Aug. 14, 1923. 1,464,527

I. HECHENBLEIKNER ET AL

METHOD AND APPARATUS FOR PRODUCING SULPHUR COMPOUNDS

Filed Aug. 15, 1921 2 Sheets-Sheet 1

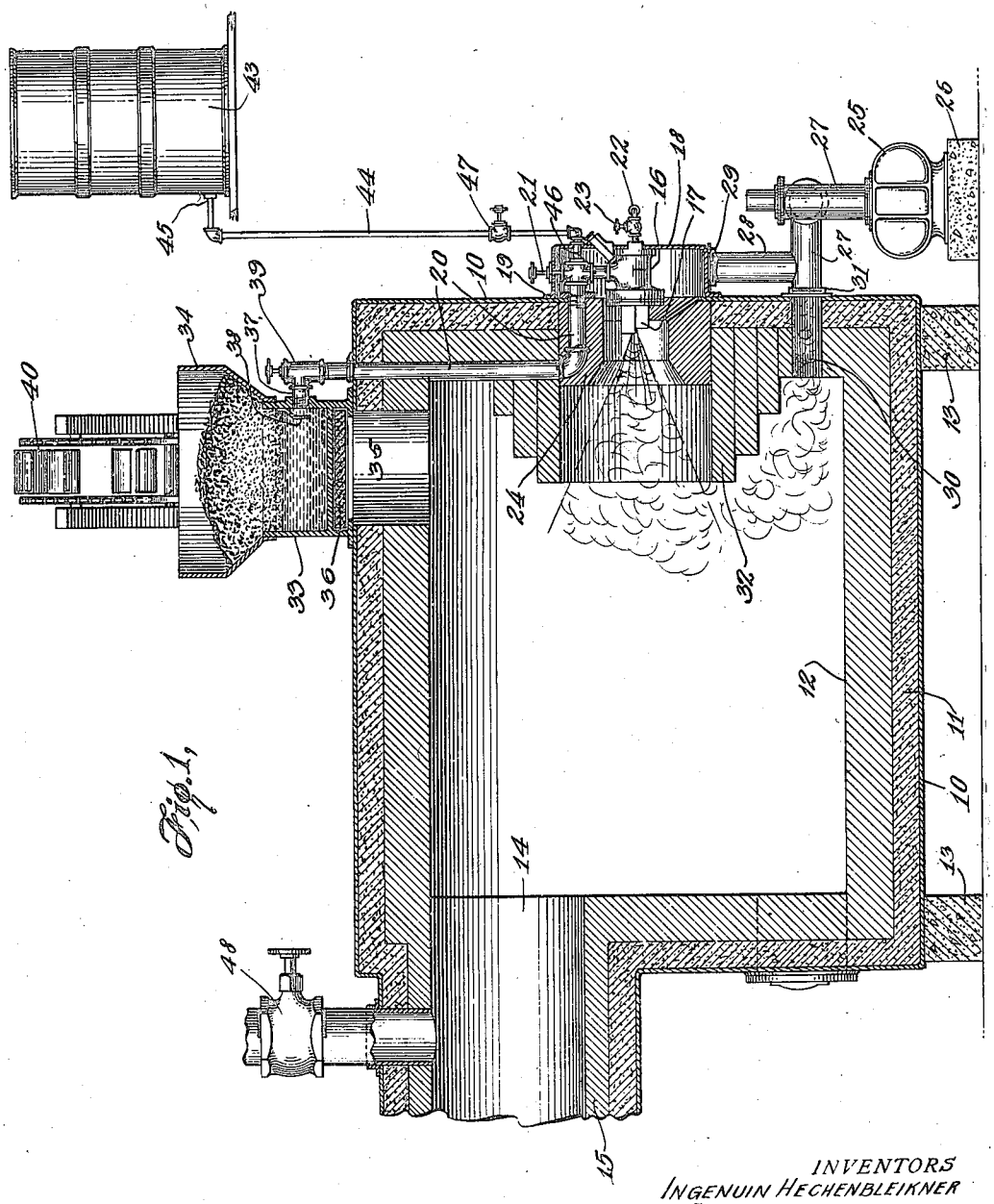


Fig. 1.

