

J. M. SCHUTZ.
FUEL BURNING APPARATUS.

APPLICATION FILED NOV. 21, 1913. RENEWED JAN. 30, 1919.

1,306,235.

Patented June 10, 1919.

3 SHEETS—SHEET 1.

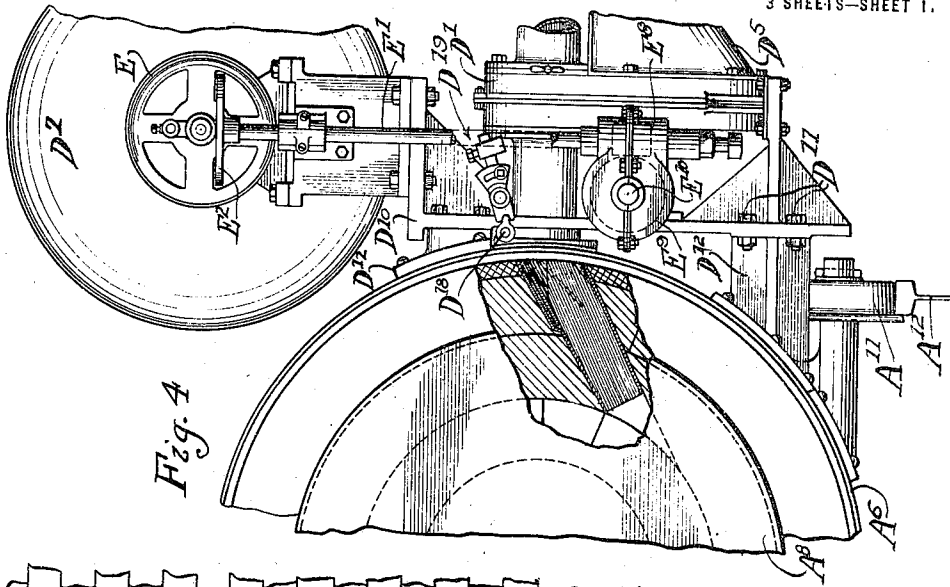


