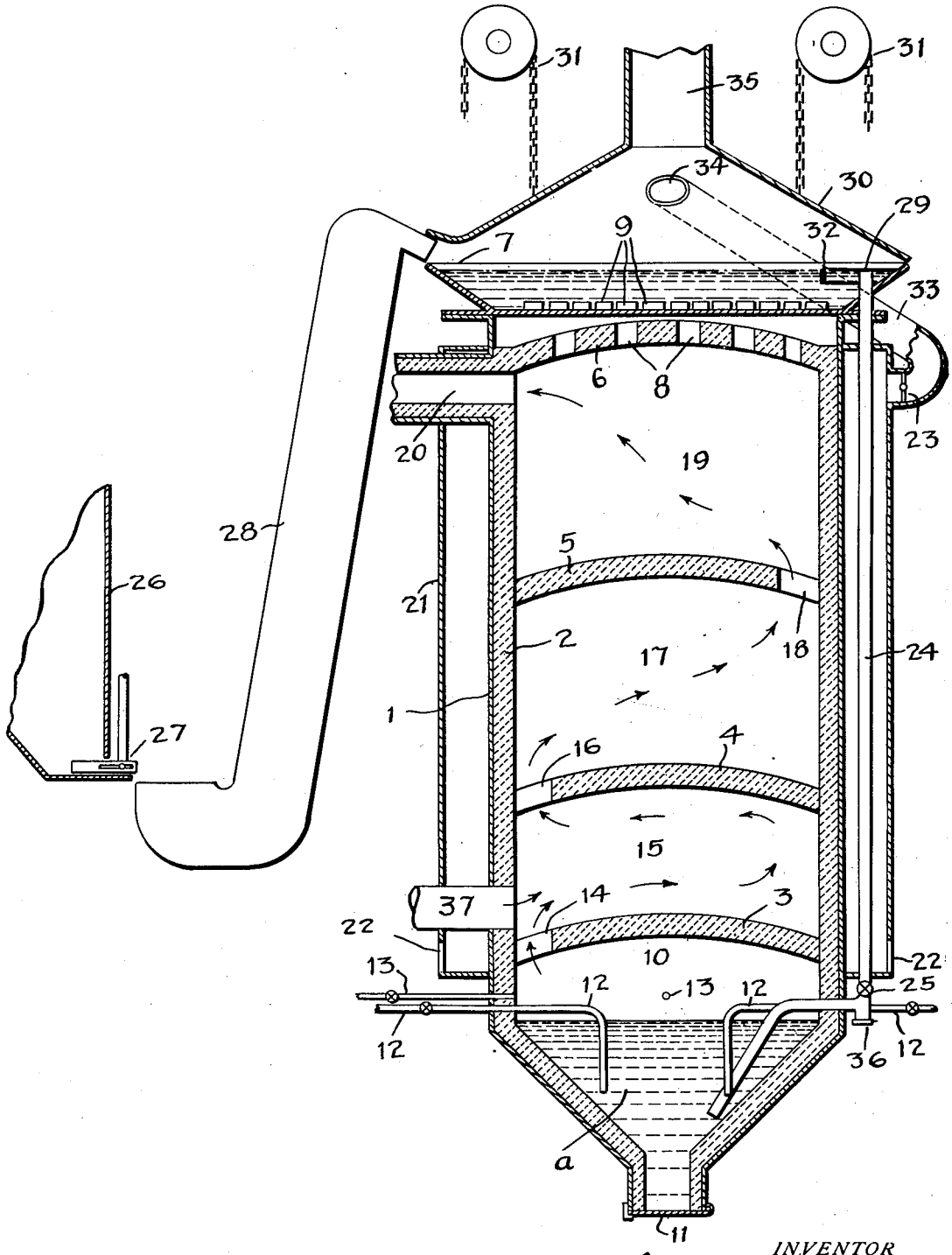
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SULPHUR BURNER

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SULPHUR BURNER

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The most important trend in modern sulphuric acid practice is in the direction of greater economy and efficiency of operation, because the slight margin of profit requires unusually large-scale production. To this end, there has been a notable effort to reduce or eliminate the elaborate, cumbersome and expensive purification equipment for the gases coming from the sulphur burners, either by some sort of pre-treatment of the available sulphur supply before it enters the burners, or by the use of catalysts of a type that will not be prejudicially affected by the impurities in the gases coming from the burners.

Since the so-called "continuously-operating" sulphur burners actually require more or less frequent shut-downs for cleaning out the accumulations of ashes in the burner itself, and are thus not actually continuous in operation, the effort has been made to mitigate the evil of ash accumulation in the burner and at the same time secure a better quality of sulphur dioxide gas coming from the burner by first melting the sulphur supply, thus permitting some or most of the impurities therein to pass off in the gaseous form, if they be volatile, or to settle out, if they be non-volatile, and then injecting under pressure a spray or mist of the liquid sulphur into the burner.