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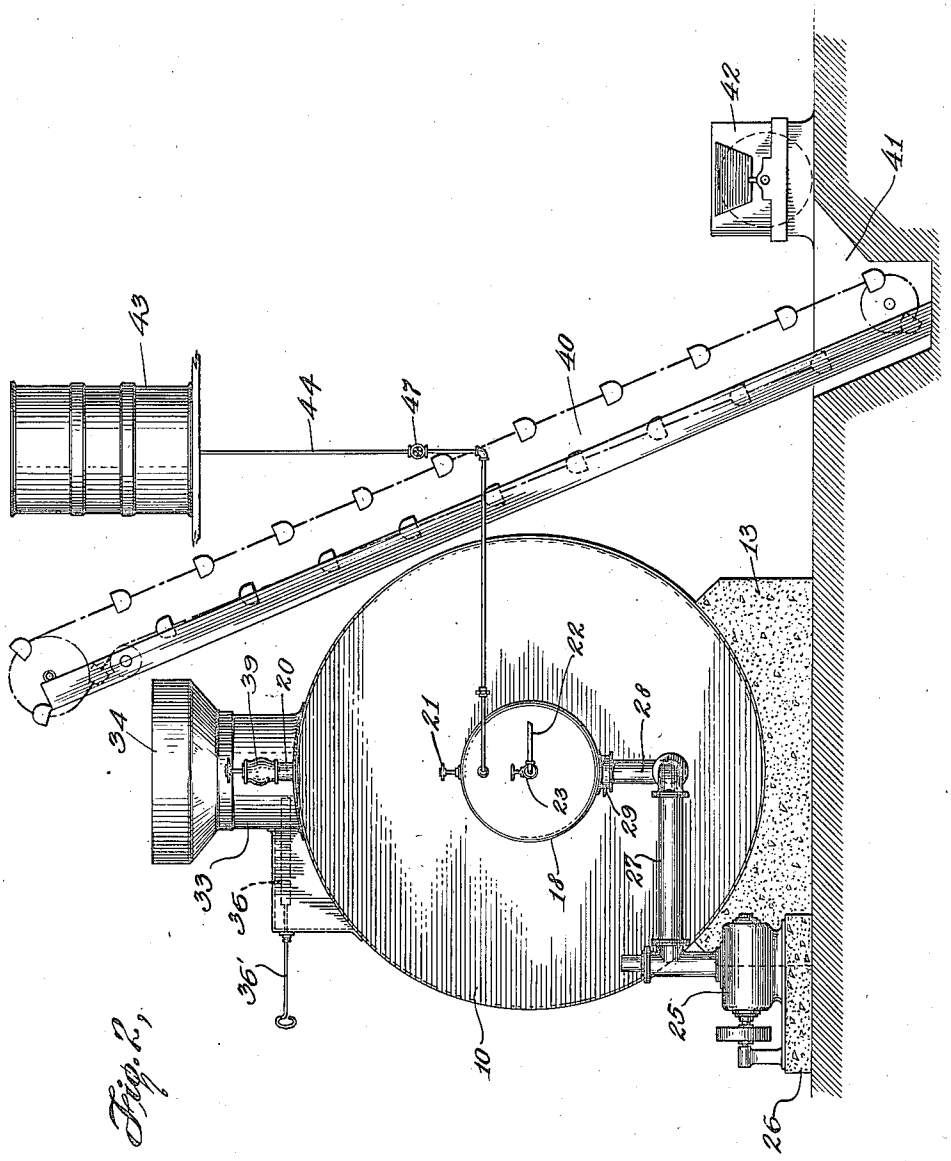


Fig. 2.

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Patented Aug. 14, 1923. 1,464,527

UNITED STATES PATENT OFFICE.

