

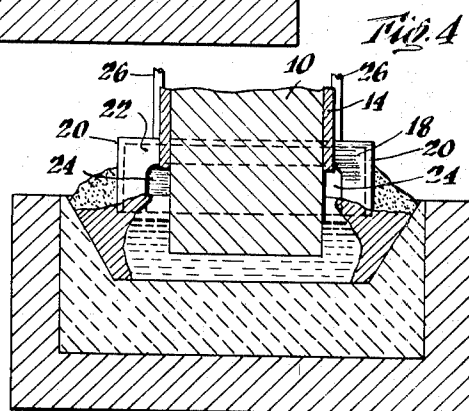
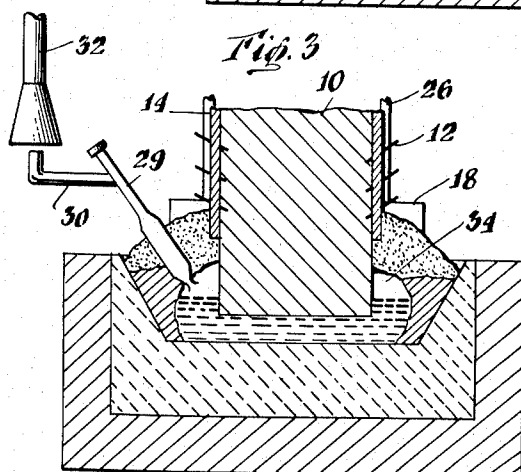
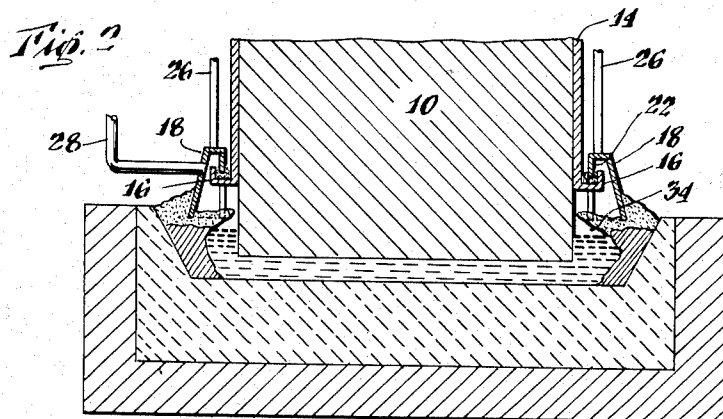
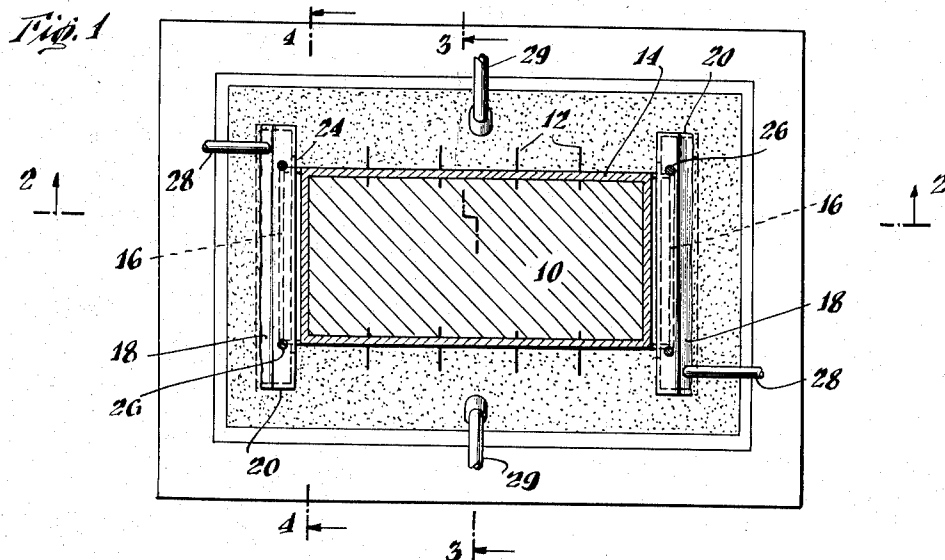
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METHOD OF COLLECTING GASES FROM ALUMINUM FURNACES

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METHOD OF COLLECTING GASES FROM ALUMINUM FURNACES

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2 Claims. (Cl. 204—67)

It is known that furnace gases from electrolytic production of aluminum contain fluorine compounds and tar fumes which may cause considerable damage to vegetation. By washing the gases with a soda solution in a gas-cleaning apparatus, fluorine may be removed and the resulting sodium fluoride solution may be employed for production of cryolite or other fluorine compounds.