Fig. 4

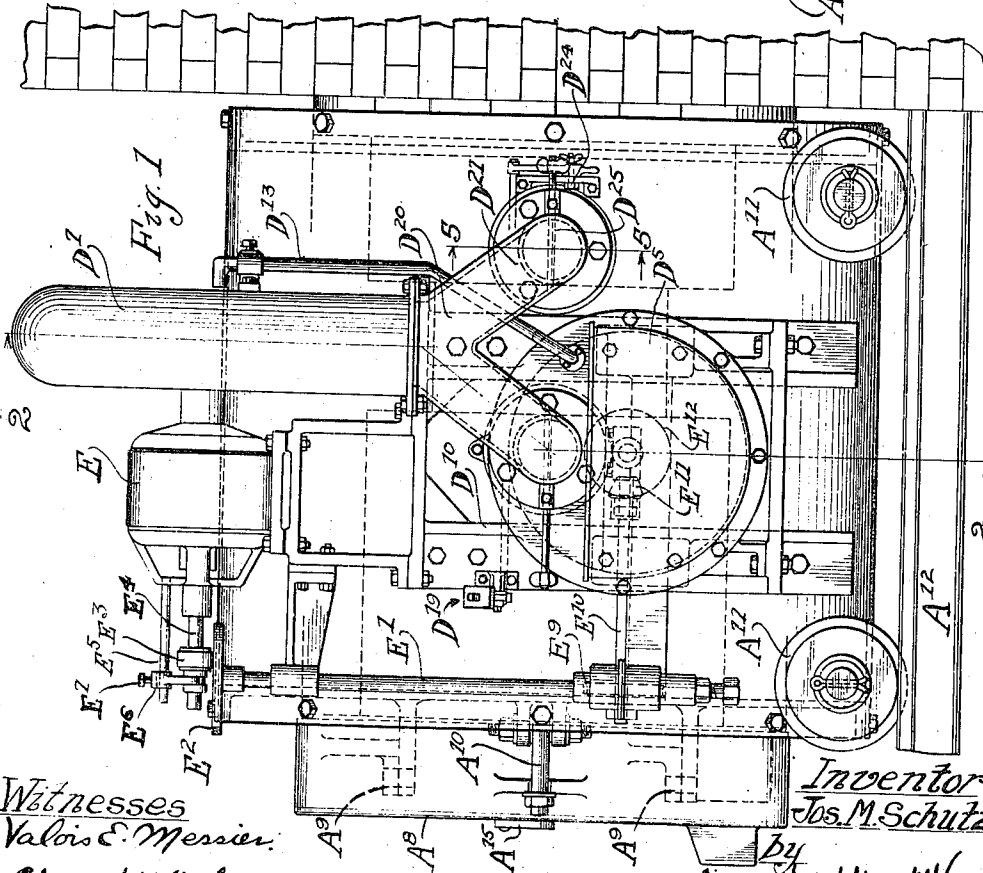


Fig. 1

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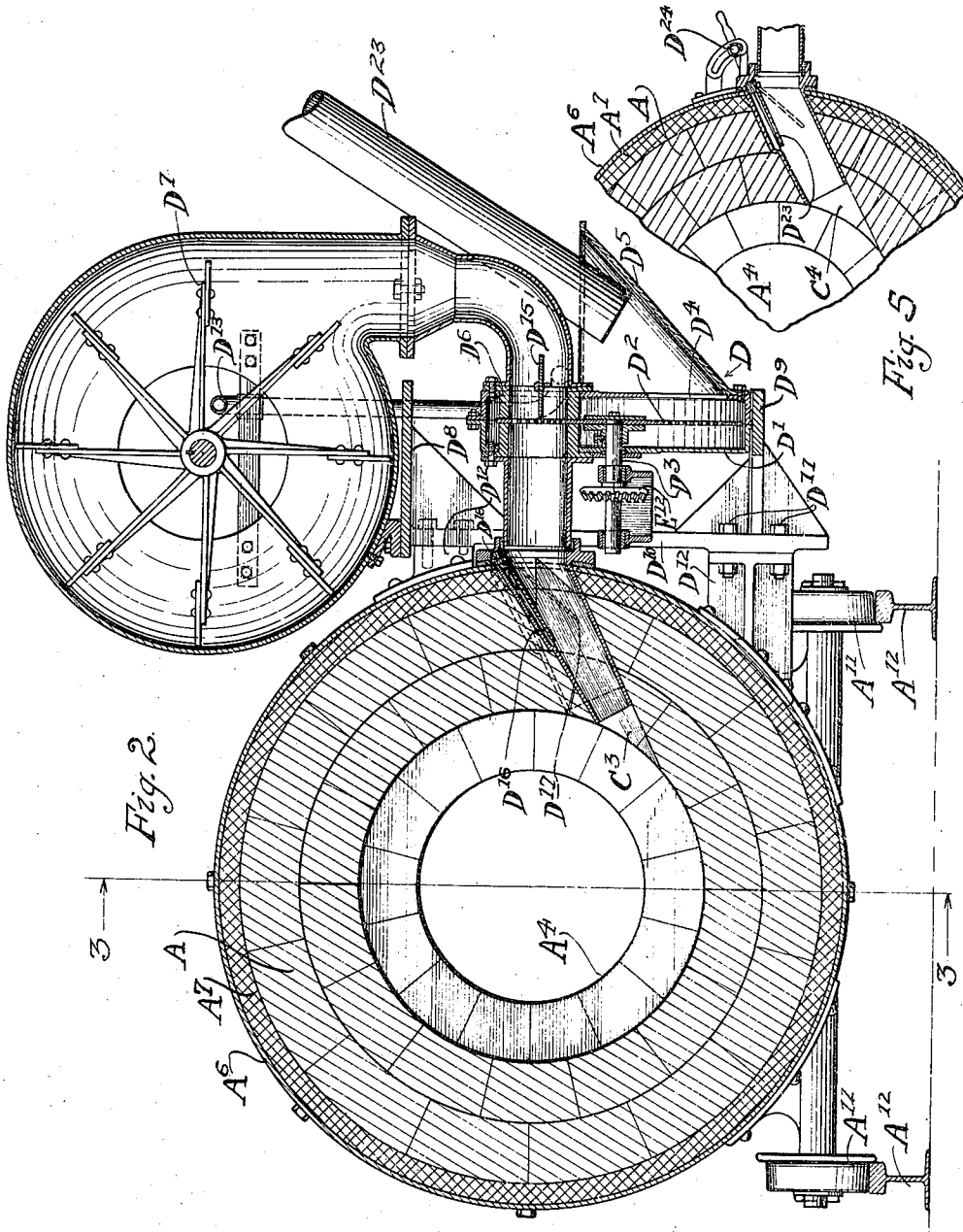


Fig. 2.