INGENUIN HECHENBLEIKNER AND THOMAS C. OLIVER, OF CHARLOTTE, NORTH CAROLINA, ASSIGNORS TO CHEMICAL CONSTRUCTION COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NORTH CAROLINA.

METHOD AND APPARATUS FOR PRODUCING SULPHUR COMPOUNDS.

Application filed August 15, 1921. Serial No. 492,369.

To all whom it may concern:

Be it known that we, INGENUIN HECHENBLEIKNER and THOMAS C. OLIVER, citizens of the United States, and both residents of Charlotte, in the county of Mecklenburg and State of North Carolina, have invented certain new and useful Improvements in Methods and Apparatus for Producing Sulphur Compounds, of which the following is a specification.

This invention relates to a method of and apparatus for producing sulphur compounds and more particularly to a method for producing sulphur dioxide gases and the furnace employed in the practice of the method; and has special reference to the provision of a furnace in which the production of the sulphur dioxide gases may be accomplished with the desired oxidation, concentration and temperature of the gases effectively controlled to suit the varying needs of service.

In the processes usually used for the generation or production of sulphur dioxide gases for use in the arts, sulphur ores are burned in the presence of a sufficient quantity of oxidizing fluid such as air, the sulphur being in this manner oxidized to produce sulphur dioxide. Methods hitherto employed and suggested range from the process involving the simple roasting of the sulphur ores in retorts through the process involving the burning of the ores while intimately mechanically mixing the sulphur with the air to effect a more rapid oxidation and a larger SO_2 yield, to the process suggested of effecting the intimate mixture of the sulphur and air by producing the sulphur in the form of an atomized spray after the manner employed in oil or tar burning processes. In all these methods an oxidizing fluid, usually air, is mixed with the sulphur, the mixing being controlled in some of the furnaces employed in the practice of the methods for the purpose of securing the desired sulphur combustion or oxidation. Although it is possible to control in these methods and furnaces the combustion of the sulphur, such combustion or oxidation cannot be properly controlled where other factors such as the temperature of the gases and the concentration or strength thereof are desired to be varied for various purposes in the arts. For example, where increased temperature of the gases is desired to be effected the supply of oxidizing fluid must be reduced, reduction of such supply having the detrimental effect of causing the sulphur to sublime or vaporize without being oxidized, combustion or oxidation being thus disadvantageously affected not only, but the sublimed sulphur, condensing on the walls and in the flues of the furnace, resulting in an undesirable clogging and a decreased efficiency of operation of the furnace. Where the temperatures are desired to be lowered, increasing the supply of oxidizing fluid to produce the lower temperatures has the effect of decreasing the strength or concentration of the gases, the attaining of low temperatures and high concentrations being thus impossible. Again, where lower concentrations of gases are desired, as for use, for example, in the sulphite process, increasing the supply of air to lower the resulting strength of the gases simultaneously decreases the resulting temperatures, gases of low concentration and high temperatures being thus impossible of attainment. Again, where high concentrations are desired, decrease of the air supply prevents the desired control of the combustion and temperature factors. With prior methods and prior furnaces, therefore, and with the factors of concentration, temperature and oxidation of the gases, all being interdependent functions of the air supply, it has been difficult and impossible to independently control the factors to meet the varying needs of service in the arts. We have therefore found it desirable to secure a method and provide an apparatus in which these factors may be independently controlled in an effective manner to the end of securing generated sulphur oxide gases of any desired concentration and temperature concomitant with the obtaining of perfect combustion and oxidation and our present invention has for its prime object the provision of a method and apparatus for accomplishing these ends.