For use of continuous self-baking Söderberg electrodes, closed furnaces have been designed which are provided with a gas exhausting and cleaning arrangement as mentioned above. In furnaces of this type the electrode is covered with a hood having shutters which are opened when charging the furnace or removing contact bolts. On account of unavoidable air leakage, especially at the door openings and the inlet of air every time the doors are opened, the furnace gas developed during the electrolysis becomes strongly diluted with air. This is necessary also to avoid formation of explosive gas mixtures.

As an example from results obtained in commercial furnaces of this type it may be mentioned that the real furnace gas amounts to 2 liters per second, while the average gas volume now exhausted is about 500 liters per second on account of surplus air. The gas volumes to be treated are thus very great, and considerable installations are required to clean the gases. It has therefore hitherto not been economical to recover fluorine by cleaning the gases, and such gas cleaning is as a rule only carried out because the gases must be neutralized to prevent damage from fumes in the near-by districts.

The above mentioned older furnace type was provided with Söderberg electrodes with current supply contacts introduced sideways into the electrodes. During the later years Söderberg electrodes have been developed with vertical contacts permitting the collection of gases in a duct surrounding the electrode at the bath surface. This duct is quite narrow and closed gas-tight at the electrode as well as at the furnace crust by means of Al_2O_3 . As it is not necessary to provide the duct with working openings or doors difficult to make air-tight, dilution of the furnace gas with air is completely avoided. It may therefore be collected in a concentrated and uncombustioned state and contains about 40 to 60% CO together with considerable tar fumes developed during baking of the electrode.

The present invention relates to a different method of collecting the gases from Söderberg furnaces and is particularly adaptable for use with furnaces of the older type provided with current supply contacts or studs introduced sideways into the electrode, though it is also useful with the modern type using the vertical contacts or studs. This invention is premised upon our discovery that if the alumina is piled up along the side of the electrode to a substantial height and then left undisturbed for a reasonable length of time, a gas channel will form under this mass of alumina. Apparently this channel is formed because the gas bubbles escaping from underneath the electrode throw hot drops of liquid up toward the upper crust. This causes a part of the upper crust to melt and corrode away so that eventually a space is formed between the

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liquid bath and the crust. While the formation of such a channel was inherent in the ordinary operation of the Söderberg electrode prior to our invention, no advantage was taken of this fact. However, we have found that we can take advantage of the formation of this channel by tapping it in such a way that the gases which collect in the channel can be led to a combustion point at a distance removed from the crust and burned at such point. By doing this, a controlled combustion can be had to consume the tar vapors, whereas heretofore the vapors simply broke through the crust from time to time and burned directly over the crust.

According to the present invention, two methods of removing the gases from within the channel along the sides of the electrode are shown. In one method a pipe is arranged so that its lower end projects into the gas channel and its upper end is connected with the appropriate combustion equipment. Such a pipe can be positioned at any desired point along the side of the electrode and one or more of them may be used as is necessary.

The other method of collecting the gases is to employ a metal gas-collecting duct across each end of the electrode with appropriate openings in it so that any gas which escapes from under the electrode at the ends will be collected just as in the case of Jouannet Patent No. 2,526,875 and by providing openings so that the gas collecting in the side channels under the crust can enter these end gas ducts. Appropriate pipes are supplied for withdrawing the gases from within the ducts. In this connection it is to be noted even where electric contacts or studs are used which are introduced sideways into the electrodes, these are used only on the long sides and not at the ends so there will be nothing to interfere with the arrangement of metal ducts on the ends of the electrode, whereas at the sides where the channels under the alumina are relied on, there are no metal ducts to interfere with the electric contacts or studs which must be withdrawn from the electrode mass before they go low enough to contact the liquid in the bath.

This invention may be readily understood from the accompanying drawings in which Fig. 1 shows a plan view of an aluminum furnace utilizing our invention; Fig. 2 is a longitudinal section; Fig. 3 is a section on line 3—3 of Fig. 1 and Fig. 4 is a section on line 4—4 of Fig. 1 showing the connections between the side channels and the end gas ducts.

In these drawings 10 designates the electrode mass and it is to be understood that in this example this mass is suspended, and electric current is to be transmitted to it, by contact studs entering the side of the mass. These are not described in detail in this application but they may be arranged, for example, as shown in Patent No. 2,337,279 to Sem et al. The position of the contact studs is simply indicated by the lines 12.

