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J. M. SCHUTZ.

PROCESS OF PRODUCING HEAT FROM FUEL.

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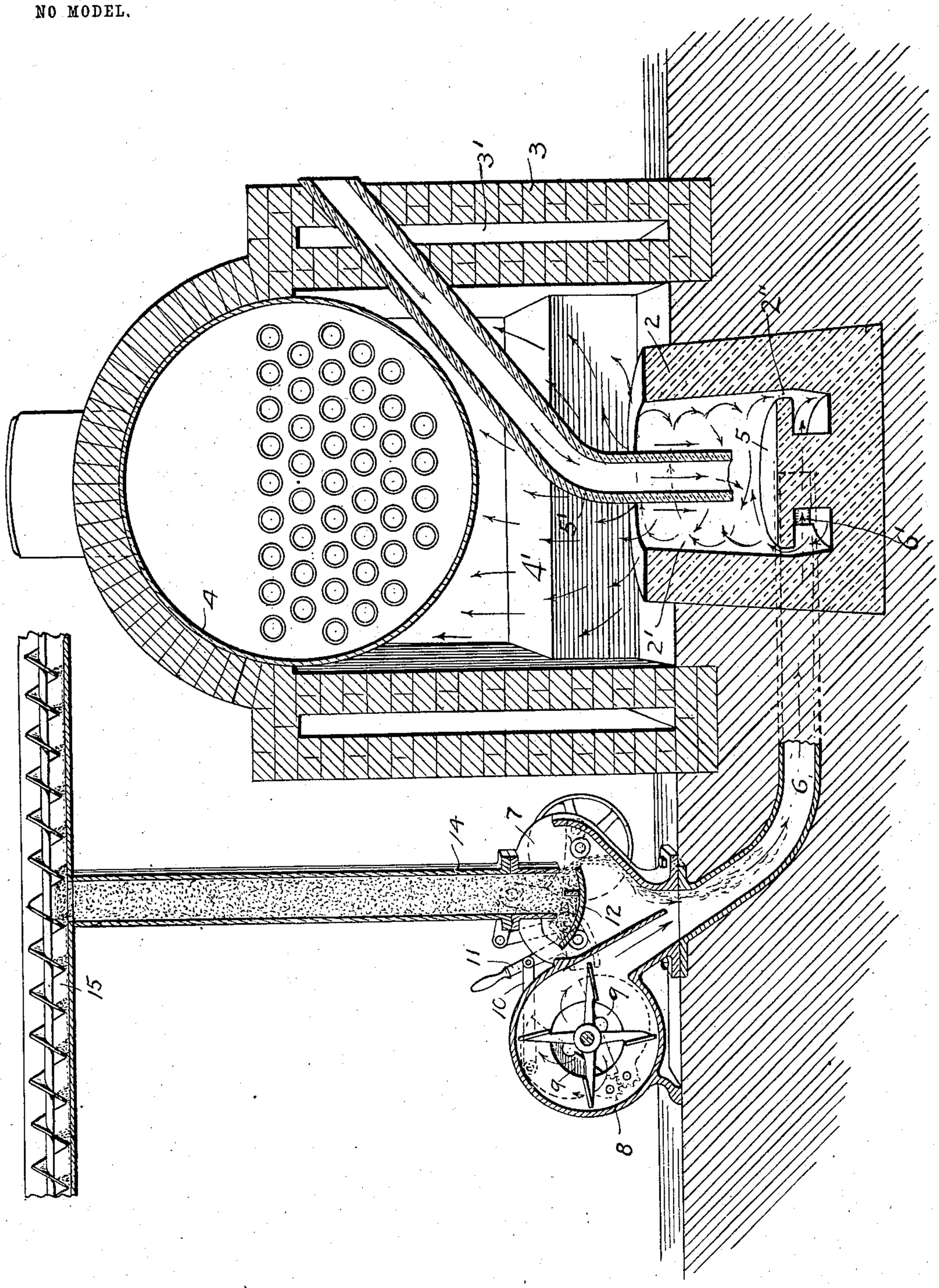
NO MODEL.



WITNESSES

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No. 751,350. Patented February 2, 1904.

UNITED STATES PATENT OFFICE.

JOSEPH M. SCHUTZ, OF MINNEAPOLIS, MINNESOTA.

PROCESS OF PRODUCING HEAT FROM FUEL.

SPECIFICATION forming part of Letters Patent No. 751,350, dated February 2, 1904.

Original application filed December 26, 1899, Serial No. 741,528. Divided and this application filed March 19, 1900. Renewed July 6, 1903. Serial No. 164,478. (No specimens.)