The principal objects of our invention may be said to include, besides the provision of a method and apparatus for producing gaseous sulphur compounds such as sulphur dioxide, in which the concentration, temperature and combustion factors may be con-

trolled in various desired combinations, the further provision of a furnace employed in the practice of the method in which primary and secondary air supplies are utilized for effecting the desired control; the provision of a furnace in which primary and secondary air streams are introduced into the furnace, the flow of the air streams being so directed as to prevent interference with oxidation or combustion to the end of effecting the desired control of the concentration, temperature and oxidation factors not only, but the effecting of a uniform production of the gases possessing substantially uniform and constant characteristics of such factors; the further provision of a furnace of this nature in which the oxidizing fluid is thoroughly comixed with an atomized stream of sulphur introduced into the furnace, the sulphur being melted by the employment of heat radiated from the furnace; the further provision of a furnace in which the heat of the furnace is utilized to prevent solidification or congealing of the sulphur; the further provision of a furnace of this nature in which the same is preliminarily heated by a fuel burning system for raising the furnace to the desired temperatures most effective for the burning of sulphur and the further provision of a furnace in which the generated SO_2 gases are led from the furnace to other apparatus in a simple and inexpensive manner, the furnace having, furthermore, a minimum of moving parts insuring long life and a minimum of attention, thus involving low cost of installation and upkeep.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, our invention consists in the elements and their relation one to the other, as hereinafter particularly defined in the claims, reference being had to the accompanying drawings which show a preferred embodiment of our invention and in which:

Figure 1 is an elevational view in cross section of a furnace employed by us in the practice of our method, and

Figure 2 is a rear elevational view of the same.

Referring to the drawings, the combustion chamber of the furnace comprises an outer metallic shell 10 formed preferably of plate metal, the said shell being lined as at 11 with brick lining, the inner walls of the furnace being lined with fire brick as at 12, the furnace being supported in any convenient manner, as by means of the piers 13. The furnace is provided at preferably the upper end thereof with an opening or port 14 for the outward conduction of the gases generated in the furnace, and with a conduit 15 communicating with said opening and forming a duct for the passage of the said gases from the furnace and to other apparatus (not shown).

Located preferably at one end of the furnace we provide a sulphur burner 16 having a nozzle 17 communicating with the furnace chamber and opening into the interior thereof, the burner 16 being positioned at said furnace end as by being attached to a casing cover 18, the said casing cover being, in turn, attached to the rear wall of the outer metallic shell 10 of the funace, as shown at 19 in Figure 1 of the drawings. The burner 16 is intended for the reception of a body of molten sulphur, molten sulphur being conducted to the burner as by means of pipe sections 20 connected to the burner, a needle valve 21 being interposed in the line of connection for controlling the supply of sulphur to the burner. For the purpose of securing an intimate intermixture of the molten sulphur with an oxidizing fluid such as air, means is provided for producing an atomized spray of sulphur and for injecting such spray into the combustion chamber of the furnace. To this end we may employ a jet of compressed air or steam active on the body of sulphur in the burner structure 16 for ejecting the same into the combustion chamber of the furnace in the form of the desired atomized stream. This may be accomplished by introducing into the burner structure 16 a jet of air or steam, preferably under pressure, the air or steam being conducted to the burner as by means of piping 22, a valve 23 being preferably inserted in said piping for controlling the volume and pressure of the air or steam jet.

For the purpose of effecting oxidation or combustion of the sulphur, a stream of oxidizing fluid is introduced into the combustion chamber, the flow of the oxidizing fluid being preferably in the direction of the flow of the atomized sulphur spray. To this end the casing cover 18 may comprise a means for receiving a primary oxidizing fluid such as air under pressure, the annular space defined by the nozzle 17 and an annular fire ring 24 built in the walls of the combustion chamber providing means for conducting or leading the primary air under pressure into the combustion chamber for intimate comixture with the sulphur spray injected into the said chamber in a manner as will be apparent from a consideration of Figure 1 of the drawings. The comixture of the primary oxidizing fluid and the sulphur spray is set into combustion in the activity of the furnace with the production of an extended flame of predetermined formation, as shown in Figure 1 of the drawings, the generation of sulphur dioxide gases being effected in this manner.

The oxidizing fluid or the primary source of air supply under pressure may be obtained as by means of a suction blower 25 suitably mounted on a foundation 26, the said blower having its induction end open

to atmosphere and being connected as by means of pipe sections 27 to a vertical pipe section 28 opening into the pressure casing 18, means being provided in the form of a regulating gate 29 for controlling the flow of the air under pressure for intermixture with the sulphur spray for combustion. Oxidation or combustion of the sulphur may be controlled by regulating the gate 29 for controlling the air supply and regulating the needle valve 21 for controlling the sulphur supply into the said furnace.

