C. B. CLARK.

SULFUR BURNING FURNACE.

APPLICATION FILED AUG. 7, 1908.

952,099.

Patented Mar. 15, 1910.

2 SHEETS—SHEET 1.

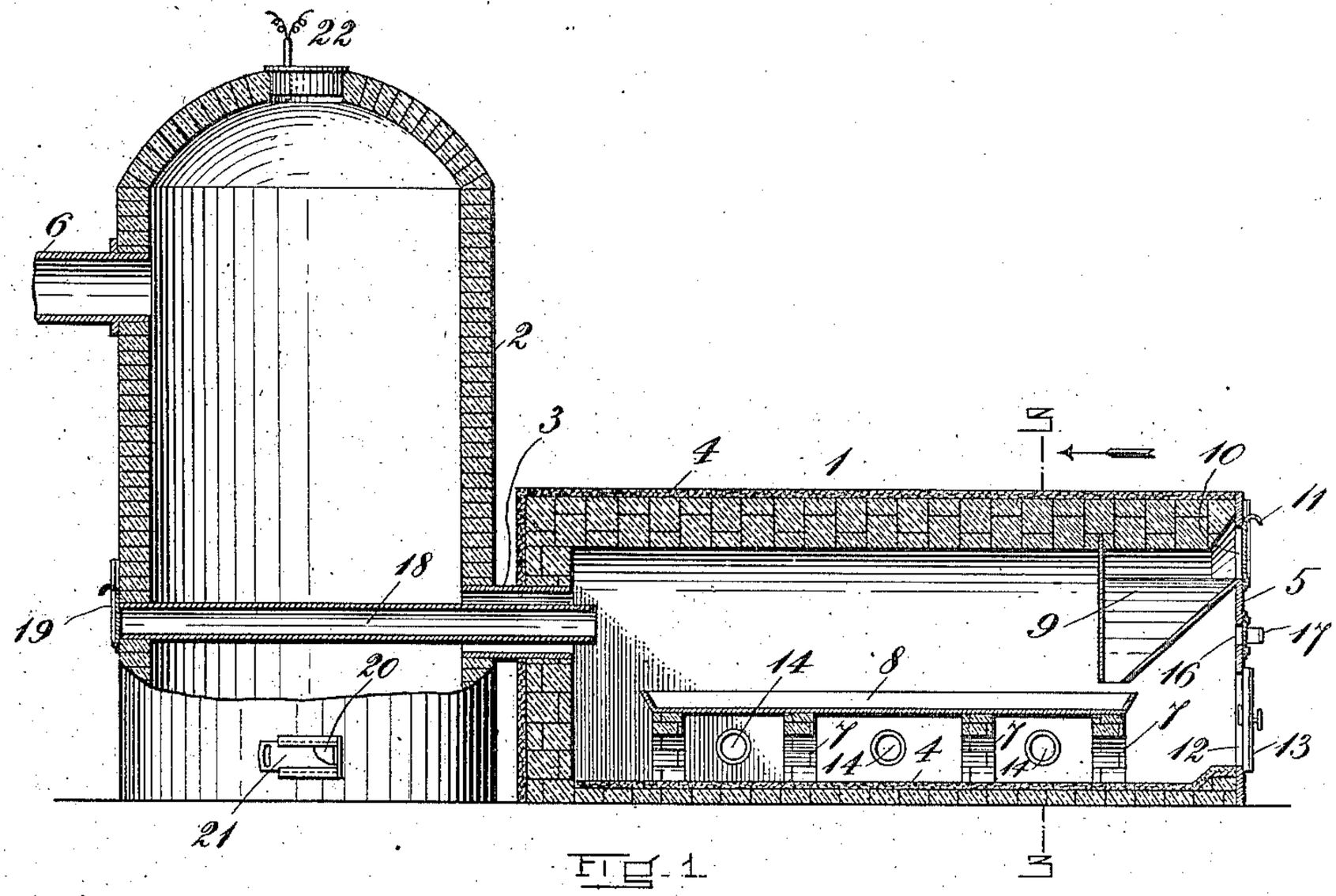

Fig. 1.

