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H. G. CHICKERING

SULPHUR BURNER

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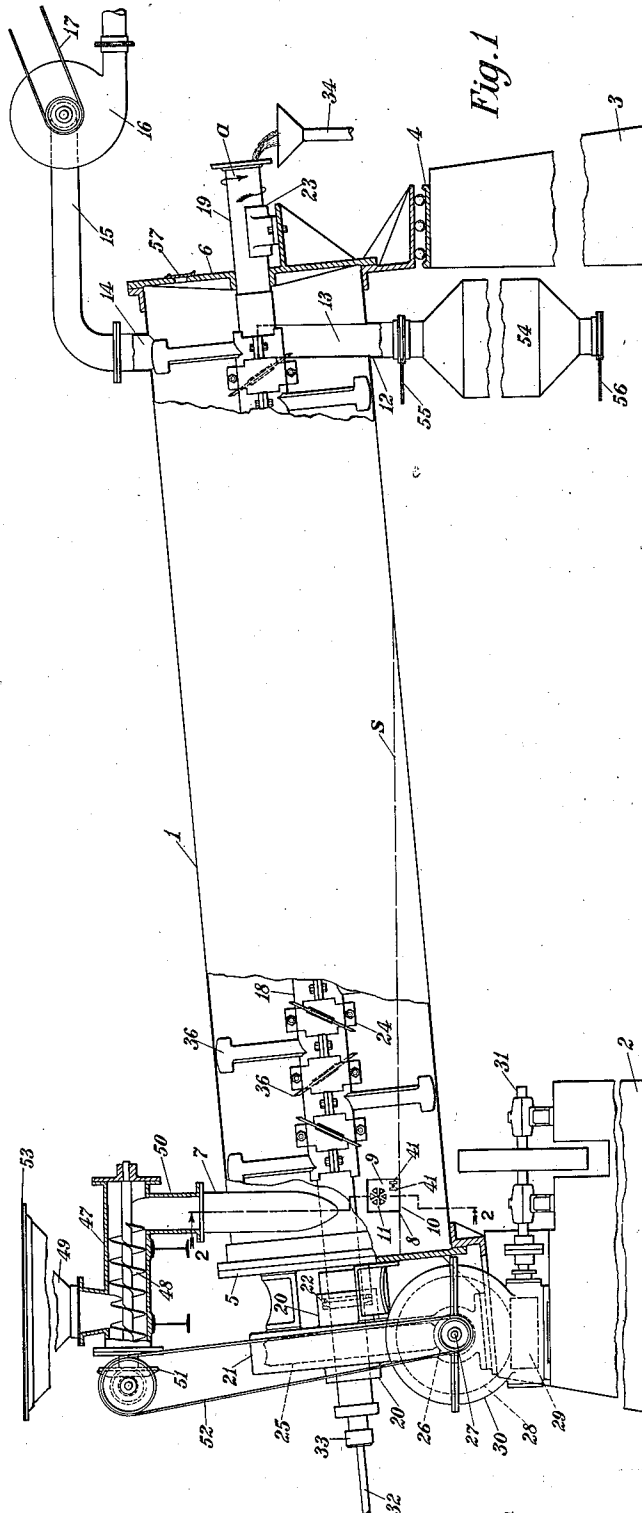


Fig. 1

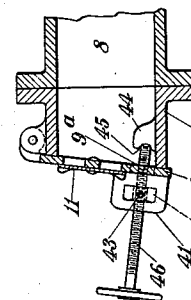


Fig. 4

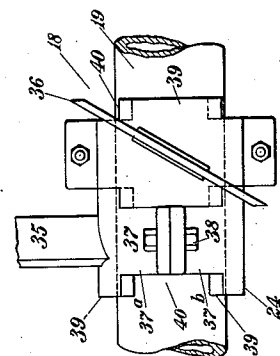


Fig. 3

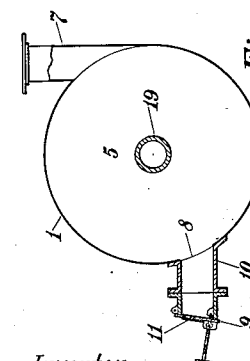


Fig. 2

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UNITED STATES PATENT OFFICE.