In prior furnaces, although oxidation could be controlled, such control was exercised at the expense of the concentration and temperature factors of the gases, the simultaneous control of all these factors in varying combinations being practically impossible of attainment. Thus, combinations of high temperatures with efficient oxidation or with low concentration or both, or low temperatures with high concentration or low concentration with high temperatures were practically unobtainable, the furnace not being capable of independent control as regards the concentration, temperature and oxidation factors. For the purpose of providing a furnace in which these factors may be independently controlled for the production of gases of any desired combination of characteristics we combine the primary air supply with a secondary source of air supply, these supplies being so regulated as to selectively effect the desired results. To these ends we provide means for conducting a secondary air flow into the combustion chamber, such means conveniently taking the form of the air duct 30 opening into the combustion chamber of the furnace and being connected preferably to the blower 25 through the conducting pipe sections 27, a second regulating gate 31 being provided in the line of connection, the gate 31 functioning for controlling the pressure and volume of the secondary air flow into the combustion chamber. With the provision of the secondary source of air supply and the means for controlling the flow of the same in conjunction with the means for controlling the flow of the primary air supply into the combustion chamber, various combinations of characteristics as is desired to meet the different conditions of service may be accomplished. Thus, higher temperatures when desired may be effected by decreasing the primary air supply, the secondary air supply being increased for preventing sublimation of the sulphur, the sublimation or vaporization of the sulphur being a result concomitant with the reduction of the primary air supply. The secondary air supply thus serves, where high temperatures are desired to be effected, for completing or aiding oxidation in its prevention of sulphur sublimation. The concentration of the resulting gases may be simultaneously controlled by adjustment of the gate 31. Where lower temperatures are desired the primary air supply may be increased, the concentration factor being adjusted by means of controlling the secondary air supply. Where a low concentration is desired the high or low temperatures may be controlled by regulating the primary source of supply, the concentration being then regulated by controlling the secondary source of supply. Thus, sulphur dioxide gases of the desired concentration, temperature and oxidation may be obtained, the concentration and temperatures being controllable without detrimentally affecting oxidation or combustion.

For the purpose of providing a furnace where uniform characteristics of the gases of combustion both as respects temperature and the quantity generated per unit of time may be obtained, it is desirable that the induction of the secondary air, especially when under pressure, shall not disturb either the formation of the oxidizing flame or the oxidation of the gases taking place during combustion. In order to prevent disturbing the flame we preferably introduce the secondary air in such manner that the secondary air comes in contact with the flame and the gases of combustion only after the process of oxidation has gone so far that the completion of oxidation cannot be hindered. To this end we provide the secondary air inlet or duct 30 in the end wall of the furnace, as shown particularly in Figure 1 of the drawings, the inlet or duct being arranged to direct the secondary air into the interior of the combustion chamber so that such secondary air will come into contact with the flame without preventing sulphur oxidation. For the purpose of further effectively preventing any of the secondary air which is driven through the duct 30 under pressure, as hereinabove referred to, from coming into contact with that zone or portion of the flame where oxidation is taking place or where oxidation is in its formative stages, we further provide an annular baffle wall 32 arranged concentrically with the burner 16 and the fire ring 24, the said baffle wall extending into the interior of the combustion chamber a predetermined distance to further prevent the inflow or inrush of the secondary air from reaching the flame zone which should remain shielded. In this manner and by this means the secondary air may be introduced into the combustion chamber without affecting the essential formation and without affecting the nature of the fuel flame, it having been found that such introduction of the secondary air into the combustion chamber will permit the production of the gases of combustion in constant quantities per unit of time and at

a constant temperature, bringing about the desired uniform characteristics.

