

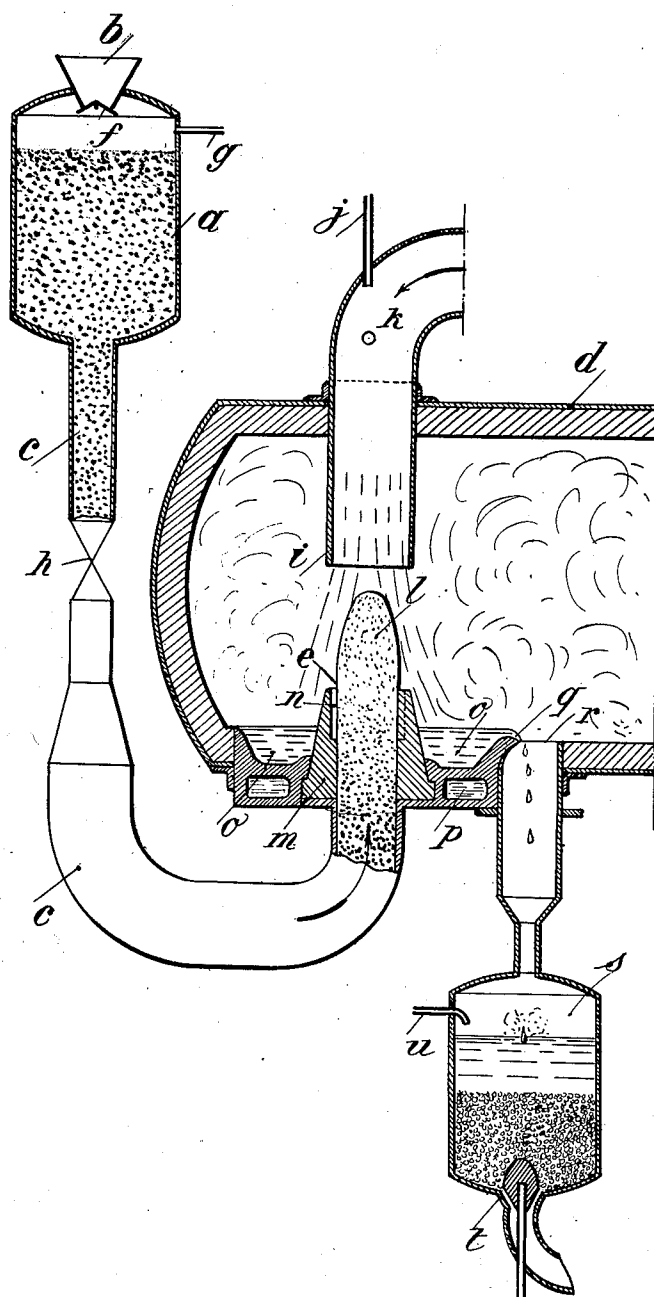
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M. DE CONINCK

PROCESS AND APPARATUS RELATING TO THE COMBUSTION OF SOLID FUEL

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INVENTOR
Marcel de Coninck
BY Townsend & Wicke
ATTORNEYS.

UNITED STATES PATENT OFFICE.

MARCEL DE CONINCK, OF CANNES, FRANCE.

PROCESS AND APPARATUS RELATING TO THE COMBUSTION OF SOLID FUEL.

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To all whom it may concern:

Be it known that MARCEL DE CONINCK, a citizen of the Republic of France, residing at Chalet Criquette Chemin de Vallauris, Cannes, Alpes Maritimes, France, has invented certain new and useful Improvements in Processes and Apparatus Relating to the Combustion of Solid fuel, of which the following is a specification.

The usual method of producing heat by burning solid fuel upon a grate has several defects. For one thing, the grate is relatively large as the weight of fuel burned per square metre of grid surface is not very high unless recourse be had to means such as forced draught and mechanical stoking for accelerating combustion and burning the fuel more quickly than is possible with hand stoking.

These special arrangements are very costly and only justify themselves in large plants. On the other hand their efficiency varies greatly according to the nature of the fuel and its state of division, etc. The heat given out by the fuel may not effectively be utilized if the fuel is of a bad quality on account of the low temperatures obtained.

This invention relates to a process and apparatus which allow the calorific power of solid fuels to be completely and conveniently utilized.

According to this invention fuel is subjected to a preparation having for effect to transform it into a semifluid or pasty compound, continuously fed in the form of a rod of suitable shape into the place where it is to be burned, that is, where it comes in contact with the air for combustion. The fuel as it approaches the combustion zone is dried and then, on coming nearer to the zone of maximum temperature, distills; the gases evolved by distillation burn at the surface of the rod which gradually cokes; the rod becomes coked and is burnt while the cinder is removed, for example, by melting and flowing away. The combustion thus attained is systematic, i. e. the fuel travels in the opposite direction to the flow of gases promoting combustion, while in order to obtain the consecutive effects of drying the fuel, distilling the volatile matters, burning the coked material and melting the cinder. One of the advantages of this process, and not the least, consists in obtaining hot gases free from dust.