Fig. 5

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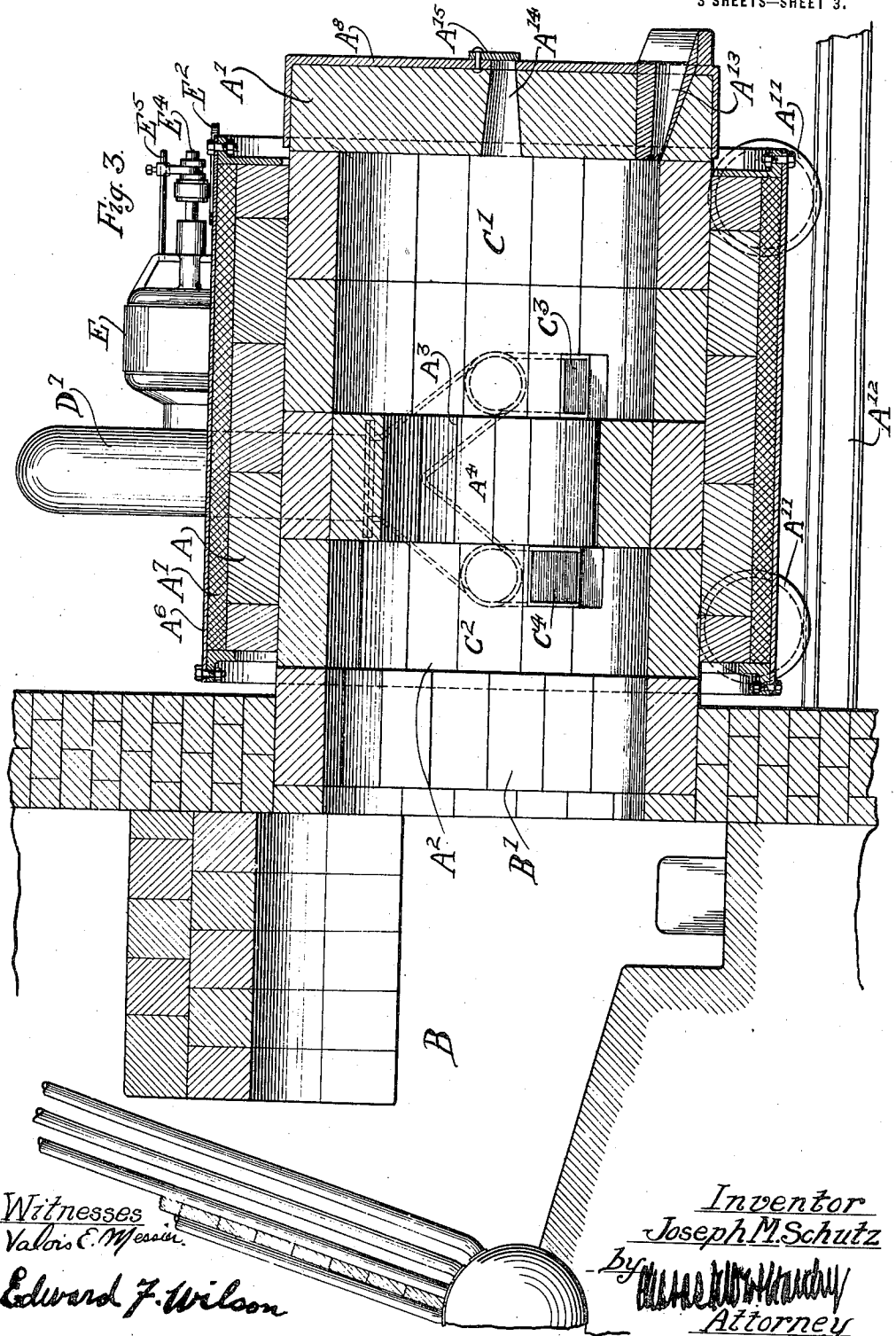
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3 SHEETS—SHEET 3.



Witnesses
Valois E. Messier
Edward F. Wilson

Inventor
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UNITED STATES PATENT OFFICE.

JOSEPH M. SCHUTZ, OF CHICAGO, ILLINOIS, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO SCHUTZ HAWLEY COMPANY, A CORPORATION OF ILLINOIS.

FUEL-BURNING APPARATUS.

1,306,235.

Specification of Letters Patent. Patented June 10, 1919.

Application filed November 21, 1913, Serial No. 802,258. Renewed January 30, 1919. Serial No. 274,129.

To all whom it may concern:

Be it known that I, JOSEPH M. SCHUTZ, a citizen of the United States, and a resident of Chicago, county of Cook, and State of Illinois, have invented a certain new, useful, and Improved Fuel-Burning Apparatus, of which the following is a specification.

My invention relates to improvements in the art of fuel burning, and has particular reference to improvements in means for economically and efficiently burning fuels and producing desirable high temperatures.

The object of my invention is to provide an apparatus in which fuel may be preliminarily heated and under some conditions partly consumed in one stage, and then in a second stage mixed, in a highly heated condition with sufficient air to insure complete and rapid combustion.