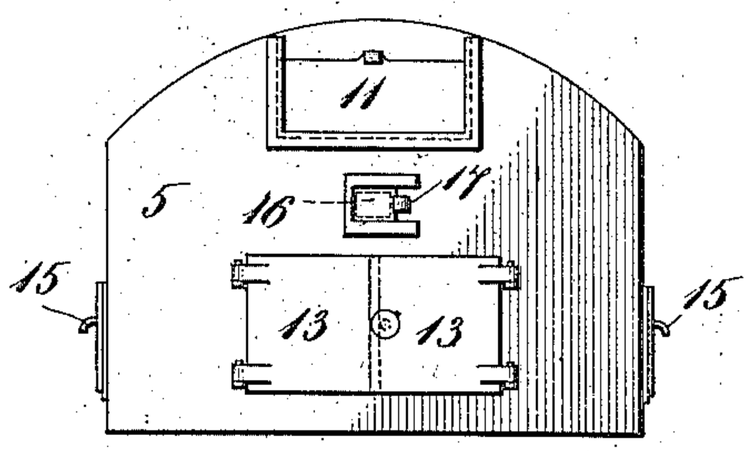

Fig. 2.

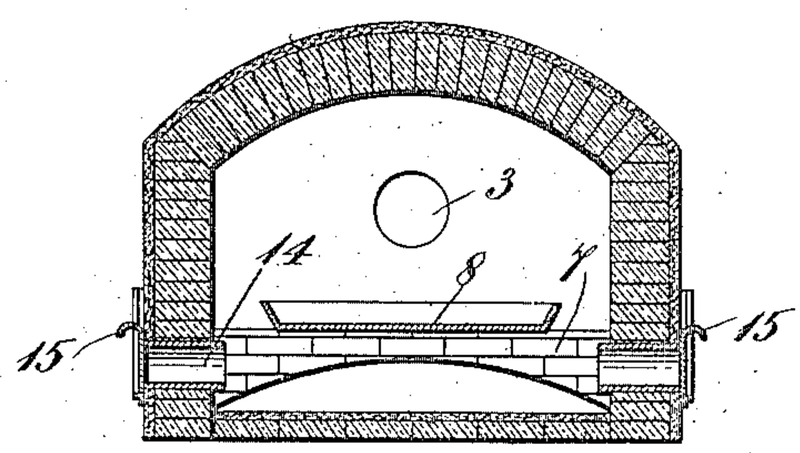

Fig. 3.

WITNESSES

M. D. Newman.

George Langton.

INVENTOR

Charles B. Clark

by his attys

Clarke Raymond & Cook

952,099.

