Sept. 3, 1929. W. E. TRENT 1,726.870

METHOD AND APPARATUS FOR BURNING FUELS

Filed April 23, 1926 2 Sheets-Sheet 1

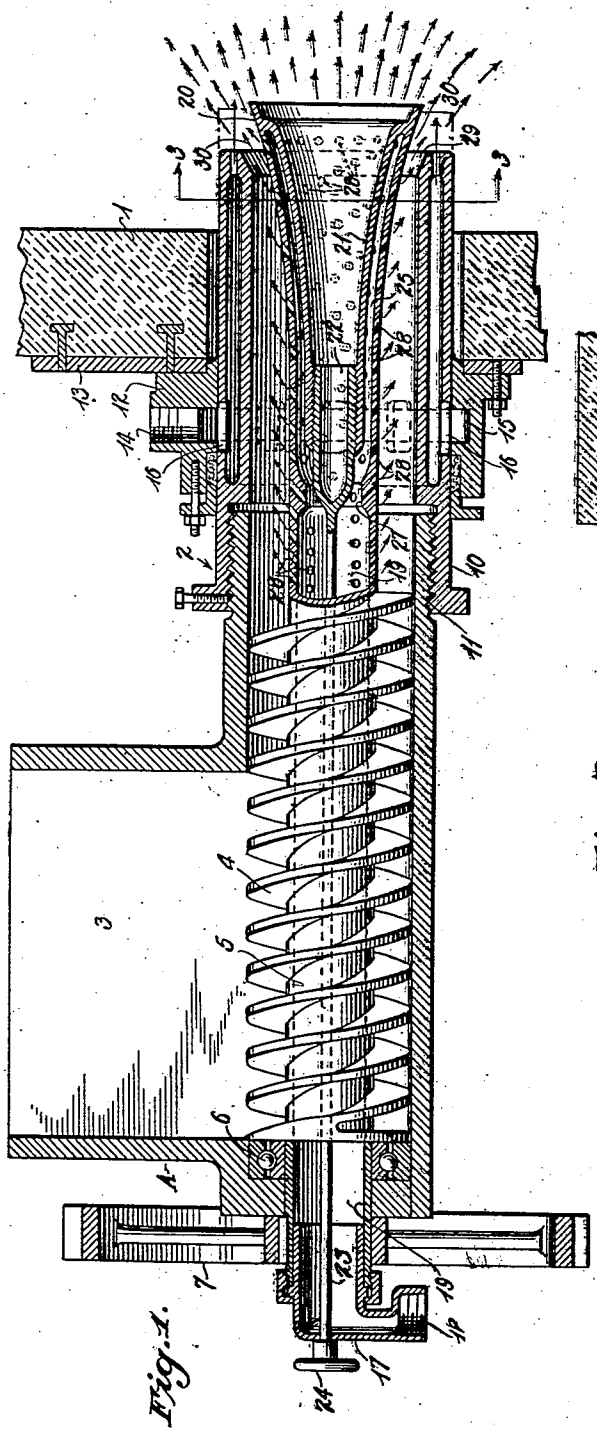


Fig. 1.

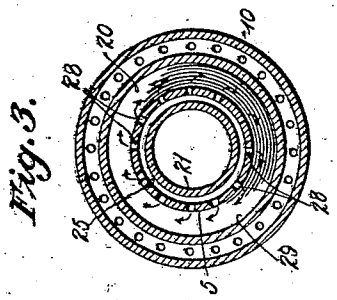


Fig. 3.

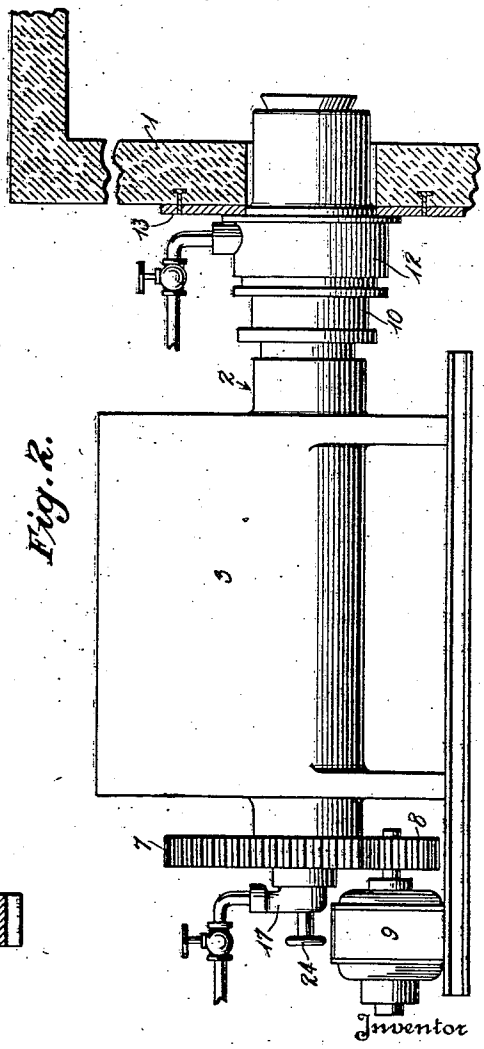


Fig. 2.