A further object of my invention is to provide such a preliminary burner or furnace wherein the fuel shall be consumed under conditions which shall result in maximum economy in the production of gases of high temperature free from dust, ash or other solid particles therein when coal is used as the fuel, and wherein the temperature, heat and flame resulting therefrom shall be readily controllable.

In simple form my invention comprises a refractory annulus or cylinder which is virtually closed at one end and at the other end has a large gas discharge opening, in combination with means for tangentially introducing fuel and air into the annulus adjacent to the end which contains said opening. In the annulus just described I conduct the first or primary step of combustion which consists in decomposing the fuel and ordinarily is so restricted as to amount to only part combustion. The final combustion takes place in a chamber or annulus which receives the products from the open end of the first annulus and wherein further air is supplied for combination with said products. As hereinafter fully described the two annuli may be virtually a single cylinder which contains the ring-like wall or baffle that forms the open end of the first or primary annulus.

My invention also includes means for regulating the quantity of fuel and the

volume and velocity of the air injected into the refractory chambers.

My invention also consists in a hollow refractory cylinder closed at one end and open at the other end and an intermedially arranged baffle or wall extending into the cylinder from its outer wall and provided with a concentric opening connecting the two parts, each portion being provided with a tangential inlet adjacent to the dividing wall, means for introducing fuel at high velocity through the inlet of the closed end, and means for introducing air at high velocity through the inlet of the open end of the cylinder.

My invention also includes the idea of varying the volume of air introduced at the closed end retaining the high velocity thereof, and means for varying the velocity of the air at the other end while holding the volume substantially constant.

My invention also consists in the several constructions, arrangements and associations of mechanisms and parts hereinafter described, and particularly pointed out in the appended claims.

My invention will be more readily understood by reference to the accompanying drawings, forming part of this specification, and in which:

Figure 1 is a side elevation of a mechanism embodying my invention and illustrating its application to a heating furnace;

Fig. 2 is a transverse section of the mechanism and furnace substantially on the line 2-2 of Fig. 1;

Fig. 3 is a vertical section on the line 3-3 of Fig. 2;

Fig. 4 is a fragmentary end view of the apparatus partly in section to show the operation of the automatic air control; and

Fig. 5 is a section of the burner taken on the line 5-5 of Fig. 1 to fully disclose the air inlet of the second chamber.

While I have illustrated my invention as embodied in a form particularly adapted for use with finely divided or ground coal as a fuel, it should be understood that this form is merely typical of the many forms in which my invention may be embodied.

I have chosen to illustrate my invention as adapted to the production of heat from coal, preferably in a more or less finely divided state, for the reason that this problem

has engaged the attention of inventors for a great many years and while some success has been attained, the many difficulties to be overcome have prevented that degree of success which is necessary before the development in the art can be said to have reached a stage of practical value. Furthermore, the production of the heat from coal in an economical and highly efficient manner has so far seldom been attained, and the results in the practical operation of any and all methods so far devised have not been satisfactory. That I have succeeded in overcoming all of the difficulties and have produced an apparatus by means of which coal can be burned, with a maximum economy and efficiency, will be made clear hereinafter.

A fundamental idea underlying my apparatus is that for the most economical and efficient production of heat from coal, the coal should first be disassociated into its gaseous constituents and heated before being mixed with the required quantity of air to produce complete combustion; that this preliminary disassociation should also be combined with a preliminary heating of the gaseous constituents, so that when they are mixed with the air the high temperature resultant therefrom may be quickly produced. Furthermore, for substantially all of the uses to which the heat derived from coal is applied, it is desirable or necessary that the ungasifiable constituents or contents of the coal should be separated from the gaseous products of combustion and prevented from traveling with these gaseous products into the furnace or chamber where the heat produced is practically applied.

The apparatus which I have devised with which to burn or consume fuel and most economically and efficiently to produce heat therefrom, for practical application, consists primarily in what may be termed a refractory cylinder or annulus, open at one end and closed at the opposite end, divided longitudinally into two parts or annuli by means of a transverse refractory wall or baffle which is provided with a central opening connecting the two parts or chambers of the cylinder. By means of this device I am enabled to practice to the best advantage the method or process of burning fuel described in my companion application, as hereinbefore mentioned, that is, I make use of the closed end of the cylinder for preliminarily heating the fuel for introduction into a second chamber in a highly heated state for mixture with the air to produce rapid and substantially perfect combustion. I also make use of the closed end of the cylinder, when I use coal as fuel, for the purpose of reducing the coal into its gaseous constituents and preliminarily heating these parts before they are introduced into the second

chamber for admixture with the necessary air to complete combustion. In the use of coal I also prefer to introduce the coal with a minimum quantity of air as a vehicle to carry the coal and this air partially consumes the coal thus introduced into the first cylinder producing a limited quantity of heat and thus aiding in the disassociation of the coal. In other words, my apparatus is constructed for what may be termed a "two-stage" or "two-step" method of burning fuel, the first step being that of preliminarily heating or gasifying the fuel, and the second step the thorough and rapid admixture of the gases with sufficient air to produce substantially perfect and rapid combustion under conditions resulting in highest possible efficiency.