C. B. CLARK.

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2 SHEETS—SHEET 2

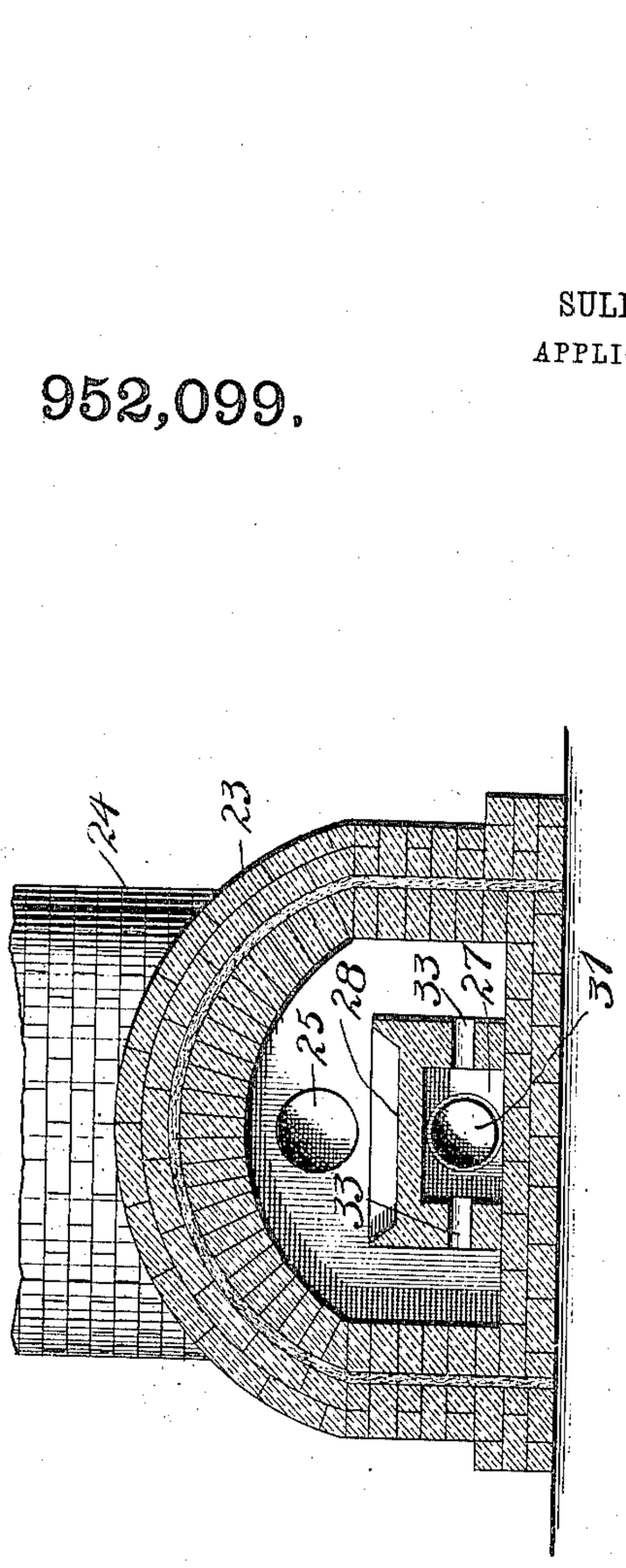

FIG. 5.