To all whom it may concern:

Be it known that I, JOSEPH M. SCHUTZ, of the city of Minneapolis, county of Hennepin, State of Minnesota, have invented a new and Improved Process of Producing Heat from Fuel, of which the following is a specification.

This invention relates to the production of heat from fuel, and particularly from broken or pulverized fuel.

Hitherto attempts have been made to burn pulverized fuel in some cases alone and in others auxiliary to the ordinary grate-fire; but in all such cases that have come to my knowledge it has been necessary to reduce the fuel to a uniform impalpable powder, and the cost of thus preparing the fuel has been prohibitive, so that even for experimental efforts success has not been claimed and but little progress has been made toward the reduction of the art to general commercial requirements and uses.

The object of the invention is to make use of all fuel products that are or may be reduced, not to a fine powder, but simply to a fineness that will admit of the carriage of the fuel products upon or by an air-blast.

The invention consists in the improved process hereinafter specifically set forth, whereby a maximum number of heat units may be obtained from fuel in a broken, pulverized, or divided state.

The invention will be more readily understood by reference to the accompanying drawing, forming a part of this specification, wherein I have illustrated a form of apparatus that is well adapted to the carrying out of my process. I do not, however, in this application make claim for the novel construction of such apparatus for the reason that the same constitutes the subject-matter of another application for Letters Patent, filed by me under date of December, 1899, Serial No. 741,528, of which this application is a division. Moreover, my improved process as herein contained is not necessarily confined in its practice to the use of any specific form or construction of apparatus beyond the general features required for performing the several steps described.

The term "fuel" as employed in this specification is intended to embrace not only coal of the best qualities, but also all the poorer kinds of bituminous coal, such as lignite and the waste or fine parts of all coals known as "screenings." The term also includes gas, oils, wood, shavings, and sawdust, combustible mixtures, and garbage products that have been calcined—in other words, any fuel substance or compound that is capable of being pulverized or separated into small particles.

The term "pulverized" as used herein is intended to describe or define that broken state of the fuel, whatever its kind, that will admit of the carrying, distributing, or feeding of the fuel by an air or gas blast of a velocity suited to the requirement of any given furnace plant.

As will be made evident hereinafter, it is unnecessary and even objectionable to reduce the fuel to substantial impalpability, for the reason that with my process combustion is induced, not spontaneously, but rather by a series of preparatory steps or stages, resulting in or causing, first, the rapid decomposition of the fuel, followed by the ignition of the resulting gases, and then the thorough admixture of the burning gases with sufficient air to produce perfect combustion.

My process may be broadly defined as comprising the following steps—to wit, forcibly mixing pulverized fuel with air, forming therefrom a rapidly moving and rotating column of the mixture, confining the column and fuel particles to spiral paths, throwing the fuel particles to the outside, and applying heat to the products during the transit of said spiral path, thereby causing decomposition of the fuel and combustion; and the process consists, further, in creating a vortex within the whirling body or column aforesaid, and thereby preventing the escape of unconsumed products from said spiral path until the same are heated to the point of combustion, and, further, the process consists in supplying air or gas to burning gases through the medium of said vortex.

The process also includes other and auxiliary steps, all of which will be better under-

stood from the description of the apparatus shown in the drawing before referred to.

In said drawing I have shown a burner constructed in accordance with the requirements of my process and as applied to a boiler-furnace. The view is a sectional perspective view showing the boiler 4, the furnace or fire chamber 4′, and the walls 3, which latter preferably contain dead-air spaces 3′. The burner 2 is annular in shape and is set in the floor of the furnace-chamber 4′, preferably projecting slightly above said floor. The inner or surface wall 2′ of the burner and ordinarily the whole of the annular burner is of refractory material capable of withstanding and retaining intense heat and of remaining substantially incandescent without rapid deterioration. The inside of the burner may taper toward the top and bottom, starting from a line near the bottom of the burner. The bottom is closed except for a tangential inlet 6′. In the lower part of the burner is the disk 5, standing up from the bottom and of less diameter than the burner, so that a narrow annular space 2″ is left between the edge of the disk and the burner-walls. This disk is above the inlet 6′.

5′ represents the vortex-tube, which leads from the outer air or from an air-heating device, if desired. The lower end of the vortex-tube is concentric with the burner-walls and dips into the burner a considerable distance. The tube 5′ is preferably made of refractory material.

