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ELECTRIC FURNACE AND SMOKE AND FUME TAKE-OFF THEREFOR

Filed March 13, 1952

2 Sheets-Sheet 1

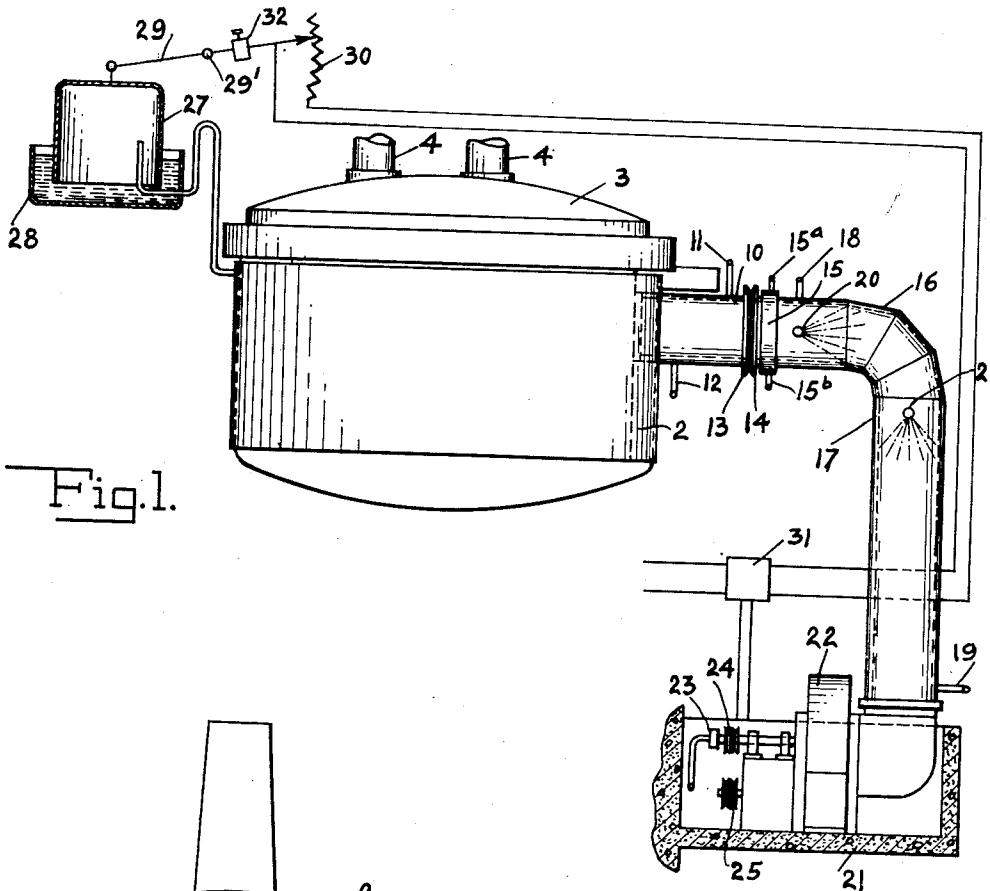


Fig. 1.

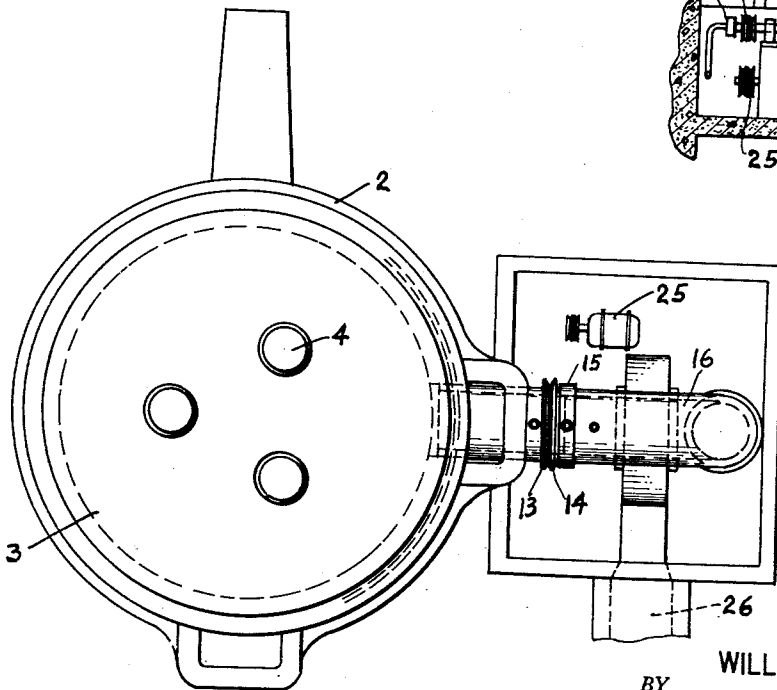


Fig. 2.