By these and similar or other means the objective of ash removal and gas purification has been attained in part, but only through the introduction of additional equipment, complicated and expensive, as, for example, in some types of burners which require the use of a steam boiler for generating the steam that is subsequently piped into steam-heated vessels for melting the sulphur, the boiler deriving its heat from a source wholly outside the burner itself or indirectly from the burner through the agency of the hot gases after their issuance from the combustion chamber. Also, the introduction of other accessory devices such as pumps for transferring the molten sulphur, injectors, etc., while they tend towards the elimination of the gas-purification equipment, all have the unfortunate effect of introducing other complications of expensive equipment into another part of the system, all of which, of course, must somehow be compensated by a relatively much greater gain in large-scale operating efficiency.

As opposed to this general trend of mere substituted complication, my invention is in the direction of utmost simplification, but with high operating efficiency at much less cost.

According to one part of my invention, the heat of the burner itself, heat which is ordinarily not conserved, is directly utilized for maintaining in a molten condition a sulphur supply in a pan or reservoir. From this pan the sulphur, freed of much of its impurities, may flow downward through a pipe under its own head of pressure, thereby forming a pool of molten sulphur within the base of the burner.

One or several air inlets preferably introduce blasts of air beneath the surface of the pool of molten burning sulphur, in addition to which air is preferably admitted over the pool. Here the sulphur is partially oxidized by the incoming air and partially sublimed. The gas with its entrained sulphur passes through an opening into a combustion chamber, meeting an incoming main supply of air, and is deflected by arches or baffles until the sulphur is all converted to SO_2.

The general construction comprises a compact vertical series of brickwork chambers and arches within a tight metal shell. The burner can be readily provided with an air jacket, to protect those in the vicinity from the intense heat and to secure the desired operating temperature in the burner. The reservoir or melting pan is preferably placed on top of this vertical burner, although it might be located elsewhere about the burner where the heat of the latter could be directly utilized for melting the sulphur and maintaining a molten supply.

The warmed jacket air is advantageously utilized to form a draft to carry away the fumes over the melting pot or pan, which is covered by an offtake hood capable of being raised in order that impurities may be removed from the supply of molten sulphur.

The accompanying drawing illustrates in vertical section a preferred embodiment of the burner, showing also a portion of a storage bin and indicating in elevation a suitable elevator conveyer.

Referring to this drawing, the burner,—which may be regarded as a combined melter, sublimer and combustion chamber, has a simple steel shell 1, preferably circular although it might be of other shape, lined with brick 2. Its dimensions may vary considerably. The burner contains a series of brick arches 3, 4 and 5, preferably three in number, in addition to the top arch 6, this top arch being pigeonholed in such manner as to afford sufficient heat, but not an excess, to the pan 7. The amount of heat applied to the bottom of the pan can be easily adjusted by the number of pigeonholes 8 which are left open or closed up, or light insulation may be put between the arch and the pan. This pan or kettle may be constructed of any suitable material, although I prefer to use cast-iron. It may be bolted or nutted to a flange of the shell 1, and its bottom is covered with loose brick 9, which may be ordinary brick, carborundum brick, or any other type most suitable for the purpose. By removing or putting back more or less of these loose brick, the heating of the sulphur in the pan can be regulated so as

to keep the sulphur in a readily flowable condition without danger of overheating.

The chamber 10 in the base of the burner, below the arch 3, is a subliming and primary burning chamber. This chamber preferably has a hopper bottom provided with a central clean-out opening tightly closed by a door 11. This chamber is designed to hold a pool of molten sulphur *a* constituting the immediate supply for burning.

A number of air-blast pipes 12 connected with a source of supply of air under pressure enter this chamber and are so disposed that their jet-delivering ends are below the surface of the pool. These jets multiply the burning surface of the molten sulphur and open up the scum which tends to form on the surface of the pool. Additional air is preferably admitted to this chamber, above the pool, through one or more air inlets 13.

The air admitted to the chamber 10 is limited to an amount which will not chill the reaction at this stage, and is much less than is required for oxidation of all the sulphur taken from the pool *a* to SO_2.

The gas formed in this chamber, carrying with it much sublimed and unconverted sulphur, rises through an opening 14 in arch 3. The gaseous mixture then circulates in a combustion chamber 15 between the arches 3 and 4, finding its outlet from this chamber through an opening 16 in the arch 4.

When the gas enters the chamber 14 it is met and deflected by a main air supply delivered under suitable pressure, preferably about five pounds, through an inlet 37 adjacent the opening 14. The air inlet 37 is preferably connected with a source of supply of air under pressure less than that supplied to the jet pipes 12 (in other words, the pressure of air to the pipes 12 is boosted sufficiently), and the amount of air admitted to the chamber 15 is considerably greater than the total amount which enters the chamber 10.