The electrode is supplied with a permanent casing 14 which is solid at the ends and may if desired be slitted on the sides for movement of the contact studs as shown in the said Sem patent. Running across the ends of the casing 14 and attached to the casing near the bottom are pocket members 16. Interlocking with the pocket members 16 are the members 18 which form gas ducts across the ends of the electrode. It is understood that the lower ends of these members are to be imbedded in the alumina carried on the crust of the furnace and at the upper end will be imbedded in alumina carried by the pocket members 16 as explained in the said Jouannet patent.

The pocket members 16 have a length equal to the length of the electrode but the members 18 extend beyond the sides of the electrode as clearly shown in Fig. 1, and at the positions where the members 18 extend beyond the sides of the electrode casing they are closed at the ends and are also partly closed on the exposed faces which lie

outside the electrode casing. The end closures are indicated at 20 in Fig. 4 and the closures for the exposed faces are shown at 22 in Fig. 4. Preferably the closures 22 do not cover the entire exposed faces but are cut away as indicated at 24 to leave space for gas to enter the ducts formed by the members 18. It is understood that the members 18 are supported in any convenient way as for example by the hangers 26. A pipe 28 is preferably connected to each member 18 through which gases collected under the members 18 may be removed to any desired combustion point.

In operating the furnace the usual crust will form on the top of the bath. Alumina is piled on this crust against the sides of the electrode and care is taken to be sure that the cut-away portions 24 of the end closures 22 are all covered. If desired, a gas-collecting pipe 29 may be positioned so that its lower end will extend down through the crust as indicated in Fig. 3 and this member is connected by pipe 30 to a point where the gases can be mixed with air and burned. The burned products of combustion are led off through the pipe 32. It is understood that the member 29 and its connected pipes is to be suspended from the regular structure of the furnace in any desired manner.

Very shortly after the alumina is piled up against the sides of the electrode the bubbles of gas escaping from under the electrode will cause the hot liquid of the bath to splatter against the under side of the alumina piled against the side of the electrode and corrode it away so that a channel will be formed under this alumina as indicated at 34 in Fig. 2. Gas will collect in this channel and then can be withdrawn through the collecting pipes 29 and also the gas from this channel will flow through the cut-away portions 24 into the gas ducts formed by the members 18 and then can be conducted through the pipe 28 to any desired point of combustion.

It is recognized that periodically the crust over the furnace has to be broken up and additional powdered alumina introduced but each time this is done the finely divided alumina is piled against the side of the electrode, as has been described, and very soon a new channel will be re-formed as indicated at 34. Piling the alumina against the side of the electrode is essential in any case, for it will be noted that the casing 14 stops short of the bath in the pot 36 so that, unless covered up, a portion

of the side of the carbonaceous electrode will be exposed to the air and tend to be consumed. The bath is of course made up of alumina dissolved in molten cryolite.

By following this procedure we have found that we can conduct the gases and tar vapors away from the immediate vicinity of the crust over the electrode bath substantially out of contact with the air and without admixing them with sufficient air for them to become explosive. Then at the desired point they can be combined with the appropriate air and burned.

What we claim is:

1. A method of collecting gases from an aluminum furnace of the type comprising a pot for the furnace charge, a rectangular casing for guiding the electrode down toward the pot and a rectangular carbonaceous electrode in said casing of greater length than width which comprises the steps of maintaining within the pot a charge of alumina dissolved in molten cryolite under conditions which result in a crust forming on such charge, maintaining a layer of alumina directly on such crust exposed at its upper surface to the outer air which layer contacts the casing along its longer sides to form a seal between the crust and the casing, maintaining conditions so that a gas channel of extended length forms along the side of the electrode beneath said crust, withdrawing gases from within said channel at the ends thereof while the channel is so maintained so that gas pressure under said layer is prevented from building up sufficiently to cause the gases to break through such layer, conducting said gases substantially out of contact with the air to a point removed from the crust and burning them at such point.

2. A method as specified in claim 1 in which gas is withdrawn from said channel at a point intermediate the ends as well as at the ends.

References Cited in the file of this patent

UNITED STATES PATENTS

2,464,267	Short	Mar. 15, 1949
2,526,875	Jouannet	Oct. 24, 1950
2,564,837	Ferrand	Aug. 21, 1951

FOREIGN PATENTS

608,656	Great Britain	Sept. 17, 1948
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