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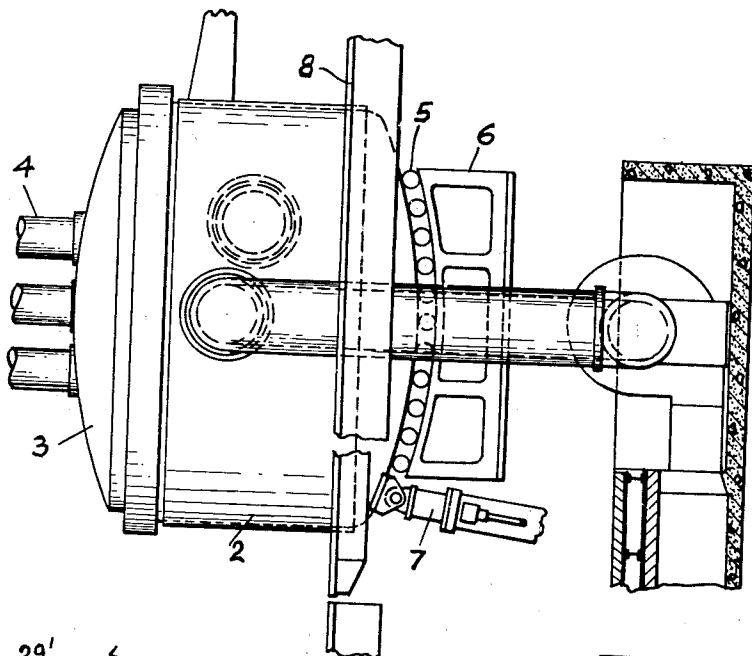


Fig. 3.

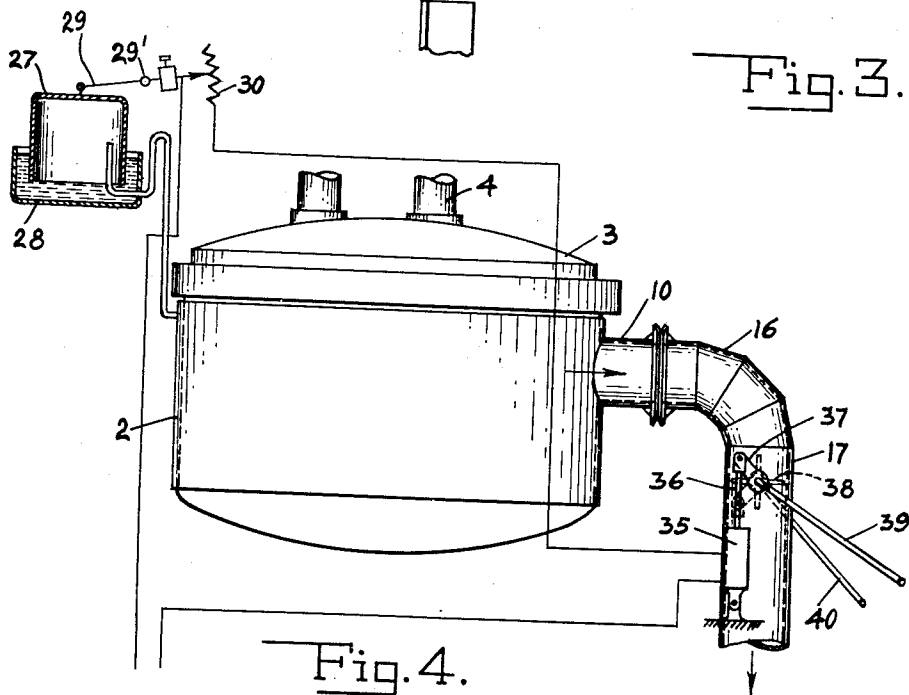


Fig. 4.

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ELECTRIC FURNACE AND SMOKE AND FUME
TAKE-OFF THEREFORWilliam E. Moore, Pittsburgh, Pa., assignor to
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1

This invention relates to electric furnaces, and particularly to a tilting electric furnace having provision for the disposal of smoke and fumes generated therein.