The burning mixture of air and gas passes from the chamber 15 through the opening 16 into a second combustion chamber 17, and from this chamber it flows through an opening 18 into a final combustion chamber 19 beneath the top arch 6. An offtake 20 from the upper portion of this chamber conducts away the sulphur dioxide gas, nitrogen and the uncombined oxygen which remains.

The chambers 15, 17 and 19 may be regarded as divisions of a combustion chamber. Air may be admitted to one or more of these chambers or divisions.

The shell of the burner is surrounded, from the top to about the level of the arch 3, by an air jacket 21, having inlets 22 for atmospheric air at the bottom and a dampened outlet 23 for heated air at the upper end. The circulation of air through this jacket is adjustable so as to keep optimum working temperatures in the burner and also to provide a fairly definite temperature inside the jacket for the purpose of keeping the molten sulphur in free flowing condition in a feed pipe 24 which leads downward from the pan 7 to the basin of the chamber 10, this pipe extending for the greater part of its length within the air jacket. Molten sulphur is free-flowing at low and at high temperatures, but at intermediate temperatures will not flow readily under static head. The air jacket lends itself most advantageously to keeping the column of liquid sulphur in the downtake in a free flowing condition. However, other means or arrangements may be employed for this purpose. A valve 25 may be provided for regulating the feed of molten sulphur through the pipe to maintain the pool *a* at the proper level.

The raw sulphur is preferably stored in a bin 26 at one side of the burner, and is delivered by any suitable regulator 27, such as a knife-feed, reciprocating or plunger-feed, star-feed, or the like, adjusted to the requirement of the melter pan 7, to an elevator 28 which carries the sulphur and deposits it in the pan at one side thereof. The sulphur becomes sufficiently molten in its slow passage to the opposite side of the pan, where the overflow outlet 29 to the upper end of the feed pipe 24 is located. In this pan or reservoir opportunity is afforded for impurities in the sulphur to evolve as gas or to settle to the bottom. The open upper end of the pipe 24 located above the bottom of the pan determines the level and therefore the quantity of the molten sulphur supply from which the internal pool is fed.

The melting pan is provided with a cover or hood 30 for carrying away vapors, and this cover is raisable by means indicated at 31 to allow of the introduction of suitable tools for clearing away the accumulation of scum and impurities which collect on the surface of the molten sulphur and on the bottom of the pan. Such operations do not necessitate, and do avoid, interrupting the continuous operation of the burner.

A guard 32 surrounding the inlet 29 of pipe 24 and extending for a distance above and below the level of the molten supply, keeps scum impurities from reaching the gravity feed pipe.

The dampered outlet 23 from the air-jacket 21 is connected by a conduit 33 with the interior of the hood 30, discharging the warmed jacket air into the hood chamber at 34 so as to create a draft which aids in carrying off fumes through the duct 35 leading from the hood. It will be understood that the conduit 33 will be provided with flexibility or will be detachable so as to permit the raising of the hood.

A clean-out 36 is shown at a lower portion of the pipe 24 for clearing it in event of its becoming choked.

A sulphur burner such as has been described can be constructed at a moderate first cost and its maintenance charges are comparatively low. It also requires less ground space and less building to house it than do ordinary sulphur burners. Simplicity and efficiency, and the ability to operate continuously over very long periods without shut-down, are primary purposes of the invention.

My invention in sulphur burners is not limited to the use of air in the sublimer and/or combustion chambers, since oxygen, which is the active constituent of the air, or any suitable oxygen mixture, may be employed instead. Such references to air in the specification and claims are for convenience, and are to be understood in this general sense.

I claim:

1. In a sulphur burner, the combination of a reservoir adapted to contain a pool of molten sulphur, the reservoir being so positioned with respect to the burner that the sulphur in the reservoir is maintained molten by heat transmitted directly from the burner, a chamber in the burner, a pipe for feeding molten sulphur from the reservoir to the chamber, means for admitting combustion-supporting gas to the chamber, a combustion chamber disposed above said first-mentioned

chamber for burning the sulphur volatilized in the first-mentioned chamber.

2. A sulphur burner comprising a chamber adapted to contain a pool of molten sulphur, means for admitting combustion-supporting gas to the chamber, a sulphur-melting reservoir positioned in direct heat transfer relation with the burner so that the sulphur in the reservoir is maintained molten by heat transmitted from the burner, and a pipe for feeding molten sulphur from the reservoir to the chamber.

3. A sulphur burner comprising a shell, a chamber in the shell adapted to contain a pool of molten sulphur, means for admitting combustion-supporting gas to the chamber, a sulphur-melting reservoir positioned on top of said shell whereby the sulphur in the reservoir is maintained molten by heat transmitted directly from said burner, and a pipe for feeding molten sulphur from said reservoir to said chamber.