6 represents the feed pipe or tube that leads to the tangential inlet 6′ of the burner. This tube leads from and is connected to the air and fuel mixer, by which fuel-laden air is forcibly blown into the bottom of the burner. This mixer comprises the hopper 7 and the blast-fan 8, the former containing the feeder 12 and the latter having the regulating dampers or slides 9. The blades of the fan and the feeder 12 are driven at proportional speeds, and a regulator, comprising the lever 11, the link 10, and some other parts, (not clearly shown,) is interposed between the driving mechanism for the feeder 12 and the dampers 9 of the fan, whereby the quantities of air and fuel may be accurately proportioned and governed according to the degree of heat required. It is evident that the operation of the regulator may be made automatic and depend on the temperature in the furnace-chamber. The pulverized fuel is supplied to the feeder 12 through a pipe 14 and the conveyer 15, which latter may be fed from a hopper or directly from a pulverizer or breaker.

The fine fuel drops from the feeder 12 through the hole in the bottom of the hopper 7 and is taken up by the blast from the fan, being thereby carried at a high velocity into the burner. As the fuel-laden air enters the base of the burner it strikes the curved walls thereof and is set to whirling upward therein in a spiral path. The disk compels the formation of the hollow annulus of fuel and air within the burner. When a strong blast is employed, the disk may be omitted and the result will be the same. Both the air and fuel are projected against said walls by centrifugal force and can only progress spirally toward the mouth or open end of the burner. Ignition of the combustibles may be accomplished by building a small fire in the burner before the fuel is blown into the same. From the beginning a portion of the finely-divided fuel will be burned and the heat generated thereby and by the original kindling under forced draft or blast will quickly raise the refractory walls of the burner to a high temperature, every unit of heat stored therein adding intensity to the combustion within the burner, and vice versa, until the walls of the burner become incandescent and the heat thereof becomes so great that the particles of fuel striking and traveling thereon or even closely approaching the hot walls in the whirling air-current will be almost instantly decomposed, the gases thereof being added to the elements of the air, which latter has been superheated. Ignition takes place almost simultaneously with the decomposition of the fuel particles, and the gases in combustion form a whirling flame that emerges from the burner at white heat. The burning of a gas-flame within the burner would not be sufficient under ordinary conditions to maintain the walls thereof at incandescence; but by whirling the body of air, gas, and fuel centrifugal force is developed to hold the combustible products in close contact with the walls of the burner, which receive the initial and greatest heat of combustion of the particles of fuel thereon, the heat being thus constantly imparted to the burner-walls and thence to the fresh products entering the burner. The walls of the burner are of comparatively small area, the annular form of the burner and the spiral paths of the fuel particles therein insuring sufficiently long contact between the fuel and the walls to produce decomposition and ignition.

The whirling of the fuel-laden air upon the walls of the burner and of the flame therefrom tends to cause a vacuum at the center of the cylinder, setting up a vortex within the burner or, in other words, within the annular field or area of heat storage and application. This vortex operates to return to the hot walls all the smoke and lighter gases and particles that seek the axis of the burner or are expelled from the walls by the heavier products whirling thereon. The result is complete combustion save for a minute quantity of fine ashes. Smoke is never thrown off from the furnace except during the first two or three minutes after starting the fire. Either air or fuel may be supplied to the burner through the vortex-tube, and the supply is suitably regulated. The intensity of the flame of the burner is regulated by the supply of fuel and air and the

velocity of the air-blast, and the degree of heat that is attainable is limited by the capacity of the refractory material to withstand heat rather than by the capacity of the burner to develop heat. After the burner is once made hot the burning of the products on the surface thereof will keep it hot, and aside from unavoidable radiation from the furnace-chamber in which the burner is located no heat energy is lost except in the initial heating of the burner-walls. It is preferred that the burner shall project into a furnace-space that is larger than the burner, whereby the velocity of the burning gases is reduced after leaving the burner and the pressure thereof also reduced, the effect being to retain the heat in the furnace for a longer time and to accentuate or perceptibly increase the velocity of the vortex within the burner. The expansion of the gases on leaving the burner results in the precipitation of the fine ashes carried by the whirling currents, and the ashes are thus deposited on the floor of the furnace-chamber and are not ordinarily carried farther into the furnace. The tapering of the burner results in a slight back pressure and the retention of the fuel-gases in the burner longer than would be the case if the exactly-cylindrical form of burner were used.