HORACE G. CHICKERING, OF WILMINGTON, DELAWARE, ASSIGNOR TO E. I. DU PONT DE NEMOURS & COMPANY, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

SULPHUR BURNER.

Application filed May 13, 1922. Serial No. 560,677.

To all whom it may concern:

Be it known that I, HORACE G. CHICKERING, a citizen of the United States, and a resident of Wilmington, in the county of New Castle and State of Delaware, have invented a certain new and useful Sulphur Burner, of which the following is a specification.

This invention relates to sulphur burners and particularly relates to a continuous burner for sulphur high in ash.

In the manufacture of sulphuric acid, wherein crude sulphur is burned to provide the sulphur dioxide used, it is frequently desired, for reasons of economy, availability of supply and the like, to use sulphur high in ash. For example crude Bolivian sulphur contains as high as 15% ash, and it is often desired to use this. But sulphur burners of the usual types cannot satisfactorily be used for the burning of sulphur of such grade, this being particularly true where it is purposed to run the burner continuously for long periods. With the burner of the present invention, sulphur high in ash can be burned continuously without difficulty from choking with ash, incomplete combustion of the sulphur, frequent interruptions for cleaning, and so forth, and in the present burner, therefore, the difficulties of the ordinary types of burner are avoided.

It is an object of the invention to provide a sulphur burner having the desirable features mentioned. To this end, and also to improve generally upon burners of the character indicated, the invention consists in the various matters hereinafter described and claimed.

Without restricting the invention thereto it is described with more particular reference to the embodiment thereof illustrated in the accompanying drawings. In these drawings:—

Figure 1 is substantially a side elevation of the burner, certain parts, notably portions of the side of the burner shell, being broken out the better to show the construction;

Figure 2 is a sectional view taken on substantially the line 2—2 of Figure 1;

Figure 3 is a fragmental view of the conveyor showing the manner of mounting the conveyor units on the shaft, and

Figure 4 is an enlarged sectional view of

the air-port door taken substantially on a portion of the line 2—2 of Figure 1.

Referring now to the drawings, the illustrated burner comprises a stationary cylindrical shell, combustion chamber, or burner proper, 1; this shell is substantially inclined to the horizontal as indicated in Figure 1 thus to conveniently give its bottom a material longitudinal slope or inclination. Desirably the slope may be about one inch per foot of horizontal length (the shell may be about fifteen feet long). Preferably the shell is carried upon supports 2 and 3 with the support 3 having a greater height than the support 2. A roller bearing 4 is desirably used at the support 3 to provide for change in length of the shell under different temperatures. The ends of the shell are closed by heads 5 and 6 giving the combustion chamber the character of a drum.

Substantially at its top, and adjacent the lower end 5 thereof, the drum is provided with a sulphur inlet 7 which, as shown in Figure 2, enters tangentially at the forward (in Figure 1) side. In the rear (in Figure 1) side, somewhat above the bottom of the chamber, and near the lower end at substantially opposite the point of arrival of the sulphur charged through the inlet 7, is provided a port 8 which serves both as a means for admitting air for combustion and as a means for the overflow of excess sulphur. The port 8 is controlled by a door 9 carried by and hinged to the port entrance 10. As shown the door is provided with a rotary-segmental-plate valve, or "stove door register", 11.

Adjacent the upper end 6 of the drum is an ash outlet or discharge 12 preferably connected tangentially at the rear (in Figure 1) side of the drum, as indicated at 13, the tangential connection extending substantially to the bottom of the drum. As indicated in Figure 1 by the line S, the overflow port 8 is so located, in relation to the slope of the bottom of the drum, that the liquid sulphur level is somewhat below the outlet 12, whereby overflow of the sulphur to the ash discharger, with loss of sulphur by the contamination of relatively small quantities of overflowing sulphur by relatively large quantities of ash, is guarded against.