While electric furnaces are not ordinarily bothersome, insofar as the generation of smoke is concerned, there are times when such furnaces, particularly when used in melting down scrap, may produce substantial quantities of smoke and fumes. Increasing public consciousness against contamination of the atmosphere, and the increasing prevalence of anti-smoke ordinances, has led to various attempts to take care of the smoke, but in the case of tilting type electric melting furnaces, the arrangements heretofore provided have not been satisfactory.

For example, these furnaces have been provided with auxiliary smoke hoods above the roof of the furnace with a suction fan to create a slight suction for the purpose of drawing off fumes and smoke generated by the furnace beneath the hood. However, such hood involves a difficult problem in the case of top-charge furnaces, since the top of the furnace is moved in a horizontal plane when charging the furnace, and drop buckets or chargers have to be swung over the furnace when it is being so charged. The larger type of furnaces, being supported on rollers, may move in a horizontal plane while they are being tilted. A hood therefore must be so located as not to interfere with the movement of the top of the furnace together with the electrodes that project downwardly therethrough, or with the masts for the mechanisms which raise or lower the electrodes. The hood also must not interfere with the movement of the charging buckets into position over the furnace, and it must not interfere with movement that takes place when the furnace is tilted.

In the tilting type electric furnace, the movable cover seats on the shell of the furnace. Electrodes project vertically through the cover, and the cover is provided with glands of some kind, through which the electrodes are slidably passed.

When a furnace is used for the melting down of some materials, as for example melting scrap, which might be coated with grease or paint, large quantities of smoke are generated, and flames and smoke are expelled upwardly around the electrodes, and from around the edge of the roof, and there may be a substantial increase in pressure inside the furnace. The presence of a smoke hood with suction tends to increase the velocity of the incandescent gases pouring out in volume

2

from around the roof and around the electrodes. This tends to greatly increase the consumption of the graphite or carbon electrodes, and has a destructive action on all equipment adjacent the roof of the furnace.

The present invention has for its primary object to provide an effective and simple way of removing and disposing of the smoke and fumes from a tilting type furnace.

A further object of the invention is to provide a smoke and fume disposal system wherein a predetermined condition of balance may be maintained between the pressure inside the furnace and the atmospheric pressure around the furnace, thus preventing or retarding the escape of fumes and smoke around the electrodes.

These, and other objects and advantages, are obtained by my invention.

According to my invention, an offtake pipe is provided on the furnace, preferably below the floor, and it projects from the side of the furnace. When the furnace is in the normal operating position, the outer end of this discharge pipe or nozzle registers with a down pipe leading to a suction fan. When the furnace is tilted, either for pouring off metal or slag, the outlet pipe or nozzle on the furnace simply swings out of register with the suction pipe. During the operations of pouring and slagging, smoke and gases in substantial quantities are not produced, and when the furnace is moved back to its horizontal position, the nozzle or offtake mates with the down pipe.

Additionally, means may be provided for regulating the suction with an increase or decrease in the change in barometric pressure inside the furnace, whereby at all times that the furnace is operating, the suction through the offtake may be regulated as the pressure of gases changes.

My invention may be more fully understood by reference to the accompanying drawings, in which:

Fig. 1 is a more or less schematic side elevation of the tilting type electric furnace, with a smoke disposal system embodying my invention, and schematically illustrating one form of regulator for the suction fan;

Fig. 2 is a top plan view of the arrangement shown in Fig. 1, the regulator, however, not being shown in this figure;

Fig. 3 is a side elevation of one form of tilting furnace showing the location of the gas offtake pipe or nozzle on the furnace, with reference to the downcomer pipe leading to the suction fan; and

Fig. 4 is a fragmentary view similar to Fig. 1, showing a slightly modified suction control arrangement.

Referring first to Figs. 1 to 3 of the drawings, 2 designates the shell of a tilting electric melting furnace having a removable roof 3, the construction of the furnace being any usual or preferred construction, and in itself it constitutes no part of the present invention. It has three electrodes, designated 4, passing through the roof thereof. The usual mechanism for raising and lowering the electrodes, or for moving the roof to permit the top charging, is not shown. The furnace may be mounted in any usual or preferred way for tilting in a vertical arc about a transverse axis. In Fig. 3 the furnace is schematically shown as being supported on rollers 5 arranged under the bottom of the furnace and on a suitable supporting structure 6, and 7 designates a hydraulic ram through which tilting may be effected. Any number of these rams may be used, this construction and arrangement being well known in the art.