For the purpose of melting the sulphur prior to the conducting of same to the sulphur burner 16 we provide a receptacle 33 associated with the furnace, the said receptacle being provided with a hopper shaped top 34, the said receptacle being preferably mounted on the top of the furnace, as shown in the drawings, the receptacle being adapted to be heated by the heat radiated from the interior of the combustion chamber, the combustion chamber being conveniently provided for this purpose with a flue 35 over which the receptacle 33 is located. For the purpose of controlling the melting of the sulphur to effect the desired fluidity, the asbestos gate 36 controlled by the operating handle 36' may be conveniently provided and located between the flue 35 and the bottom of the receptacle 33. The receptacle 33 is intended for the reception of the raw sulphur product, the radiated heat from the furnace melting the same, the sediment settling to the bottom of the receptacle, the melted sulphur having exit through the pipe section 37 connected to the pipe section 20, a trap 38 being preferably provided to prefent any floating impurities from entering the feed lines 37 and 20 to the burner proper, the said feed lines being also preferably provided with a valve 39 for controlling the flow of the sulphur into the feed lines.

For the purpose of economy of construction and for preventing congealing of the sulphur in the pipe sections or feed lines 20, we preferably locate these feed lines 20 in the furnace, as shown in Figure 1 of the drawings, so as to be heated by the walls of the combustion chamber, the location being such as to prevent a too high heating of the sulphur in the feed lines to retain the desired fluidity of the melted sulphur.

For the purpose of feeding the raw sulphur product into the melting receptacle 33 we may provide a chain and bucket elevator 40 feeding the sulphur from a pit 41 and discharging the same into the hopper top construction 34, a clod breaker 42 being also preferably provided for breaking the sulphur ore or other product prior to discharging the same into the pit 41.

Preliminary to the burning of the sulphur to sulphur dioxide it is desirable to heat the furnace to the desired operating temperature for the purpose of securing an initial efficient combustion of sulphur and for the further purpose of melting the sulphur and feeding the same in proper fluid condition to the sulphur burner. To accomplish this end we preferably provide a fuel burning system associated with the furnace adapted to be operated as a preliminary step to bring the furnace to the desired temperature. This may be accomplished by providing an elevated oil tank 43 and by providing piping 44, connected at one end 45 to the oil tank and connected at its other end 46 to the burner 16 for conducting an oil fuel to the burner 16 for comixture with the supply of pressure air for purposes of combustion at the initial stage of operation of the furnace, the valve 47 being provided in the piping 44 for shutting off the supply of the oil fuel when the desired temperature is attained, opening of valve 21 then effecting feeding of the sulphur into the burner for the combustion hereinbefore described. For the purpose of preventing the gases of combustion resulting from burning the oil fuel from being conducted to the apparatus connected to the furnace and for the further purpose of supplying an initial draft in the combustion chamber for use with the oil fuel, the relief valve 48 opening into the conduit 15 may be provided.

The operation and use of our furnace and the practice of our method will be, in the main, apparent from the above detailed description thereof. For preliminarily heating the furnace the oil fuel supply 43 is utilized, the fuel being conducted through the piping 44 and to the burner 16 for comixture with the primary source of air supply, combustion of the intermixture being utilized for preheating the furnace and for melting the sulphur in the receptacle 33. When the desired preheating is obtained the supply of oil fuel is turned off by means of valve 47, valves 39 and 21 being then controlled for feeding the sulphur to the burner 16, the sulphur being injected into the combustion chamber in the form of an atomized spray by the employment of a jet of steam or air injected into the burner 16 through the piping 22, the steam or air jet being controlled by the valve 23. The primary source of air supply is regulated by means of the gate valve 29 to effect the desired comixture of the atomized sulphur spray and the oxidizing fluid for effecting the desired combustion. The secondary source of air supply flowing into the combustion chamber through the inlet 30 is controlled by the regulating valve 31, the regulation of the valves and gates being utilized for obtaining any desired combination of characteristics of the sulphur dioxide gases produced, as hereinabove described in detail. The primary and secondary air supplies are obtained by means of the positive pressure blower 25, this blower feeding the air streams to the combustion chamber under pressure, such pressure being controllable, in addition to the regulating gates, by the speed of operation of the blower, this control being exercised when it is desired to overcome any back pressure, as it is often desired to burn the sulphur under and against a pressure.