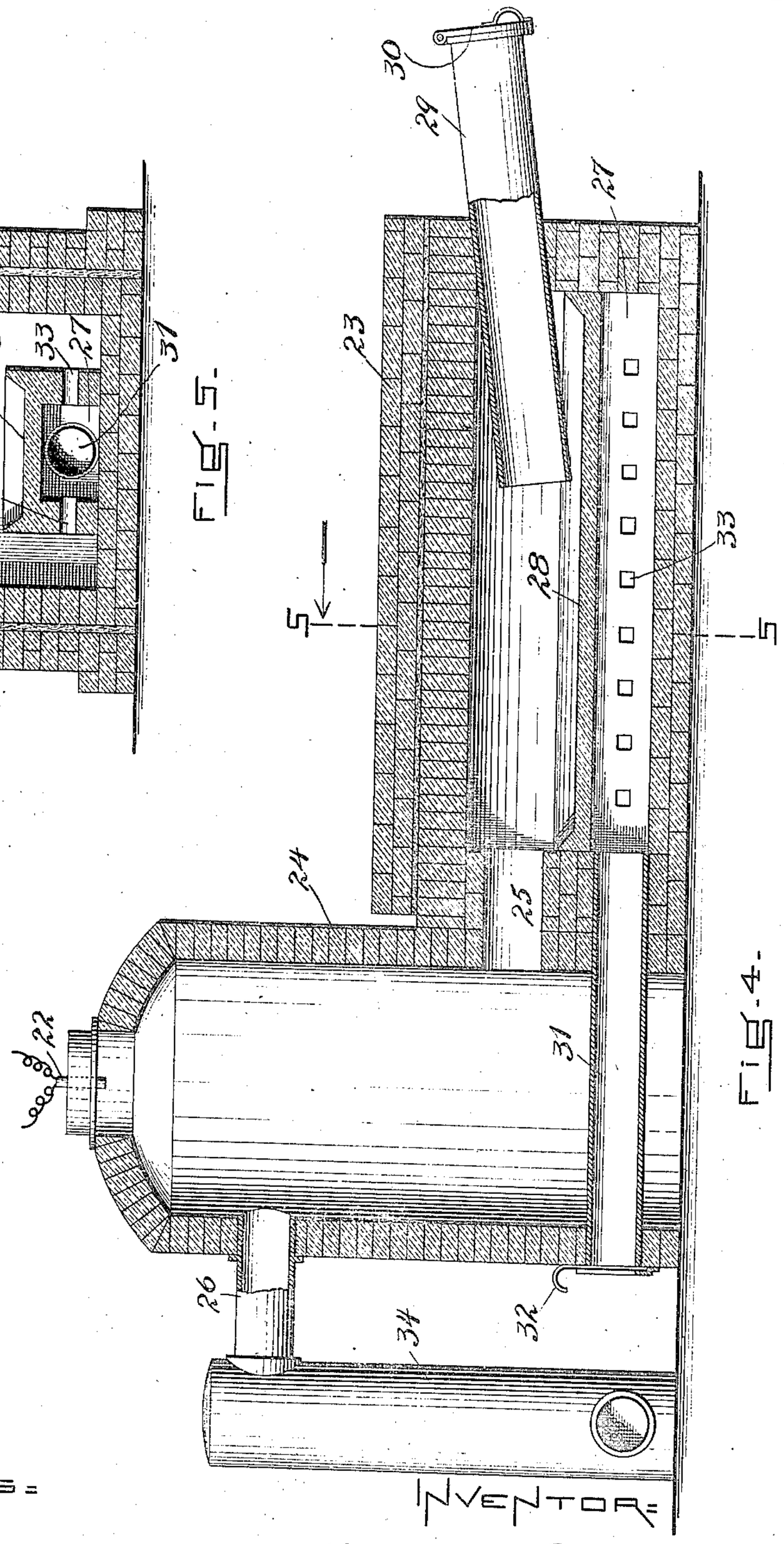

FIG. 4.

WITNESSES:

M. E. Flaherty.
W. O'Brien.

INVENTOR:

Charles B. Clark
by his atty
Charles Raymond Lacey

UNITED STATES PATENT OFFICE.

CHARLES B. CLARK, OF BANGOR, MAINE.

SULFUR-BURNING FURNACE.

952,099. Specification of Letters Patent. Patented Mar. 15, 1910.

Application filed August 7, 1908. Serial No. 447,350.

To all whom it may concern:

Be it known that I, CHARLES B. CLARK, of Bangor, in the county of Penobscot and State of Maine, a citizen of the United States, have invented a new and useful Improvement in Sulfur-Burning Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification, in explaining its nature.

My invention relates to an improvement in sulfur burning furnaces of that kind which are designed especially for making sulfur dioxid to be used in connection with the sulfite process of manufacturing wood pulp, and a furnace, also, especially adapted for practicing the process described in my copending application for Letters Patent of the United States, filed June 8, 1908, Serial No. 437,213, and appertaining to the same subject matter.

Among the essential objects of my invention are:—to provide a furnace capable of producing a large amount of sulfurous acid gas; to provide a furnace which in order to operate properly will not necessitate the employment of any auxiliary power to revolve or agitate it, but which furnace will be self-acting, or, in other words, complete in itself; to provide a furnace in which a small amount of sulfur trioxid will be produced relatively to the sulfur dioxid produced therein; to provide for the conversion of any sulfur trioxid that may form in the furnace into sulfur dioxid prior to its delivery or exit from the furnace through the pipes of any system in connection with which the furnace is used; and to provide also for the consumption and conversion into sulfur dioxid of any vaporized sulfur that may be unconsumed in the main body of the furnace or chamber where the sulfur is initially burned.

My invention will be understood by reference to the drawings in which—

Figure 1 shows the furnace mainly in cross vertical section. Fig. 2 shows an elevation of the front end of the body of the furnace. Fig. 3 is a section on the line 3—3 of Fig. 1. Fig. 4 shows mainly in vertical section a slightly modified embodiment of the furnace. Fig. 5 is a section on line 5—5 of Fig. 4.

1 represents the main body of the furnace or burner proper.

2 is a combustion chamber which connects with the rear end of the body 1 of the furnace by a connecting pipe 3.

The main body of the furnace comprises a structure made preferably arched, with walls formed mainly of firebrick or other heat-retaining substance, preferably coated with a layer of asbestos 4, as is also the floor of the chamber under the furnace body.

In Figs. 1–3, where I have represented the first embodiment of my invention, I have shown the face 5 of the furnace body as being made of metal plate for the reason that more convenient access is had through such a place into the interior of the furnace than through a wall formed of bricks. I prefer, however, as shown in Figs. 4 and 5, where there is represented another embodiment of my invention, that even the front wall of the furnace body be made of firebrick or other heat-retaining substance.