My apparatus, as illustrated in the drawings, consists of a refractory cylinder A arranged preferably with its axis substantially horizontal. Said cylinder is closed at its rear end by means of a refractory wall or door A¹, and at its other end A² it is preferably open. Between the ends of the cylinder I arrange a transverse wall or baffle A³, providing this baffle with a concentric or central opening A⁴ which is somewhat smaller in diameter than the diameter of the cylinder, whereby the cylinder is divided into a rear or first chamber C¹ and a forward or second chamber C². The cylinder is preferably made up of one or more layers of firebrick arranged within a metal casing A⁵ and I preferably arrange a heat-insulating substance A⁷ between the refractory brick and the metal shell. This heat insulating substance is preferably softer than the brick and permits the expansion thereof without undue strains. The end wall A¹ is preferably carried in a metal casing A⁶ in the form of a large door mounted upon hinges A⁹ and held in position by means of a latch bolt A¹⁰. This door may be readily swung open, when desired, for examination or for building a fire within the cylinder when it is desired to put the device into operation. The device as a whole is mounted upon suitable wheels A¹¹ which are adapted to run upon a track A¹² and the apparatus is thus portable and may be placed in proper relation to a furnace B. The furnace is preferably provided with an opening B¹ with which the mouth or open end A² of the cylinder is adapted to register when placed in position. The furnace B, illustrated in the drawings, is typical of a water tube boiler furnace. Adjacent to the baffle wall A³ and within the rear chamber C¹, I provide a tangential inlet C³ through which I project the fuel at high velocity, and adjacent to the forward face of the baffle wall, and within the chamber C², I provide a second inlet C⁴, through which I inject or force the air at high velocity which is necessary

for the complete combustion of fuel. Both of these inlets enter the chambers tangentially and the incoming air or gases are forced to travel around the cylindrical walls of the chambers at high velocity.

For use with coal, I preferably provide a feeder or controller D. This feeder or controller comprises a chamber D¹ which is preferably cylindrical in form, and within which I arrange a perforated disk or plate D² in vertical position, mounting it upon a horizontal shaft D³ for rotation thereby. This chamber is provided with an opening D⁴ at its lower part which communicates with a suitable hopper D⁵ by means of which finely ground or granulated coal may be fed into the chamber. Through the upper part of the chamber I carry a conduit D⁶ through which I force air at high velocity by means of a fan D⁷ mounted upon a suitable bracket D⁸ above the controller. The controller itself is mounted upon a bracket D⁹ and I preferably join the two brackets D⁸ and D⁹ together into a unitary structure or rigid frame D¹⁰ and secure the whole to the shell of the burner by means of bolts D¹¹. For this purpose I provide the shell with suitable brackets D¹² to which the frame D¹⁰ is secured. The perforated plate D² is transversely interposed in the conduit D⁶ and when the plate is revolved it carries the coal from the lower part of the chamber to the upper part, the perforations in the plate carrying the coal into the conduit D⁶ and by means of the air which is forced through the conduit by the fan the coal is carried into the burner through the tangential inlet C³, which forms a continuation of the conduit D⁶. While the fan and the plate D² might be operated in any suitable manner, I prefer to make the device as a whole portable and independent of other power connections, and I therefore provide an electric motor E as a source of power for both the fan and the controller. I preferably mount the motor E in alinement with the fan and drive the fan directly by the motor, as the fan is preferably driven at relatively high speed. For the purpose of rotating the disk which I desire to rotate at a relatively low speed, I provide a power transmitting mechanism by means of which the disk E² is rotated at a low speed, and by means of which its speed of rotation may be readily varied within relatively wide limits for the purpose of adjusting or controlling the quantity of coal which is supplied to the burner. This power transmitting mechanism comprises a vertical shaft E¹ carrying at its upper end a friction disk E² and adapted to be rotated by means of a friction pulley E³ carried by the shaft E⁴ of the motor E. This friction pulley is movable from and toward the center of the friction disk E² and is held and secured in its desired posi-