Also adjacent the upper end of the drum but at its top is the sulphur dioxide outlet 14. To this is connected the conductor 15 for conducting the sulphur dioxide to any desired point. In the conductor is installed a suction fan 16 for drawing air into the chamber through the port 8 and removing the sulphur dioxide. The fan is designed to be continuously driven from any suitable prime mover (not shown), as by the belt-and-pulley 17.

A conveyor, designated generally 18, is axially mounted with respect to the drum, the rotatable shaft 19 thereof passing closely through the ends 5 and 6 and being borne by the radial bearings 20, 20 of the gear casing 21 and the thrust bearing 22, and by the radial saddle bearing 23. The shaft 19 carries a conveying element, made up of the units 24, which extends from somewhat in advance of the sulphur inlet 7 to the ash outlet 12, and is arranged to advance material up the chamber when rotated in the direction of the arrow *a*, i. e. rotated to carry the units 24 at the upper side of the shaft toward the observer (Figure 1). As will be noted, the units 24 are arranged and contoured to travel close to the surface of the shell. Conveniently the conveyor is rotated by the wormwheel 25, on the shaft 19, meshing worm 26 on the shaft 27, wormwheel 28 also on the shaft, and meshing worm 29, these various parts being carried in the casings 21 and 30 with the casing 30, containing the parts 28 and 29, lying forward, in Figure 1, of the casing 21. The worm 29 is driven by power from any suitable prime mover (not shown) applied to its shaft 31.

The shaft 19 is in the character of a pipe, as shown, with the blade or conveyor units 24 assembled thereon in non-rotatable relation thereto. This pipe construction provides for the water cooling of the shaft, which is highly desirable. A water inlet pipe 32 is coupled to the lower end of the shaft in a manner to give a water-tight joint permitting relative rotative movement between the shaft and pipe 32, a "steam joint" 33 being desirably used for this purpose. At the upper end of the shaft the cooling water may be merely discharged into an open drain, as 34.

As here illustrated, the blade units, heretofore designated generally as 24, are each made up of an arm 35 (Fig. 3), carrying the blade unit proper 36, and a hub 37. The hub is composed of halves 37^a and 37^b to be clamped tightly on the shaft 19 by binding means, as the bolts 38 at each side for drawing the halves toward each other and against the shaft. Desirably the several hubs are locked together against relative rotation by tongues 39 and corresponding tongue-receiving recesses 40 on immediately adjacent hubs, the hubs thus forming a continuous

sleeve clamped upon the shaft along its length. As shown, the blade units are arranged at 90°, giving four, equally spaced circumferentially, per 360°.

As indicated in Figure 1 the blade units proper 36 are of such length and location that their paths overlap somewhat. A conveyor composed of arms carrying a relatively narrow ribbon-like "blade" such as that made up by the plurality of narrow sections 36 is highly advantageous, as compared to a "full" blade such as used in the ordinary "full type" screw conveyor, as it does not substantially interfere with the flow of gases through the burner; but the leaving of a ridge of ash between the path of one blade and the path of the next should be provided against, else such a ridge may form, and slide toward the lower end of the shell, giving rise to various operating difficulties. The present conveyor, with its arm-supported narrow blade sections with those sections arranged to overlap, provides for non-interruption of the gas flow while at the same time preventing a ridge of ash liable to cause difficulties.

Returning now to the port 8 for the admission of air for combustion and the overflow of excess sulphur, the means for controlling the opening of the door 9 may preferably be as here shown. A pair of ears 41, 41 is provided upon the door and between these a nut 42 is carried by the pin type bearing members 43, carried by the ears, for oscillation about the axis determined by the members 43. An abutment block 44 is fixed within the opening 10 and has a seat 45. A hand screw 46 is screwed through the nut 42, passed freely through an aperture 9^a in the door, and seated in the seat 45. Evidently, by turning the screw the door 9 can be opened or closed as desired, the seat 45 and the permitted oscillation of the nut 42 providing for the called for changes in the relative positions of the screw and door.