There are many fuel products that are at present practically worthless, all thereof being of the class distinguished by the matting of the fuel when burned on an ordinary grate and also by the presence in many of the fuels of other elements than carbon and which are ordinarily incombustible. By my process it is possible to advantageously and economically consume many elements and products which under present methods are either deposited in the furnace chamber or flues or go into the ashes.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The process of burning fuel, that consists in mixing the pulverized fuel with air, creating therefrom a hollow cylinder of fuel-laden air in rapid rotation, confining the same, and applying heat to the exterior thereof to liberate the gases of the fuel and to ignite the gas, substantially as described.

2. The process of burning fuel, that consists in mixing the pulverized fuel with air, creating therefrom a hollow cylinder of fuel-laden air in rapid rotation, confining the same, applying heat to the exterior thereof to liberate the gases of the fuel, and ignite the gases, and by rapidly rotating the cylindrical body of air and discharging the same longitudinally, thereby creating a vortex, for the purpose specified.

3. The process of burning fuel, that consists in mixing pulverized fuel with air, forcing forward and rotating the column of fuel-laden air, applying heat to the exterior thereof and permitting the gases to expand at a point beyond the place of application of heat, substantially as described.

4. The herein-described process that consists in forcibly mixing pulverized fuel and air, creating therefrom a rapidly moving and rotating column, confining the column to a spiral path and heating the fuel products or elements to the point of decomposition, ignition and combustion during their transit of the spiral path, substantially as described.

5. The herein-described process that consists in creating a rotating and longitudinally-moving annulus of fuel-laden air, confining the same, applying heat thereto throughout a given area, and thereby decomposing and burning the fuel products, substantially as described.

6. The herein-described process that consists in creating a rotating and longitudinally-moving annulus of fuel-laden air, confining the same and applying heat thereto throughout a given area, thereby decomposing the fuel, igniting and burning the gases and creating and maintaining a vortex within said annulus that prevents the escape of combustible products, substantially as described.

7. The process of burning fuel, that consists in forcibly creating a spirally-moving body of fuel-laden air, applying heat to a given area thereof, thereby igniting and burning the fuel products, the resulting flame being delivered from the area of heat application, substantially as described.

8. The process of burning fuel, that consists in creating a spirally-moving body of fuel-laden air or gas and therein a vortex, supplying air to said vortex, applying and storing heat to and in a given area of said fuel-laden body, thereby causing decomposition of the fuel elements, their ignition and the burning thereof, substantially as described.

9. The process of burning fuel, that consists in creating a longitudinally moving and whirling body of fuel-laden air, confining the same during part of its longitudinal movement, applying heat to the exterior of the whirling body and thereby decomposing the fuel elements and igniting and burning the same while confined, substantially as described.

10. The process of obtaining heat from pulverized fuel, that consists in forcibly mixing the fuel with air in motion, setting up rapid rotation as well as longitudinal movement of the mixture, confining the body against expansion during a part of the transit of its path of discharge, applying heat thereto during its confinement and thereby liberating the gases of the fuel and igniting the gases of combustion, substantially as described.

11. The herein-described process that consists in creating a rotating and longitudinally-moving annulus of fuel-laden air, confining the same, applying heat thereto throughout

a given area, permitting the expansion of the gases beyond said area, thereby inducing a vortex and adding air, substantially as described.

12. The herein-described process that consists in creating a rotating and longitudinally-moving annulus of air, adding fuel thereto, storing heat from and applying heat to a given area of said annulus, a vortex being created, substantially as described.

13. The process of producing heat from fuel that consists in forming a rapidly-rotating annulus of air and imparting longitudinal movement thereto, forcing fuel into said annulus, confining said annulus of air against expansion during a part of its longitudinal movement, and permitting the expansion thereof thereafter, thereby setting up a return-vortex within said annulus and establishing a high temperature in said annulus, substantially as described.

14. The process of obtaining heat from fuel that consists in creating by a tangential blast a rapidly-rotating and longitudinally-moving annulus of combustible fluid, confining said annulus during a portion of its longitudinal movement, forcing fuel into said annulus, and establishing in said annulus a high temperature and a return-vortex, substantially as described.

15. The process of producing heat from fuel that consists in establishing a high temperature in a heat-retaining annulus, forcing a combustible fluid tangentially into said annulus, thereby establishing centrifugal action and a vortex, and forcibly mixing fuel with said fluid, substantially as described.

16. The process of producing heat from fuel that consists in forming and causing the combustion of a rotating longitudinally-moving column of combustibles and by the rotation thereof producing a vortex therein, substantially as described.

In testimony whereof I have hereunto set my hand this 28th day of February, 1900.

JOSEPH M. SCHUTZ.

In presence of—

A. C. PAUL,

M. E. GOOLEY.