tion by means of a guide rod E⁵, a yoke E⁶, and a set screw E⁷ carried by the yoke. The lower end of the shaft E¹ carries a worm I which meshes with a worm wheel E⁹ arranged upon the outer end of a horizontal shaft E¹⁰, and the inner end of the shaft E¹⁰ carries a pinion E¹¹ which meshes with a gear E¹² carried by the shaft D³ upon which the disk D² is mounted for rotation. The conduit D⁶ which passes through the upper part of the chamber D¹ is severed to permit the interposition of the disk D² and the disk fits quite closely between the severed ends of the conduit to prevent the escape of air from the conduit into the chamber, but as some air may escape from the conduit into the chamber I provide a vent pipe D¹³ entering the upper part of the chamber to permit any air which might accumulate there to escape freely and thus prevent the accumulation of pressure. Furthermore, as the air which might escape from this vent pipe would probably include more or less fine dust, I lead this vent pipe to the inlet of the fan for the purpose of causing any dust which might escape through this vent pipe to be carried back by the air through the conduit into the burner. The fuel may be fed into the hopper D⁵ by any suitable means, such as a conveyer tube D²³. For the purpose of regulating the volume of air which I inject into the chamber C¹ through the inlet C³ I provide a valve D¹⁵ in the conduit D⁶ and preferably between the fan and the disk D². I desire, however, to maintain the velocity of the air at a maximum as it enters the chamber C¹ and for this purpose I provide a balanced deflector or valve D¹⁶ arranged at the entrance end of the inlet C³ and adapted to normally lie in such a position that the air in flowing through said passage tends to raise this damper or valve and increase the opening between the end D¹⁷ of the valve and the lower side of the inlet C³. When the valve D¹⁵ is completely closed and the air is prevented from flowing through the conduit D⁶ the valve D¹⁶ completely closes the outer end of the tangential opening C³ and when the valve D¹⁵ is opened to permit air to flow through the conduit D⁶ this air forces the valve D¹⁶ away from the lower wall of the inlet C³ and provides an opening of sufficient size to permit the air to flow into the chamber C¹ through the inlet C³ and at the highest possible velocity. For the purpose of thus permitting the air automatically to adjust the valve D¹⁶ I mount the valve upon a horizontal shaft D¹⁸ and connected with one end of the shaft, I provide a suitable balancing device D¹⁹ so that the air can easily adjust the valve D¹⁶ to its required position with the least possible effort. This arrangement of valves serves to permit the volume of air which is being

admitted to enter the chamber C^1 at the highest possible velocity and thus project the fuel upon and around the cylindrical wall of the chamber C^1 with the greatest force.

In operation I preferably maintain the chamber or annulus C^1 at an extremely high temperature, at least a temperature of sufficient intensity to cause the ungasifiable products contained within the coal to be fused or slagged and thus retained within the chamber C^1 . The continuous operation of this device and the continual feeding of coal into the chamber C^1 would cause an accumulation of this slag, which is mostly fused ash, within the chamber and for the purpose of the convenient removal of this slag from the chamber I provide a drain hole or slag opening A^{13} in the lower part of the door through which this accumulating slag may drain out of the chamber. I also provide in the door A^1 a central sight-hole or opening A^{14} through which the operation of combustion may be observed, closing this hole or opening by means of a pivoted plate A^{15} .

I divide the outlet D^{20} of the fan into two parts, one of which supplies air to the conduit D^6 and the other of which D^{21} supplies air directly to the inlet C^4 of the second chamber C^2 . I provide in the outer end of the inlet C^4 a valve D^{23} similar to the valve D^{10} in the inlet C^3 , except that this valve is not adjusted by the flowing of the air, but is adjusted by hand and set or held in its adjusted position by means of a set screw or bolt D^{24} . By means of this valve D^{23} , which I can arrange in any relative position to the bottom wall of the inlet C^4 , I am enabled to adjust the velocity of the air flowing through the inlet C^4 to any degree desired within practical limits. I also provide in the pipe D^{21} a valve D^{25} , similar to the valve D^{15} in the conduit D^6 , for the purpose of controlling the volume of the air supplied to the second chamber C^2 . By means of the volume adjusting valve D^{25} and the velocity regulating valve D^{23} I am enabled to regulate the volume and velocity of the air entering the second cylinder as desired for the regulation of the length and intensity of the flame produced by the burner, and by regulating the quantity of coal and the volume of air introduced through the inlet C^3 into the chamber C^1 I am enabled to control the quantity of heat produced by the burner. The introduction of the coal with the air into the rear chamber adjacent to the inner wall or ring, A^8 , serves to cause the coal and air to impinge tangentially upon the cylindrical wall of the chamber C^1 and travel upon this wall to the opposite or closed end of the chamber, the coal becoming disassociated and the resultant gases being partially consumed by the air and producing more or

less heat. The gases are forced to the center of the chamber at the rear end and caused to travel forward to the opening A^4 to be discharged from this chamber, traveling thus forward within the outer annulus of gases they are prevented from carrying any solid particles with them, all of the solid particles remaining within the chamber C^1 and under proper conditions becoming fused and being withdrawn from the chamber C^1 through the drain hole A^{13} . I preferably only admit sufficient air into the chamber C^1 to serve as a vehicle to properly carry the coal within this chamber and cause it to advance along the wall in a spiral path to the rear end of the chamber.