Inventor

Walter E. Trent

By Charles M. Thomas

Attorney

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METHOD AND APPARATUS FOR BURNING FUELS

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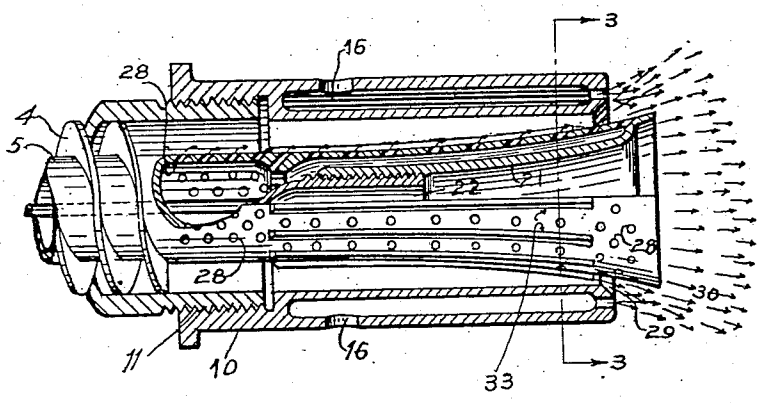


Fig. 4.

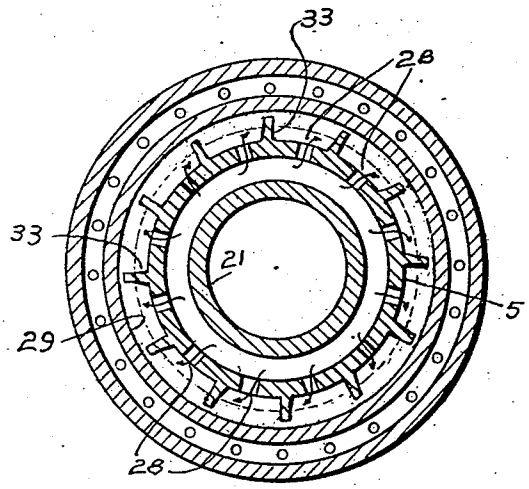


Fig. 5

INVENTOR.
Walter E. Trent
BY Charles M. Thomas
ATTORNEYS.

Patented Sept. 3, 1929. 1,726,870

UNITED STATES PATENT OFFICE.

WALTER E. TRENT, OF NEW YORK, N. Y., ASSIGNOR TO TRENT PROCESS CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

METHOD AND APPARATUS FOR BURNING FUELS.

Application filed April 23, 1926. Serial No. 104,112.

The invention relates to an improved method and apparatus for burning fuels.

The invention has particular application to the burning of fuels, consisting of a mixture of pulverized coal and oil, although it is applicable to the burning of any fuel capable of being extruded.

In carrying out the invention, if a fuel consisting of pulverized coal and oil of a plastic consistency is being used the same is fed in a cylinder or tube form to the furnace while heated air passes through the fuel for the purpose of vaporizing volatiles therein and producing carbonized fuel particles as a residue which are fed with the air and volatiles to the combustion chamber and there consumed. This permits of a more or less perfect combustion of the fuel providing an exceedingly rich mixture as a fuel for the combustion chamber.

It is a further object of the invention to provide a process and apparatus in which auxiliary air may be admitted to commingle with the heated air carrying the volatiles and the carbonized coal particles at a point where such substances are about to enter the combustion chamber.

The invention further comprises an improved form of apparatus for carrying out the process above described.

Figure 1 is a longitudinal sectional view partially shown in elevation of my improved burner.

Figure 2 is a side elevation thereof showing the wall of the furnace in section.

Figure 3 is a sectional view taken along the line 3—3 of Figure 1.

Figure 4 is a longitudinal sectional view of a modified form of my burner employing cutting knives to aid in breaking up the plastic mass.

Figure 5 is a sectional view taken along 5—5 thereof.