The sulphur-feeding means for charging the sulphur into the inlet 7 may be of any type suitable for the desired ends. The illustrated feeding means is designed to continuously feed with substantial exclusion of air. It is of the screw-conveyor type and comprises the cylinder 47 with the rotating screw 48 therein and provided with the charging hopper 49 and the discharge pipe 50 connected with the inlet 7. Conveniently the screw is driven, in the direction to carry the sulphur from the hopper to the pipe 50, by the gearing 51 driven from the shaft 27 by the chain 52. If desired a cover 53 may be provided for the hopper for closing the same when it is intended to charge intermittently, or empty the hopper and casing of sulphur between charges.

That the ash may be discharged without access of air, the outlet pipe 12 preferably

discharges into a receiver 54 having the upper and lower closures or gates 55 and 56, desirably of the sliding plate type. With this arrangement, with the gate 55 open and the gate 56 closed the ash is discharged into the receiver 54 and when it is wished to empty the receiver the gate 55 is closed and the gate 56 opened.

The operation of the burner should be substantially evident from the above description but is briefly reviewed:—Sulphur is supplied by the feeder 47—49 in sufficient quantity to form a puddle of molten sulphur extending to somewhat short of the ash outlet 12, as indicated by the lines; the inclination of the burner bottom provides for the formation of this puddle. At the start of the operation the first sulphur charged in is ignited by a gas flame, or in some other convenient and suitable manner; but after the operation is under way the burning sulphur in the burner of course ignites the added charges. The rotating conveyor continuously carries the ash up the incline and into the discharger 12, acting somewhat as a skimmer. The air entering at the inlet 8 is at once heated by the burning sulphur—it is to be noted that the air enters close to the surface of the sulphur—and not only supports combustion but in its passage along the burner assists in distilling off the sulphur from the ash, whereby any hindering of the combustion by the ash interfering with the ready access of the air to the sulphur is avoided. In the meantime the air is drawn in at the inlet 8, and the sulphur dioxide drawn out at 14 by the fan 16. Should for any reason, as excessive charging of sulphur, the sulphur puddle tend to reach too far along the burner, the excess can escape at the port 8 rather than flowing into the ash in the receiver. In normal operation there is of course substantially no excess. The air supply is regulated by the adjustment of the valve 11 in the door 9, and, if need be, by the opening of the door, controlled by the screw 46. As occasion requires, the ash is removed from the receiver 54 by closing the normally open upper gate 55 and opening the gate 56. It will be seen that the present apparatus provides for the burning of sulphur high in ash in such a manner that the operation can be continuous, and the complications and difficulties which, because of that high ash, would be encountered were it attempted to burn such sulphur in a burner of the ordinary type, can be entirely avoided.

As will be understood by those skilled in the construction of furnaces and the like, such bolts, fastenings, and so on, as are required for the structure are provided, but for simplicity many such structural details are omitted from the drawings. If desired the shell may be provided with suitable lagging, as asbestos. Such peepholes and the

like (normally covered) may be provided as found desirable, preferably in the end of the shell as indicated at 57. Should circumstances recommend it the shell may be provided exteriorly with a spaced jacket shell giving a combustion-air warming chamber, the opposite ends of the chamber being connected one with the outer air and the other with the interior of the combustion chamber, and the connection with such chamber being at either end but preferably the upper end thereof, in which case the sulphur dioxide outlet would desirably be placed at the lower end.

I claim:

1. In a sulphur burner for continuous'y burning sulphur high in ash, in combination, a combustion chamber with its bottom inclined to provide a sulphur-puddle portion, means for charging sulphur into said chamber at the lower end of said portion, an ash discharger adjacent the upper end of said portion, a gas outlet and an air inlet spaced from each other along said chamber, and means immersed in the puddle upon said portion for continuously removing the ash therefrom and discharging the same into said ash discharger.