It will be apparent from the foregoing that we have provided a method and apparatus in which gaseous compounds of sulphur, such as sulphur dioxide, may be produced in a simple and in an efficient manner to meet the various desired conditions or needs of service in the arts, the gases produced having the factors of concentration, temperature and oxidation independently controlled and controlled in a facile manner for the production of the gases of the desired combination of characteristics, the resulting gases produced having, furthermore, uniform characteristics.

While we have shown our device in the preferred form, it will be obvious that many changes and modifications may be made in the structure disclosed without departing from the spirit of the invention, defined in the following claims.

We claim:

1. The method of producing sulphur compounds which consists in melting a body of sulphur, in atomizing the same by means of a fluid jet, in introducing a stream of the atomized sulphur into a furnace chamber, in conducting into said chamber a primary oxidizing fluid in intermixing relationship with and in the same general direction of movement of said stream for combustion to produce gaseous sulphur compounds and in comixing the gaseous compounds of combustion with a secondary fluid.

2. The method of producing sulphur compounds which consists in melting a body of sulphur, in atomizing the same by means of a fluid jet, in introducing a stream of the atomized sulphur into a furnace chamber, in conducting into said chamber and surrounding said stream a primary oxidizing fluid in intermixing relationship with said stream for combustion to produce gaseous sulphur compounds and in intermixing the gaseous compounds of combustion with a secondary fluid in said chamber.

3. The method of producing sulphur compounds which consists in atomizing sulphur by means of a fluid jet, in introducing a stream of the atomized sulphur into a furnace chamber, in conducting into said chamber a primary oxidizing fluid in intermixing relationship with and in the same general direction of movement of said stream for combustion to produce gaseous sulphur compounds, and in commixing the gaseous compounds of combustion with a secondary fluid.

4. The method of producing sulphur compounds which consists in conducting an atomized sulphur stream and a primary oxidizing fluid in intermixing relationship for combustion and for the production of an oxidizing flame of predetermined formation and in conducting a secondary fluid for contact with the flame and for intermixture with the gases of combustion, the conduction of the secondary fluid being so directed that the flow of the secondary fluid will not distort the said predetermined flame formation.

5. The method of producing sulphur compounds which consists in atomizing sulphur by means of a fluid jet, in conducting a stream of the atomized sulphur and a primary oxidizing fluid in intermixing relationship for oxidation and combustion and in conducting a secondary fluid for contact with the resulting flame and for intermixture with the gases of combustion, the conduction of the secondary fluid being so directed that the flow of the secondary fluid will not interfere with the oxidation of the sulphur by the said primary oxidizing fluid.

6. The method of producing sulphur compounds which consists in providing a furnace, in utilizing the heat of the furnace for melting a body of sulphur, in introducing the molten sulphur in an atomized stream into the said furnace by means of a fluid jet, in conducting into said furnace a primary oxidizing fluid in intermixing relationship with and in the same direction of movement of said stream for combustion to produce gaseous sulphur compounds and in introducing into the said furnace a secondary fluid in comixing relationship with the said gaseous compounds of combustion.

7. The method of producing sulphur compounds which consists in providing a furnace, in utilizing the heat of the furnace for melting a body of sulphur, in introducing the molten sulphur in an atomized stream into the said furnace by means of a fluid jet, in conducting into said furnace a primary oxidizing fluid under pressure in intermixing relationship with and in the same direction of movement of said stream for combustion to produce gaseous sulphur compounds and in introducing into the said furnace a secondary fluid under pressure in comixing relationship with the said gaseous compounds of combustion.

8. A sulphur burning furnace comprising a combustion chamber, means for atomizing a body of sulphur by a fluid jet and introducing a stream of the atomized sulphur into said chamber, means for introducing a primary oxidizing fluid in the general direction of movement of and into comixing relation with the atomized sulphur stream for combustion and means for comixing the resulting gases of combustion with a secondary fluid.