The fuel may be brought into a semifluid

state by reducing the solid fuel (coal, coke, lignite, turf, etc.) to a suitable state of division by grinding, pulverizing or any other means, then mixing it intimately with a certain proportion of a liquid binding material such as mineral or vegetable oil, tar oil, or even water, together, if desired, with suitable components with a view to obtaining certain qualities (such as a nonfreezing mixture or a cinder having a convenient fusibility or special chemical properties).

A mixture will thus be obtained whose fluidity is comparable, for example, with that of artists' colors in tubes, and thus capable of being forced through an orifice by pressure.

The invention relates further to apparatus suitable for carrying out the said process in a very advantageous manner from the point of view of bulk, simplicity of installation, easy operation and maintenance. The calorific power of low grade fuels is readily utilized, while the removal of cinder is easily effected.

The apparatus comprises a duct terminating in a nozzle capable of resisting a high temperature, through which the rod of fuel is forced, means for feeding the semi-fluid or pasty fuel into this duct, and for progressively ejecting it from the end of the nozzle, means for bringing air or other combustion promoting gas to the fuel, and means for removing the cinder, which may be in a molten state. In this process the use of grates is avoided.

One method of carrying out the invention is illustrated in the accompanying figure of the drawing. *a* is a tank provided, if necessary, with stirrers and containing the semifluid fuel passing out from a hopper *b*. A tube *c* connects tank *a* with a combustion chamber *d*. For the sake of clearness tank *a* is shown to a scale smaller than that of chamber *d*. The semifluid fuel is forced by pressure into chamber *d* through an inlet *e*, for example, either by placing tank *a* in connection with a source of pressure greater than that prevailing in chamber *d*, or by making the tank *a* air tight by a valve *f* and introducing therein fluid under pressure through a pipe *g*. The fuel passes into chamber *d* in the form of a plastic cylinder moving at a speed which may be varied by adjusting a valve *h* or by varying the pressure prevailing in tank *a*.

Opposite the fuel inlet *e* is a tube *i* for the

inlet of the gas for promoting combustion, such as air, which is blown into chamber *d* by a fan or compressor, for example, not shown in the drawings. Fuel from inlet *e* burns in the presence of the air blast entering through tube *i*. To start the burning of the fuel, gas or a vaporized fuel may be injected through a pipe *j* and ignited by an electric sparking plug *k*. The flame thus produced is directed onto the rod *l* of fuel. Rod *l* is guided by a nozzle *m* preferably made of refractory material inside which the volatile matters contained in the fuel commence to distillate under the action of the heat prevailing in this portion of chamber *d*. The fuel then moves forward in the form of a column of coke which burns in the current of air blown in through pipe *i*. Nozzle *m* may be provided with longitudinal grooves *n* which facilitate the discharge of the volatile products which also burn round rod *l*. The temperature of combustion on the surface and at the apex of rod *l* may without inconvenience be very high, since there is no grate liable to destruction by over-heating. The fuel itself forms its own support.

Fuel may be burnt with still greater rapidity if the air be previously heated. The air is, moreover, already heated in the apparatus as illustrated, by its passage through tube *i* which is surrounded by the hot gases of combustion. The intensity of combustion which is already greater than that obtained on grates, owing to the high temperatures attained and to the speed of the current of air, may again considerably be increased if chamber *d* is under pressure, that is, if the burning power per unit of volume of air introduced through tube *i* attains several times the value that it possesses under usual conditions of burning at atmospheric pressure.

The high temperatures to which rod *l* is heated have for effect to melt the cinder which then flows away in a liquid state and will collect in an annular vessel *o* surrounding nozzle *m*. If solid particles become detached from the burning rod *l*, they will float on the surface of the liquid cinder and burn. The bottom of vessel *o* may be cooled by a water jacket *p* whereby a lining of solidified material will be formed which will completely protect the metal of which the vessel is made.

The cinder in a molten state flows out through a spout *q* and falls through an opening *r* formed in the lower portion of the combustion chamber into a vessel *s* containing water in which the molten cinder is submerged while becoming pulverulent under the boiling action produced when the fused material comes into contact with the water. The heat of the steam evolved is not lost as it mixes with the current of hot gases passing out of the combustion chamber.

For the sake of clearness, vessel *s* is shown to a smaller scale than that of chamber *d*.