Referring to Fig. 3, the floor around the furnace is designated 8, and part of the disposal system, to be hereinafter described, is preferably located in a pit under the floor.

In accordance with the present invention, a short gas offtake pipe or nozzle 10 is constructed on the side of the furnace below the roof, and it opens into the interior of the furnace. It may be of a water-jacketed construction with a water inlet 11 to the jacket, and a water outlet 12. Flexible hoses (not shown) may be connected to the water inlets and outlets. The end of the pipe 10 terminates in a wiper plate 13, the surface of which is a plane, but the edges of which may be curved back toward the furnace. When the furnace is in its horizontal or normal operating position, the plate 13 registers with a similar plate 14 on an adjustable collar 15, which is slidable along the terminal of a horizontal elbow 16 at the top of a downcomer pipe 17. The collar 15 may be water-cooled, having inlet and outlet connections at 15a and 15b, and it is slidable on the terminal of the pipe 16 so that the plate 14 may be in reasonably close engagement with the plate 13. The downcomer pipe 18—17 may also be water-jacketed with a water inlet connection at 18 and a water outlet connection at 19. In addition to being water-jacketed, or in lieu of being water-jacketed, the downcomer pipe may be provided with internal spray nozzles for cooling the gases and protecting the pipe. Such nozzles are schematically illustrated in Fig. 1 at 20 and 21.

The pipe 19 is preferably connected directly to a suction blower, and this blower is desirably a blower of the so-called Theissen type. Such a blower, which is well-known in the art, has a hollow shaft for receiving water at its driven or pulley end. From this inlet the water flows to the hub of the fan, and from the hub of the fan it is discharged out along the faces of the fan blades and whipped into a mist. In the drawings, 22 designates the fan, and 23 is the water connection at the pulley end of the fan shaft. 24 is the driving pulley, and 25 schematically illustrates the motor for driving the fan.

While, as indicated above, I prefer to use a Theissen type, or equivalent kind of fan, because it brings the gases and water into intimate contact, my invention is not restricted to the use of such a fan. Inasmuch, however, as the substances constituting the smoke and fumes are

largely substances which may be entrained or absorbed by water, the use of sprays or other equipment for intimately contacting the gases and water, and thus cleaning the gases, are desirable quite apart from the cooling of gases.

The fan discharges into a combined flue and drain designated 26, and which is shown as passing under the floor of the pit to a point (not shown) where it discharges to atmosphere.

During the time that the furnace is in operation, and hence generating fumes and smoke, the discharge nozzle 10 on the furnace is in registering alignment with the downcomer pipe, and there is a reasonably close fit between the face plates 13 and 14 so that the smoke and fumes may be drawn directly from the furnace. When the furnace is tilted, either for pouring of metal, or for slagging, the nozzle 10 moves out of alignment with the downcomer pipe, and at this time it is open to atmosphere. This is indicated in dotted lines in Fig. 3. However, at this time the furnace is generating little smoke or fumes, and it is only in this position during a relatively small time in the entire cycle of operation.

At certain periods in the operation of the furnace, as indicated above, smoke is generated more freely than at other times, and at such times the pressure within the furnace may increase. It is desirable, in order to avoid the escape of the incandescent gases and smoke from around the roof and around the electrodes, to then remove the gases at a higher rate and reduce the pressure to substantially atmospheric pressure. On the other hand, as the heating of the metal continues, less smoke is evolved, and it is not desirable to operate the fan at full capacity since it may then merely serve to draw excessive amounts of cold air into the furnace. Consequently, my invention further contemplates the regulation of the suction according to the changing needs as the melting cycle progresses. While this could be regulated to some extent by manual operation through the use of a variable speed motor for example in driving the exhaust fan, together with a manual control, I have shown an automatic control. In Fig. 1 a flexible tube leads from the furnace and has its opposite end terminating under a bell float 27 which is in a receptacle 28 in which there is a body of water. As the pressure in the furnace changes, the change of pressure is communicated to the space within the bell 27, increasing or decreasing its buoyancy. As the bell rises or falls, it may be used to control the suction. For this purpose I have schematically illustrated the bell as being connected to a lever 29 pivoted at 29', and which moves over a rheostat 30, which operates a variable speed control 31 for the variable speed motor 25 that drives the exhaust fan. Thus as the pressure under the bell increases, due to the increase in volume of smoke and gases, less resistance is imposed in the control circuit to cause the motor 25 to speed up, and as the pressure under the bell 27 decreases, more resistance is included in the circuit to reduce the motor speed. Adjustment of the control is indicated diagrammatically by a weight 32 adjustable along the lever 29.