The combustion chamber 2 comprises a structure that preferably rises some distance above the main body of the furnace. This chamber like the body of the furnace is also preferably made of firebrick or other heat-retaining and acid proof material. The gases from the main body 1 of the furnace enter the combustion chamber by way of the connecting pipe 3 and pass out of the chamber by way of an outlet pipe 6.

Located within the chamber of the main body 1 of the furnace and supported by the sides thereof is a series of arches 7 made preferably of firebrick. These arches support a pan 8 raised above the floor of the chamber a sufficient amount to permit of the chamber being cleaned out between and underneath the supporting arches.

In the front of the body of the furnace emptying into the pan 8 is what may be termed a hopper 9 for into this hopper the sulfur to be burned is first deposited from outside the furnace from whence it passes into the pan 8. The sulfur is introduced into the burner by an opening 10 located in the face plate 5, which opening is controlled by a slide 11. Near the bottom of the face plate 5 is an opening 12 affording an inlet into the interior of the body of the furnace and providing a cleanout. This opening is controlled by doors 13.

Air is admitted into the interior of the furnace body by way of the openings 14 formed in the side walls of the furnace body

a little above the floor thereof. These openings are controlled from the outside by means of slides 15 by which a graduated amount of air may be admitted through the openings. Another opening 16 for admitting air is also preferably provided in the front or face plate 5, this opening being controlled by a slide 17.

Extending into the interior of the combustion chamber 2 from the outside thereof and preferably passing through the same and the connecting pipe 3 to enter into the rear end of the body of the furnace, is a pipe 18 which affords also another inlet for air. This pipe conducts the air entering through it to mingle intimately with the gases passing out of the body of the furnace into the combustion chamber. The open end of this pipe is controlled outside the combustion chamber by a gate or slide 19. At or near the base of the combustion chamber another air inlet 20 is also, preferably, provided. This opening or inlet is controlled from outside the combustion chamber by means of a gate or slide 21.

To determine the temperature in the combustion chamber a pyrometer 22 may be placed in the top thereof.

The operation is as follows:—The hopper 9 having been filled with sulfur and a portion thereof having passed into the pan 8 a fire of burning sulfur is made preferably on the floor of the furnace body beneath the pan. The heat causes the sulfur in the pan to melt and the pan soon becomes filled with hot melted sulfur. As the sulfur melts in the pan fresh sulfur will pass into the pan from the hopper 9 thereby tending to keep the pan full of melted sulfur. The pan being kept thus full, the sulfur tends to overflow the pan and drop onto the floor or hearth of the burner where it continues to burn with the effect that the sulfur burning on the floor is kept in a condition of constant agitation by the sulfur dripping from the pan. When the heat within the chamber of the burner, retained as it is by the brick walls of the chamber, becomes sufficiently high a considerable amount of sulfur will also burn in the pan itself or become vaporized therein. The heat will also cause more or less of the sulfur in the hopper to become melted before passing into the pan. The effect and working of all this is similar to that obtained with a revolving furnace but with the advantage that no power is required to operate the furnace. Though a large amount of sulfur dioxid will be formed in the main body or burner of the furnace, yet there will also be formed sulfur trioxid and unconsumed vaporized sulfur which will pass out of the chamber of the burner and enter the combustion chamber. These products are taken care of according to the process described in my said application, the sulfur vapor being consumed and the sulfur trioxid converted into sulfur dioxid and oxygen. The sulfur vapor is consumed through the admission of air to it by way of the air inlet pipe 18 which mingles with the vaporized sulfur in the chamber of the burner where its consumption is begun and passes with it into the combustion chamber where the combustion of the vapor is completed. The sulfur trioxid is decomposed or converted into sulfur dioxid and oxygen by the maintenance of a substantially constant and proper temperature within the combustion chamber, or in other words, such a temperature as will convert sulfur trioxid into sulfur dioxid and oxygen. This temperature is referred to in my said application as one approximating 1100° C., it being inadvisable to maintain a temperature below 950°. C. nor above 1200° C. though excellent results are obtained at a temperature maintained at about 1150° C. Now by the entry of air through the inlet pipe 18 supplemented by the opening or inlet 20 not only can a sufficient amount of air be introduced to effect the burning of the vaporized sulfur, but a proper temperature can also be maintained in the combustion chamber, for as the air enters through the inlet pipe 18, passing as it does through the combustion chamber, it will be heated by the gases therein so that when it ultimately mingles with these gases it will not appreciably affect their temperature and their temperature may be regulated by a relatively slight amount of air admitted through the air opening or inlet 20. If the air opening 20 is relied upon to let in air for burning the vaporized sulfur, or if for the same purpose an excess of air is let in through the air inlets or openings 7 in the body of the furnace it is impossible to maintain such temperature in the combustion chamber as will decompose the sulfur trioxid and there is danger also of converting much of the sulfur dioxid into sulfur trioxid. The amount of air admitted through the pipe 18 and opening 20 may be regulated by the gates or slides 19, 21, respectively.