Vessel *s* is provided at its lower portion with a purge orifice provided with a valve *t* allowing the cinder to pass outwards by gravity or by the action of the pressure prevailing in chamber *d* if under pressure. A water inlet *u* compensates for losses due to evaporation and to removal with the cinder.

In place of passing the molten cinder into water, the cinder may remain glowing and be removed by any known means. This is particularly the case when the cinder is to be used as a supply of a material comparable to "molten cement". For this object suitable components may be added while mixing the fuel with the binding liquid in order to give the cinder the proper chemical properties.

The apparatus illustrating the invention may be modified without in any way changing the nature of the invention. In particular, the system for supplying the combustion chamber with semi-fluid fuel may vary according to the conditions of working. For example, if the pressure in the chamber is sufficiently high, as may be the case with an internal combustion turbine, it would not be economical to make a large reservoir such as *a* sufficiently strong to resist high pressures. It may be advantageous in this case to feed the chamber with fuel by means of small cylinders operating as pump bodies with a slow to and fro movement and in which the semi fluid mixture is displaced by a piston actuated mechanically by a screw, rack or other means, or by the pressure of a fluid. The speed of advance of the fuel may also be regulated by numerous known means.

As illustrated the combination chamber contains a single rod of fuel but it is evident that there may be a plurality of said rods without changing the principle of the invention. The combustion chamber may have a vertical or inclined axis with a view to its adaptation for forming a boiler furnace in which advantage is taken of the direct radiation of the incandescent fuel.

What I claim is:—

1. A process of utilizing solid fuels which consists in reducing said fuel to a pulverulent state, mixing it with a liquid to form a semi-fluid paste, progressively feeding said paste into a furnace, raising the paste to ignition temperature and causing an opposing current of a combustion promoter to impinge against the apex of said fuel body during the combustion thereof.

2. A process of utilizing solid fuels which consists in reducing said fuel to a pulverulent state, mixing it in the form of a semi-fluid paste with liquid and solid components in order to obtain a mixture possessing definite physical and chemical qualities, progressively feeding said paste into a furnace,

raising the paste to ignition temperature and causing an opposing current of a combustion promoter to impinge against the apex of said fuel body during the combustion thereof.

3. An apparatus for burning fuel in the state of a semi-fluid mixture, comprising means for feeding said mixture into a furnace, a nozzle leading the mixture into the furnace in the form of a projecting rod, means for setting on fire said combustible rod, an inlet duct for the combustion promoter causing the later to impinge against the apex of said burning rod, and means for removing the cinder.

4. An apparatus for burning fuel in the state of a semi-fluid mixture, comprising means for feeding said mixture into a furnace, a nozzle leading the mixture into said furnace in the form of a projecting rod, means for setting on fire said combustible rod, an inlet duct for the combustion promoter surrounded by the hot gases of combustion, means for causing a current of preheated combustion promoter to impinge against the apex of the burning rod, and a vessel for collecting the molten cinder flowing from the burning rod.

5. An apparatus for burning fuel in the state of a semi-fluid mixture, comprising means for feeding said mixture into a furnace, a nozzle leading the mixture into said furnace in the form of a projecting rod, means for setting on fire said combustible rod, an inlet duct for the combustion promoter surrounded by the hot gases of combustion, means for causing a current of preheated combustion promoter to impinge against the apex of the burning rod, a vessel

collecting the molten cinder flowing from the burning rod, and means for cooling the molten cinder discharged from said collecting vessel.

6. In an apparatus for burning fuel in the state of a semi-fluid mixture, the combination with a fuel combustion chamber of a fuel residue collecting vessel at the bottom of the chamber, an upwardly directed fuel inlet pipe passing through the bottom of said vessel, means for allowing the fuel residue to outflow from said vessel, and means for leading a combustion promoter such as air into said chamber.

7. In an apparatus for burning fuel in the state of a semi-fluid mixture, the combination with a combustion chamber, of a fuel residue collecting vessel at the bottom of the chamber, an upwardly directed fuel inlet pipe passing through the bottom of said vessel, means for allowing the fuel residue to outflow from said vessel, means for cooling said vessel, and means for leading a combustion promoter such as air into said chamber.

8. In an apparatus for burning fuel in the state of a semi-fluid mixture, the combination with a combustion chamber, of means for feeding fuel in a semi fluid paste condition through a pipe leading into the said chamber, a nozzle on said pipe located within the combustion chamber, an outlet from the bottom of said chamber for molten cinder, and means for leading a combustion promoter such as air into said chamber.

In testimony that I claim the foregoing as my invention I have signed my name this seventh day of January, 1924.

MARCEL DE CONINCK.