2. In a sulphur burner for continuously burning sulphur high in ash, in combination, a combustion chamber with its bottom inclined to provide a sulphur-puddle portion, means for charging sulphur into said chamber at the lower end of said portion, an ash discharger adjacent the upper end of said portion, a gas outlet and an air inlet spaced from each other along said chamber, means for forcing the travel of gases from said inlet through said outlet, and means immersed in the puddle upon said portion for continuously removing the ash therefrom and discharging the same into said ash discharger.

3. In a sulphur burner for continuously burning sulphur high in ash, in combination, a combustion chamber with its bottom inclined to provide a sulphur-puddle portion, means for continuously charging sulphur into said chamber at the lower end of said portion without access of air to said chamber, an ash discharger adjacent the upper end of said portion and provided with means for the removal of ash without access of air to said chamber, a gas outlet and an air inlet spaced from each other along said chamber, means for forcing the travel of gases from said inlet through said outlet, means for controlling the air supply to said inlet, and means immersed in the puddle upon said portion for continuously removing the ash therefrom and discharging the same into said ash discharger.

4. In a sulphur burner for continuously burning sulphur high in ash, in combination, a combustion chamber with its bottom in-

clined to provide a sulphur-puddle portion, means for charging sulphur into said chamber, an ash discharger adjacent the upper end of said portion, a liquid-sulphur overflow adjacent the lower end of said portion with its port to said chamber a substantial distance above said bottom, thereby to provide for a substantial puddle depth at the lower end of said portion, said port being at a less height than the entrance to said ash discharger thereby to provide for overflow through said overflow in avoidance of flow through said discharger, means for admitting air to said chamber, and means for removing sulphur dioxide therefrom.

5. In a sulphur burner for continuously burning sulphur high in ash, in combination, a combustion chamber in the character of a drum with its longitudinal axis inclined to provide for the formation and retention of a sulphur puddle upon the bottom of said chamber, means for feeding sulphur to the lower end of said chamber, an air inlet for said chamber adjacent the lower end thereof, a sulphur dioxide outlet adjacent the upper end thereof, an ash discharger adjacent the upper end of said chamber and communicating therewith beyond the intended upper margin of the puddle, and a screw conveyor mounted axially of said chamber with its screw immersed in said puddle for continuously removing the ash therefrom and discharging the same into the ash discharger.

6. In a sulphur burner for continuously burning sulphur high in ash, in combination, a combustion chamber in the character of a drum with its longitudinal axis inclined to provide for the formation and retention of a sulphur puddle upon the bottom of said

chamber, means for feeding sulphur to the lower end of said chamber, an air inlet for said chamber adjacent the lower end thereof, a sulphur dioxide outlet adjacent the upper end thereof, an ash discharger adjacent the upper end of said chamber and communicating therewith beyond the intended upper margin of the puddle, and a screw conveyor mounted axially of said chamber with its screw immersed in said puddle for continuously removing the ash therefrom and discharging the same into the ash discharger, said conveyor comprising a shaft with arms radiating therefrom and carrying screw-portions.

7. In a sulphur burner for continuously burning sulphur high in ash, in combination, a combustion chamber in the character of a drum with its longitudinal axis inclined to provide for the formation and retention of a sulphur puddle upon the bottom of said chamber, means for feeding sulphur to the lower end of said chamber, an air inlet for said chamber adjacent the lower end thereof, a sulphur dioxide outlet adjacent the upper end thereof, an ash discharger adjacent the upper end of said chamber and communicating therewith beyond the intended upper margin of the puddle, and a screw conveyor mounted axially of said chamber with its screw immersed in said puddle for continuously removing the ash therefrom and discharging the same into the ash discharger, said conveyor comprising a shaft with arms radiating therefrom and carrying screw-portions with said arms and portions relatively located to provide overlapping paths for said portions.

In testimony whereof I affix my signature.

HORACE G. CHICKERING.