Referring now to the further embodiment of my invention shown in Figs. 4 and 5: 23 represents the body of the furnace. This is substantially like the body 1 of the furnace shown in Fig. 1. 24 is the combustion chamber, the same as before described. 25 is the passage connecting the chamber inside the body of the furnace with the interior of the combustion chamber. 26 represents the outlet from the combustion chamber. Inside the body 23 of the furnace and extending longitudinally along the floor of the chamber thereof is a conduit 27 supporting a pan 28 formed in the top side thereof. Emptying into this pan is an in-

clined hopper 29 which extends through the front wall of the furnace and the outer end thereof is controlled by a door 30.

Communicating with the interior of the conduit 27 is an air inlet pipe 31 which extends through the combustion chamber. The open end of this pipe outside the combustion chamber is controlled by a slide 32. The air which is let in through the pipe 31 into the conduit passes out of the same into the chamber of the body 23 by way of the auxiliary passages 33 cut through the wall of the conduit and entering the chamber just above the bottom thereof. Attention is also directed to the drum 34 which lies back of the combustion chamber and just adjacent to the air inlet pipe 31 extending through the chamber and into which drum hot gases from the combustion chamber are directed from the outlet pipe 26. The drum is preferably made of wrought iron in order to withstand the excessive heat to which it is subjected.

The adaptation of the parts and operation of the furnace is as follows:—The sulfur is deposited in the tube or hopper 29 where it melts and runs down into the pan 28. In the first instance, if the furnace is started up cold, a small amount of sulfur is placed in the pan and there ignited for melting the sulfur in the tube. If, however, the furnace has not been shut down for too long a time, the heat retained in it is sufficient to melt the sulfur in the tube and cause it to run into the pan. The sulfur burns in the pan and a very large amount vaporizes therein. It frequently overflows the pan and burns on the hearth. In fact; the heat is so intense within the chamber that the sulfur will burn anywhere within the chamber either in the pan or outside of it, but the majority of it being burned in the pan.

The air for burning the sulfur is a heated air introduced by way of the pipe 31 which extends through the interior of the combustion chamber and connects with the conduit 27 beneath the pan, the air passing out into the main chamber of the body of the furnace by way of the auxiliary passages 33. Now the advantage of introducing a heated air into the chamber in the manner above described resides in the fact that I am enabled not only to induce the initial burning of the sulfur, but I am enabled also to admit sufficient air to burn the vaporized sulfur and at the same time to maintain a proper temperature in the combustion chamber for the purpose before described.

Another advantage of admitting a heated air into the main body of the furnace to induce the initial burning of the sulfur resides in the fact that very little sulfur trioxid will be formed. Sulfur trioxid cannot well be produced between 420 and 1100 degrees C., and so by burning the sulfur in air heated above 420° C., practically only sulfur dioxid will be obtained. Should sulfur trioxid be formed by the heat not quite reaching this point the heat retained by the combustion chamber will as before described decompose it into sulfur dioxid and oxygen. The advantage of having the hot gases from the combustion chamber pass into the drum 34 lying just adjacent to the air inlet pipe 31 resides in the fact that the air before it enters the pipe 31 must pass around the drum and accordingly becomes less and less heated before entering the air inlet pipe, which I have found to be of more or less practical benefit.