By means of my apparatus I am enabled not only to produce heat under conditions of the greatest economy, but also to regulate the heat, temperature and the flame results with the greatest facility. I am further able to produce heat from finely divided coal or coal dust, the gases of combustion being free from all solids, this latter being of great value in many metallurgical processes and particularly for use with furnaces in which steel or other metals are heated to high temperature and in direct contact with the gases of combustion.

I claim:

1. The improvements herein described comprising a refractory cylinder open and unobstructed at one end and closed at the opposite end and divided longitudinally into a rear chamber and a forward chamber by means of an intermediate partition provided with a central opening joining the two chambers, each of said chambers being provided with a tangential inlet, for the purposes described.

2. The improvements herein described comprising a refractory cylinder open at one end and closed at the opposite end divided longitudinally into a rear chamber and a forward chamber by means of an intermediate refractory wall provided with a relatively large opening joining the two chambers, each of said chambers being provided with a tangential inlet, the inlet of the rear chamber being at its forward end adjacent to said wall.

3. The improvements herein described comprising a refractory cylinder open and unobstructed at one end and closed at the opposite end, and a refractory wall dividing the cylinder into a forward chamber and a rear chamber, said wall being provided with a relatively large centrally arranged opening or passage joining the two chambers, each of said chambers being provided with a tangential inlet arranged adjacent to said dividing wall.

4. The improvements herein described comprising a refractory cylinder open and unobstructed at one end and closed at the

opposite end and divided by an intermediate transverse wall into a rear chamber and a forward chamber, said wall having a relatively large central opening connecting the two chambers, each of said chambers being provided with a tangential inlet, means for introducing fuel at high velocity into the rear chamber through its inlet, and means for introducing air at high velocity into the forward chamber through its inlet.

5. The improvements herein described comprising a refractory cylinder divided between its ends into a forward chamber and a rear chamber by an intermediate refractory wall, said wall being provided with a relatively large central opening connecting the two chambers, the rear chamber being closed at its rear end and the forward chamber being open at its forward end, the rear chamber being provided with a tangential inlet arranged adjacent to said dividing wall, and the forward chamber being provided with means for admitting air thereinto, means for forcing fuel at high velocity through the inlet of the rear chamber and means for introducing air at high velocity through the inlet of the forward chamber.

6. The improvements herein described comprising a refractory cylinder open and unobstructed at one end and closed at the opposite end and divided longitudinally into a rear chamber and a forward chamber by means of an intermediate partition provided with a central opening which joins the two chambers, the rear chamber being provided with a tangential inlet arranged adjacent to the intermediate wall, means for introducing fuel conveying fluid through said inlet at high velocity, means for regulating the volume of fluid so introduced, and means for preserving the velocity thereof substantially constant.

7. The improvements herein described comprising a refractory cylinder open and unobstructed at one end and closed at the opposite end, and divided into a forward chamber and a rear chamber by an intermediate transverse refractory wall provided with a relatively large central opening joining the two chambers, the rear chamber being provided with a tangential air and fuel inlet and the forward chamber being provided with a similar tangential inlet arranged adjacent to the forward face of said wall, means for projecting air through the inlet of the forward chamber at high velocity, and means for regulating both the volume and velocity of air so introduced.

8. A two-stage fuel burner comprising a forward refractory cylinder and a rear refractory cylinder arranged end to end, the rear cylinder being closed at its rear end and the forward cylinder being open at its forward end, a wall separating the two cylinders provided with a relatively large open-

ing through which gases of combustion may pass from the rear cylinder to the forward cylinder, the rear cylinder being provided with a tangential inlet adjacent to its discharge end, and a slag outlet arranged in its lower part, the forward cylinder being provided with a tangential air inlet also arranged adjacent to the dividing wall.

9. A heat-producing furnace for use with coal, comprising a refractory cylinder open at its forward end and closed at its rear end and divided into a rear chamber and a forward chamber by an intermediate refractory wall provided with a relatively large opening, through which gases of combustion may pass from the rear chamber to the forward chamber, the rear chamber being provided with a tangential inlet adjacent to the dividing wall through which finely divided coal and air may be introduced, means for introducing the coal and air at high velocity, the forward cylinder being provided with a tangential air inlet arranged adjacent to the forward face of said dividing wall, and means for introducing air at high velocity into the forward chamber through said inlet.