4. In a sulphur burner the combination of a reservoir adapted to contain a pool of molten sulphur, the reservoir being so positioned with respect to the burner that the sulphur in the reservoir is maintained molten by heat transmitted directly from the burner, a chamber in the burner, a pipe for feeding molten sulphur from the reservoir to the chamber, means for admitting combustion-supporting gas beneath the surface of the molten sulphur in the chamber, and a combustion chamber disposed above said first-mentioned chamber for burning the sulphur volatilized in the first-mentioned chamber.

5. In a sulphur burner, a chamber adapted to contain a pool of molten sulphur, means for introducing combustion-supporting gas beneath the surface of the sulphur in the pool, a reservoir adapted to contain a supply of molten sulphur, and means for feeding molten sulphur from the reservoir to said chamber.

6. A sulphur burner comprising a subliming chamber at the base thereof adapted to contain a pool of molten sulphur, means for supplying combustion-supporting gas to the subliming chamber, a series of combustion chambers arranged vertically over the subliming chamber and in communication therewith for burning in the presence of combustion-supporting gas the volatilized sulphur in the gases rising from the subliming chamber, a sulphur-melting reservoir on top of the burner arranged in heat transfer relation therewith, whereby the sulphur in said reservoir is maintained molten by heat transmitted from the burner, and means for feeding molten sulphur from the reservoir to the subliming chamber.

7. A sulphur burner comprising a subliming chamber at the base thereof adapted to contain a pool of molten sulphur, combustion chambers disposed immediately above the subliming chamber and in communication therewith, a sulphur-melting reservoir at the top of the burner arranged in heat transfer relation therewith, whereby the sulphur in the reservoir is maintained molten by heat transmitted directly from the burner, means for feeding raw sulphur to the reservoir, an air jacket about the burner, and a pipe extending downwardly within the air jacket for feeding molten sulphur from the reservoir to the subliming chamber.

8. A sulphur burner comprising a subliming chamber at the base thereof, a combustion chamber disposed immediately above the subliming chamber and in communication therewith, a sulphur-melting reservoir on top of the sulphur burner arranged so as to be heated directly by the heat of the sulphur burner whereby the sulphur in the reservoir is maintained molten, means for feeding raw sulphur to the reservoir, a pipe for feeding molten sulphur from the reservoir to the subliming chamber, a hood covering said reservoir for carrying away fumes from the melting sulphur therein, and means for raising the hood to permit removal of impurities from the reservoir.

9. A vertical sulphur burner comprising a subliming chamber at the base thereof, a combustion chamber disposed immediately above the subliming chamber and in communication therewith, a sulphur-melting reservoir on top of the burner arranged so as to be heated directly by the heat of the sulphur burner whereby sulphur in the reservoir is maintained in the molten condition, means for feeding raw sulphur to said reservoir, a pipe for feeding molten sulphur from the reservoir to the subliming chamber, a hood covering said reservoir for carrying away fumes from the melting sulphur, means for raising the hood to permit removal of impurities from the reservoir, an air jacket surrounding the sulphur burner, and means for conducting heated air from said jacket to the interior of the hood to create a draft for carrying off fumes.

10. A vertical sulphur burner comprising a subliming chamber at the base thereof adapted to contain a pool of molten sulphur, a combustion chamber disposed immediately above the subliming chamber and in communication therewith, means for feeding combustion-supporting gas to each of said chambers, an air jacket surrounding the combustion chamber, and means for regulating the flow of air through said air jacket.

11. A sulphur burner having a chamber adapted to contain a pool of molten sulphur, a sulphur-melting reservoir heated directly by the heat of the sulphur burner, means for delivering raw sulphur to said reservoir, and an overflow pipe for determining a level of molten sulphur in the reservoir and for feeding molten sulphur into the chamber.

12. A sulphur burner comprising a vertically disposed shell, a sublimer chamber in the bottom of the shell, a combustion chamber in the shell disposed above and communicating with the sublimer chamber, an air jacket surrounding the shell, a reservoir adapted to contain a supply of molten sulphur, and a pipe extending downward within said air jacket to feed molten sulphur from the reservoir to the sublimer chamber.

13. A sulphur burner comprising a vertically disposed shell, a chamber in the base of the shell adapted to contain a pool of molten sulphur, means for admitting combustion supporting gas to the chamber, a combustion chamber in the shell disposed above and communicating with said first mentioned chamber for burning the sulphur volatilized in the first mentioned chamber, a sulphur-melting reservoir positioned on top of said shell whereby the sulphur in the reservoir is maintained molten by heat transmitted directly from the combustion chamber, and a pipe for feeding sulphur from the reservoir to said first-mentioned chamber.

LOWRY GILLETT.