What I claim as my invention is

1. In a sulfur-burning furnace, the combination of a burner in which the sulfur is burned, a combustion chamber connecting therewith into which the gases and vapors from the burning sulfur are directed to pass and be confined before issuing from said chamber, means whereby air heated by the contents of the combustion chamber may be admitted to the chamber of the burner for inducing combustion therein and means also whereby air may be admitted for regulating the temperature of the contents of the combustion chamber, substantially as and for the purposes set forth.

2. In a sulfur-burning furnace, the combination of a burner in which the sulfur is burned, a combustion chamber connecting with said burner for receiving the hot gases and vapor from the burning sulfur, said combustion chamber having an opening therein by which air may be admitted into said chamber, and an air inlet pipe within said chamber in communication with the outside thereof for directing air passing through said pipe and heated by the contents of said chamber into the hot gases and vapor entering said chamber.

3. In a sulfur burning furnace, the combination of the body of the furnace having a chamber in which the sulfur is burned, a combustion chamber connecting with said body for receiving the hot gases and vapor from the burning sulfur, and an air inlet pipe of the furnace passing through said combustion chamber.

4. In a sulfur burning furnace, the combination of the body of the furnace having a chamber in which the sulfur is burned, a combustion chamber connected with said body to receive the hot gases and vapor from the burning sulfur, said combustion chamber having an outlet; an air inlet for regulating the temperature in said chamber, and an air inlet pipe passing through said chamber for delivering air into the chamber of said body of the furnace.

5. In a sulfur burning furnace, the combination with a burner having a chamber in which the sulfur is burned, of means where-

by air may be supplied for effecting an initial burning of the sulfur, a combustion chamber independent of said chamber of the burner and into which combustion chamber the gases and vapors from the initial burning of the sulfur are directed to pass, means whereby hot air may be supplied to commingle with the gases and vapors of the burning sulfur for inducing a consumption of the vaporized sulfur and whereby, also, a substantially constant high temperature may be maintained in the combustion chamber, and means whereby cool air may be admitted to said combustion chamber for controlling the temperature of the gases and vapors therein as occasion may require.

6. In a sulfur burning furnace, the combination of the body of the furnace having a chamber in which the sulfur is burned, a combustion chamber connecting therewith into which the gases and vapor from the burning sulfur are directed to pass, said combustion chamber having an outlet, and an air inlet pipe passing through said combustion chamber whereby the air entering the pipe may be heated by the gases in said combustion chamber, substantially as and for the purposes set forth.

7. In a sulfur burning furnace, the combination of the body of the furnace having a chamber in which the sulfur is burned, an air receiving conduit located in said chamber and opening into the same, a combustion chamber connecting with the chamber of said body into which the gases and vapor from the burning sulfur are directed to pass, said combustion chamber having an outlet and an air inlet pipe passing through said combustion chamber and connecting with said conduit.

8. In a sulfur burning furnace, the combination with a burner having a chamber in which the sulfur is burned, of means whereby air may be supplied for effecting an initial burning of the sulfur, a combustion chamber independent of said chamber of the burner and into which combustion chamber the gases and vapors from the initial burning of the sulfur are directed to pass, means whereby air heated by the hot gases and products of combustion may be supplied to commingle with the gases and vapors of the burning sulfur for inducing a consumption of the vaporized sulfur and whereby, also, a substantially constant high temperature may be maintained in the combustion chamber, and means whereby cool air may be admitted to said combustion chamber for controlling the temperature of the gases and vapors therein as occasion may require.

9. In a sulfur-burning furnace, the body of the furnace having a chamber in which the sulfur is burned, a pan located in said chamber and elevated above the hearth thereof, said pan being of such size and relative disposition that melted sulfur in said pan may flow over the edge thereof onto said hearth, an air-receiving conduit located in the bottom of said chamber and opening laterally into said chamber, and means whereby air may be supplied to said conduit.

10. In a sulfur-burning furnace, the combination with the body of the furnace having a chamber in which the sulfur is burned, an air-receiving conduit located within said chamber and opening into the same, a combustion chamber connecting with the chamber of said body and into which the gases and vapor of the burning sulfur are directed to pass, said combustion chamber having an outlet and an air inlet, and an air inlet pipe passing through said combustion chamber and connecting with said conduit for supplying air thereto.

CHARLES B. CLARK.

Witnesses:
CHARLES C. HOYT,
FRED C. DOLLIVER.