With this arrangement it is possible to keep the pressure within the furnace at just about atmospheric pressure, so as to avoid the blowing out of incandescent gases around the electrodes, and at the same time avoid the introduction of an excess volume of air into the furnace.

In Fig. 4 I have illustrated an alternative ar-

5 rangement where, instead of using a variable speed drive for the exhaust fan, the fan may operate at a constant speed, but a damper or control valve in the downcomer pipe may throttle the flow of gases to the fan. In this figure, all of the parts are the same as in Fig. 1, and the same reference numerals have been used, and a similar bell float is shown with the same reference numerals. Instead of the resistance 30, however, being connected to a control for a variable speed motor, it is in this instance connected with a solenoid 35 positioned alongside the downcomer pipe 17, and the solenoid armature is connected through linkage 36 to an arm 37 to turn a butterfly valve 38 inside the downcomer pipe. This butterfly valve or damper is preferably water-cooled, and 39 designates a pipe leading to a hollow trunnion at one end of the butterfly valve, and 40 designates a discharge pipe leading from the trunnion at the other end of the butterfly valve. Through these trunnions water circulation for cooling the butterfly valve is provided, as is well understood in the art.

My invention provides a simple arrangement for removal of smoke from a tiltable electric furnace. It does not require any flexible conduits for the gases, and hence the matter of water-cooling the gas takeoff apparatus is relatively simple and free of complications. The space over the roof of the furnace is not obstructed in any way, and no hood is required. The provision of the registering face plates 13 and 14 that permit sliding movement, enables the tilting of the furnace to be effected without complication. The use of the pit under the furnace enables the suction fan to be disposed in a position where it does not interfere with the charging or other operations of the furnace, and allows the water to be carried away to a sewer. For these reasons I prefer to have the suction pipe 17 extend downwardly, rather than laterally or upwardly, although if need arose, the gas offtake pipe could extend in some other direction.

While I have shown and described more or less schematically certain preferred embodiments of my invention, it will be understood that the invention may be otherwise embodied, and that the invention is not restricted to the particular construction and arrangement of parts specifically described.

I claim:

1. A tilting electric furnace having a furnace body, a tilting support for the body, a roof and electrodes passing through the roof, said body having a smoke offtake pipe projecting laterally therefrom eccentric to the axis about which the body tilts, a fixed smoke offtake pipe having a terminal with which the offtake pipe on the furnace registers when the furnace is in a normal horizontal position, and relative to which the offtake pipe of the furnace moves in a direction transverse to the axis of said offtake pipe when the furnace is tilted, an exhaust fan to

which said fixed offtake pipe connects, a discharge duct from the fan and means for cleaning the smoke which is drawn off from the furnace.

2. A tilting electric furnace as defined in claim 1 having means for regulating the volume of gases removed from the furnace.

3. A tilting electric furnace as defined in claim 1 having means responsive to variations in pressure in the furnace for varying the suction effect of the fan with variations of gas pressure in the furnace.

4. The combination with a tilting electric furnace having a furnace body, a tilting support for the body, a roof and electrodes passing through the roof, said body having a smoke removal port on the side wall thereof eccentric to the axis about which the body tilts, which port is moved in an arc when the furnace is tilted, of a fixed smoke offtake pipe having a terminal which mates with said port when the furnace is in normal operating position, and relative to which the port moves when the furnace is tilted.

5. The combination with a tilting electric furnace having a furnace body, a tilting support for the body, a roof and electrodes passing through the roof, said body having a smoke discharge nozzle projecting from the side wall thereof eccentric to the axis about which the body tilts, of a smoke disposal system comprising a duct having a terminal which is slidably mated with the end of said nozzle on the furnace when the furnace is in normal operating position, a suction fan with which the duct communicates, a discharge duct leading from the fan, and means in said system for cleaning the smoke.

6. The invention defined in claim 5 wherein the pressure-responsive means is connected to the furnace, and means controlled by said pressure-responsive means for effectively varying the suction of the fan.

7. The invention defined in claim 5 wherein a pressure-responsive means is connected to the interior of the furnace, and means operated by the pressure-responsive means for varying the speed of the fan to increase the speed when the volume of smoke is increased, and decrease the speed when the volume of smoke is reduced.

8. The invention defined in claim 5 wherein the smoke disposal system includes means responsive to pressure changes in the furnace for regulating the suction effect of the exhaust fan.

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