only a portion of the front wall 11 and the retort tube 12 which projects into the chamber, are shown. A solidified seal 13 between wall 11 and retort tube 12 prevents leakage of the molten material within the furnace. Each tube 12 includes a heavy furnace tube section 14 and a lighter condensation tube section 15 welded to it. A flanged plate 16 is provided through a cover 18 having a flared flange 17 and hingedly supported by an evacuation pipe 18 which includes an extensible bellows section 19 on the exhaust header 20. The header is closed at one end 21 and has a pintle 22 pivoted on the support 23. The other end of the header is joined through a union 24 to the exhaust line 25 which serves as the opposite support. A handle 26 facilitates rotation of the header and its associated covers to the position shown in dotted line in Figure 1 when the union 24 is loosened.

The outer end of the condensation section 15 is encompassed by a water jacket 27 having connections 28 which support it in place. The vacuum seal between the cover 18 and the tube 15 is effected by a rubber ring gasket 29 which bears against the water jacket 27, the outer surface of the tube 15 and the inner surface of the flared flange 17. No other seal or locking device is required since the reduced pressure within the tube is more than sufficient to hold the cover tightly in place while the proximity of the water jacket prevents deterioration of the gasket due to the retort heat.

The condensing chamber 30, as shown in Figure 3, includes a heat dam 31, a condensation sleeve 32 and as a gas chamber 33. The heat dam 31 comprises a short section of pipe 34 to which is secured a diaphragm 35 having a central aperture 36 and a baffled plate 37. It slides in the condensing chamber 30 until it comes to rest against the end of the heavy section 14 of the retort, and its purpose is to reflect heat from the retort chamber and prevent its ready transmission to the condensation area.

The sleeve 32 is another section of sleeve pipe 38 which will slide into the condensing chamber 30 and is open at the retort end and has removable two-spaced walls 39 and 40 at the outer end, forming the gas chamber 33. The outer wall 40 has a central aperture 41 which opens to the space 42 defined by the cover 18; and the inner wall 39 has a crescent-shaped aperture 43 in its lower portion. This accommodates a split pipe 44 which rests freely inside the sleeve pipe 38 and traverses the inner wall 39. Pegs 45 are welded at each end of the split pipe 44 and are used to secure it from the heat dam 31 and the outermost wall 40 to insure free access between the pipe 44 and the condensing chamber 30 at one end and the pipe and gas chamber 33 at the other. While in the present instance, the split pipe is shown as a segment of a standard pipe, it will be understood that it could assume any structural form such as a channel, angle, or even a complete pipe of smaller diameter, it being essential only that an auxiliary passage is formed within the condensing chamber which communicates with the condensing chamber at one end and the evacuating means at the other, and is at a somewhat lower temperature. The advantage of the section shown is that it readily placed and removed and is generally easy to handle.

In operation, a charge, represented by the briquettes 46 is placed in the retort tube 12; the heat dam 31 and sleeve pipe 38 are inserted in the condensation section 15, the split pipe 44 resting freely within the sleeve. The retort cover is then brought over the end of the condensation tube 15 and the vacuum pumps are started evacuating the space 42, chamber 33 and the interior of the retort and completing the seal between the cover and the tube. The charge is brought to proper temperature and chemical reaction occurs releasing gaseous magnesium and other components, which pass through the aperture 36 in the diaphragm 35 in response to impressed evacuation to the condensing chamber 30 and are impelled rearwardly therein by prior condensation of the gases at the end of the condensing chamber. After the magnesium gas content has been condensed the remainder is drawn off, as indicated by the arrows, through the split pipe 44 and thence into the gas chamber 43. However, the temperature in the split pipe is somewhat lower than that prevailing in the remainder of the condensation chamber, and the gaseous sodium will be condensed within the conduit formed by the split pipe and adjacent sleeve. It thus follows that a co-current flow is set up in response to the combined vacuum imposed and the condensation effect within the chamber so that while the magnesium is deposited in a solid block indicated at 41 the sodium is separately condensed within the split pipe 44 and a free circulation is maintained at all times between the interior of the retort and the evacuating means to permit maintenance of the vacuum and removal of other gaseous products.

In prior structures, a simple sleeve was used with a heat baffle at the inner end and a diaphragm with a restricted opening at the outer. In practice, however, it is found that magnesium tends to build up in the manner shown and the outer aperture would frequently fill with condensed metal so that continued operation was impossible. In addition, the sodium would also condense along with the magnesium with possible dangerous results when the retort was opened. In the present structure, a countercurrent effect is achieved which not only separates the sodium and magnesium, but at the same time assures that the circulation through the system will not be impeded. It further obtains, in a relatively short condensation chamber, the same results which heretofore have required an extremely long condensation chamber. In effect, these advantages are directly traceable to the use of auxiliary conduits formed by the split pipe 44 and the proper location of the cooling areas at the outer end of the condensation area.

Some changes may be made in the arrangement, construction and combination of the various parts of the improved construction without departing from the spirit of the invention and it is the intention to cover by the claims
such changes as may be reasonably included within the scope thereof.

The invention claimed is:

1. In a condensing unit for a tube retort, a sleeve fitting within said tube open at the inner end and closed at the outer end, and a conduit providing a supplementary passage opening adjacent the inner end of said sleeve and traversing the closed end of said sleeve.

2. In a condensing unit for a tube retort, a sleeve fitting within said tube, said tube open at the inner end and closed at the outer end, a conduit within said sleeve providing a supplementary passage, said conduit opening at one end adjacent the open end of said sleeve and traversing the closed end of said sleeve.

3. In a condensing unit for a tube retort, a sleeve fitting within said tube, said sleeve being open at the inner end and closed at the outer end, a conduit within said sleeve providing a supplementary passage, said conduit opening adjacent the open end of said sleeve and traversing the closed end of said sleeve.

4. In a condensing unit for a tube retort, a sleeve fitting within said tube, said sleeve being open at the inner end and closed at the outer end, a conduit providing a supplementary passage opening adjacent the open end of said sleeve and traversing the closed end of said sleeve, a water jacket surrounding said tube adjacent the closed end of said sleeve, a cover at the outer end of said tube, a chamber formed between the outer end of said sleeve and said cover, said conduit communicating with said chamber.

5. In a condensing unit for a tube retort, a sleeve fitting within a portion of said tube, means to create reverse circulation of said gases admitted to said sleeve from said tube comprising a supplementary conduit opening adjacent the inner end of said sleeve and providing the sole means of removing the gaseous contents of said sleeve therefrom.

6. In a condensing unit for a tube retort, a sleeve fitting within said tube, said sleeve open at the inner end and closed at the outer end, a dam having a restricted opening adjacent the inner end of said sleeve, a conduit providing a supplementary passage opening adjacent said dam and extending beyond the closed portion of said sleeve to remove gases therefrom, and cooling means effective adjacent the closed end of said sleeve.

7. In a condensing unit for a tube retort, a sleeve fitting within said tube, said sleeve being open at the inner end and having a closure adjacent the outer end, a dam disposed in said tube inwardly of said sleeve and having a restricted opening, a cover at the end of said tube, a chamber formed between said cover and said sleeve, cooling means disposed around said tube adjacent said chamber, a conduit providing a supplementary passage opening adjacent the open end of said sleeve and traversing said closure, the outer end of said conduit communicating with said chamber, and means for positioning said conduit with respect to said dam and said closure to maintain said communication therethrough.

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