10. A combined coal-gasifier and furnace comprising a forward refractory cylinder and a rear refractory cylinder arranged end to end and separated by a refractory wall provided with a relatively large central opening through which gases may pass from the rear cylinder into the forward cylinder, the rear cylinder being closed at its rear end and provided adjacent to said refractory wall with a tangential inlet through which finely divided coal and air may be introduced, the forward cylinder being open and unobstructed at its forward end and provided with a tangential air inlet arranged adjacent to the forward face of said dividing wall.

11. A furnace for producing gases of combustion from coal and free of all solid or ungasifiable products comprising a refractory cylinder, an intermediate refractory wall dividing the cylinder into a forward chamber and a rear chamber, the rear chamber being closed at the rear end, and the forward chamber being open at its forward end, the intermediate wall being provided with a relatively large central opening through which gases may pass from the rear chamber to the forward chamber, the rear chamber being provided with a tangential air and coal inlet arranged adjacent to the rear face of said division wall, means for introducing finely divided fuel at high velocity into said rear chamber through said inlet and means for withdrawing the ungasifiable products from said chamber, in slagged or fused form.

12. The improvements herein described, comprising a retarding-combustion cham-

ber in the form of a refractory cylinder closed at one end, an acceleration-combustion chamber also in the form of a refractory cylinder and open at one end, a refractory passage of smaller diameter than the cylinders connecting the two opposite ends of the two cylinders and through which the gases of combustion may flow from the first to the second, said first chamber being provided with a tangential inlet arranged adjacent to its discharge end and the second cylinder being provided with a tangential inlet arranged adjacent to its inlet end.

13. The improvements herein described, comprising a refractory annulus closed at one end and open at the other and containing an intermediate annular baffle wall and there being two tangential inlets respectively adjacent to opposite sides of said wall, and means for feeding fuel into the inlet upon that side of said baffle which is the nearer to the closed end of the annulus.

14. The fuel burner herein described comprising a refractory annulus closed at one end, in combination with a second refractory annulus, a smaller refractory annulus which connects the first and second annuli and the first and second annuli having tangential inlets adjacent respective ends of the smaller annulus.

15. A fuel burner comprising a refractory annulus, having a substantially horizontal axis, a rear end containing a slag-discharge opening at the bottom of the annulus and a forward end containing a large flame-discharge opening, in combination with a twyer entering the annulus tangentially at the inner side of said forward end, and means for supplying combustibles at high velocity through said twyer, substantially as and for the purpose described.

16. A fuel burner comprising a refractory annulus having a substantially horizontal axis, a rear end containing a slag-discharge opening at the bottom of the annulus and a forward end containing a large flame-discharge opening, in combination with a twyer entering the annulus tangentially at the inner side of said forward end, means for supplying combustibles at high velocity through said twyer, and a secondary combustion chamber to receive the flame from said opening in the forward end of the annulus, substantially as and for the purpose described.

17. A fuel burner comprising a refractory annulus having a substantially horizontal axis, a rear end containing a slag-discharge opening at the bottom of the annulus and a forward end containing a large flame-discharge opening, in combination with a twyer entering the annulus tangentially at the inner side of said forward end, means for supplying combustibles at high velocity through said twyer, a secondary combustion chamber to receive the flame from said annulus, and means for supplying air to support combustion in said secondary chamber, substantially as and for the purpose described.

18. A fuel burner comprising a refractory annulus having a substantially horizontal axis, a rear end which is substantially closed and a forward end containing a large flame-discharge opening, in combination with a twyer entering the annulus tangentially at the inner side of said forward end, and means for supplying combustibles at high velocity through said twyer substantially as and for the purpose described.

19. A fuel burner comprising a refractory annulus having a substantially horizontal axis, a substantially closed rear end and a forward end containing a large flame-discharge opening, in combination with a twyer entering the annulus tangentially at the inner side of said forward end, and hence at a point remote from said rear end, means for supplying combustibles at high velocity through said twyer, a secondary combustion chamber to receive the flame from said annulus, and means for supplying air to support combustion in said secondary chamber, substantially as and for the purpose described.

20. A fuel burner comprising a refractory annulus having a substantially horizontal axis and a substantially closed rear end with a slag-discharge opening at the bottom of the annulus and a forward end which contains a large flame-discharge opening, in combination with means for directing combustibles helically against the inner periphery of the annulus beginning at the inner side of said forward end, substantially as and for the purpose specified.

In testimony whereof, I have hereunto set my hand, this 3rd day of November, 1913, in the presence of two subscribing witnesses.

JOSEPH M. SCHUTZ.

Witnesses:

EDWARD F. WILSON,
JOHN R. LEFEVRE.