9. A sulphur burning furnace comprising a combustion chamber, means for introducing a stream of atomized sulphur into said chamber, means for introducing a primary oxidizing fluid into comixing relation with the atomized sulphur stream for combustion and for the production of an oxidizing flame of predetermined formation, pro-

visions for introducing a secondary fluid into the said chamber for contact with the flame and for intermixture with the gases of combustion, the said provisions being constructed and arranged relative to the said means so that the inflow of the secondary fluid will not disturb oxidation.

10. A sulphur burning furnace comprising a combustion chamber, means for introducing a stream of the atomized sulphur into said chamber, means for introducing a primary oxidizing fluid into comixing relation with and surrounding the atomized sulphur stream for combustion and for the production of an oxidizing flame of predetermined formation, provisions for introducing a secondary fluid into the said chamber for contact with the flame and for intermixture with the gases of combustion, the said provisions being constructed and arranged relative to the said means so that the inflow of the secondary fluid will not disturb the said flame formation.

11. In a sulphur burning furnace, a combustion chamber, a sulphur burner including means for injecting into the furnace a stream of atomized sulphur, primary air inlet means communicating with said chamber and surrounding said burner, secondary air inlet means also communicating with said chamber and provisions between the said primary and secondary air inlet means operative for shielding the burner and the formative portion of its flame zone from a current of air flowing from said secondary inlet means.

12. In a sulphur burning furnace, a combustion chamber, a fuel burner including means for injecting into the furnace a stream of atomized sulphur, primary air inlet means surrounding the burner and communicating with the chamber, secondary air inlet means also communicating with the chamber and an annular baffle wall extending into the chamber and located between the primary and secondary air inlet means.

13. A sulphur burning furnace comprising a combustion chamber, means associated with said chamber for melting a body of sulphur, the association being such as to effect the melting of the sulphur by the heat radiated from said chamber, means for atomizing the molten sulphur by a fluid jet and for introducing a stream of the atomized sulphur into the said chamber, means for introducing a primary oxidizing fluid into comixing relation with the atomized sulphur stream for combustion and means for comixing the resulting gases of combustion with a secondary fluid.

14. A sulphur burning furnace comprising a combustion chamber, means associated with the said chamber for melting the sulphur, the sulphur being adapted to be melted by the heat radiated from said chamber, means for conducting the melted sulphur to the combustion chamber, said conducting means being also arranged to be heated by the heat from the said chamber, means for atomizing the sulphur by a fluid jet and introducing a stream of the atomized sulphur into the said chamber, means for introducing a primary oxidizing fluid into comixing relation with and surrounding the atomized sulphur stream for combustion and means for introducing a secondary fluid into said chamber for comixture with the gases of combustion.

15. A sulphur burning furnace comprising a combustion chamber, means for atomizing a body of sulphur by a fluid jet and introducing a stream of the atomized sulphur into said chamber, means for introducing a primary oxidizing fluid in the same general direction of movement of and into comixing relation with the atomized sulphur stream for combustion, means for comixing the resulting gases of combustion with a secondary fluid and means for controlling the flow of primary fluid into the said chamber.

16. A sulphur burning furnace comprising a combustion chamber, means for atomizing a body of sulphur by a fluid jet and introducing a stream of the atomized sulphur into said chamber, means for introducing a primary oxidizing fluid in the same general direction of movement of and into comixing relation with the atomized sulphur stream for combustion, means for introducing a secondary fluid into said chamber for comixture with the gases of combustion and means for independently controlling the flow of both the primary and the secondary fluids into the said combustion chamber.

Signed by the said INGENUIN HECHENBLEIKNER at Charlotte, in the county of Mecklenburg and State of North Carolina this 10th day of August, A. D. 1921.

INGENUIN HECHENBLEIKNER.

Signed by the said THOMAS C. OLIVER at New York, in the county of New York and State of New York, this 12th day of August, 1921.

THOMAS C. OLIVER.