Referring now more particularly to the drawings wherein like reference characters indicate corresponding parts, the numeral 1 designates the wall of a combustion chamber. To this wall there is attached a burner 2. This burner embodies a feed hopper 3 in the bottom of which there is a screw conveyor 4. The fuel introduced to this hopper may vary, but I have found that a very successful fuel to use is a mixture of coal in a fine state of sub-division of say from 100 to 200 meshes per linear inch thoroughly admixed with a hydrocarbon oil in such quantities as to be of a plastic consistency. The conveyor is mounted on a hollow shaft 5 that is rotatably supported at the point 6 in the wall of the hopper A. This shaft with the conveyor is rotated by the driving wheel 7 keyed thereto, this wheel being driven by the gear 8 operated by a motor 9. The hopper 3 at its outer end is threaded to the casting 10 by the threads 11. The entire burner is supported on the combustion chamber by the collar 12 having suitable means 13 for engaging and holding the collar to the wall. The collar likewise has an air feeding opening 14 communicating with the annular air passage 15 in the casting, the inner side of this passage being in communication with air discharging slots 16 the annular chamber having apertures at the end thereof by means of which air is injected into the combustion chamber.

At one end the hollow shaft has a rotatable joint with the elbow 17. This elbow has an air inlet 18 by means of which heated air is admitted to the interior 19 of the hollow rotatable shaft. The open end of the elbow may be directed downwardly as shown in Fig. 1 or upwardly as shown in Fig. 2, since the position of this elbow is of no consequence. This air enters the hollow interior of the shaft under pressure and is preferably at a temperature of say 300° C. The hollow shaft near its outer end is bell shaped as indicated by the reference character 20. The cone shaped portion of the shaft extends beyond the edge of the casting 10 and is provided with an imperforate inner annular wall 21 spaced from the outer wall of the shaft. This inner wall is threaded to receive a valve 22 operated by a stem 23 connected with a handle 24. The inner annular wall 21 is spaced from the outer wall of the hollow shaft to provide the air passage 25 through which all the air passing through the hollow interior 19 of the hollow shaft must pass inasmuch as the wall 21 is imperforate and its forward end is closed by the valve 22.

It will be observed that the hollow shaft at a point slightly in front of the forward end of the annular wall 21 is formed with an annular flange or shoulder 27 which serves to coact with the curved surfaces of the valve 22 to vary and regulate the quantity of the air that is to pass to the annular opening 25 at the bell shaped end of the hollow shaft and to also vary the velocity of this air. It will

be furthermore apparent that the outer wall of the hollow shaft is provided with a series of slots 28 extending therethrough from a point immediately in front of the valve to the outer part of the flared end of the shaft and that a space 29 is provided between the end of the casting 10 and that part of the annular end of the hollow shaft to provide an outlet for fuel and gases as shown by the arrows 30 in a manner which will be now described.

In operating the device the hollow shaft is rotated by the gear wheel 7. The screw conveyor on this shaft continuously extrudes or feeds a column of the plastic material from the container or hopper 3 over the surface of the hollow shaft. The surface of this shaft gradually increases in diameter by reason of the flaring end so that this extruded column of material is gradually decreased in thickness as it proceeds along the shaft. At the same time a body of hot air under any desired pressure and of a temperature of say 300° C. is continuously admitted at the air inlet 18 to the hollow interior 19 of the shaft. This air flows rapidly through this hollow shaft and passes out through the series of slots 28 arranged therein. It is apparent that the extruded column of fuel is continuously passing over the perforated end of the hollow shaft and that this column becomes thinner as it approaches the discharge point of the burner. There is no outlet for the air save through the slots 28. This heated air must therefore pass through the column of fuel thoroughly contacting therewith to vaporize the volatiles contained in the fuel and to leave a residue in the form of partially or totally carbonized particles. As the air moves under pressure these particles are swept with the air and gases as indicated by the arrows 30 through the feed opening 29 into the combustion chamber and the gas vapors and fuel particles are there consumed. By reason of this passage of air through the film or tube of material the volatiles are released from the fuel before it enters the combustion chamber producing a fine rich mixture of heated air, oil vapor and carbonized particles. Additional heated air may be introduced to the combustion chamber through the line 14, the annular passage 15, and the outlets 16 of the casting 10, when this air is needed to support combustion or to increase the efficiency of the burner.

The heated air admitted to the hollow shaft should not be of a temperature so high as to cause a fusion of the fine particles when it passes through the column of extruded fuel. In other words, a coking of these particles should not occur. I therefore preferably limit the temperature of this air to a point approximately 300° C. although this temperature will vary depending upon the coal being treated. While the hot air is depended upon to disintegrate the column of fuel by vaporizing the oil and will do so in actual operation, I may, if desirable, as shown in Figs. 4 and 5 place cutting points or knives on the bell shaped end of the hollow shaft as indicated by the reference character 33 for the purpose of assisting in loosening or releasing the material from the surface of the hollow shaft.

It will be furthermore observed that the valve 22 is employed for regulating the quantity of air discharging through the bell shaped end of the hollow shaft.

While the invention has been particularly described as being used for feeding fuel of a plastic nature, it will be understood that it is not limited to use with such a fuel, and is applicable to any fuel that can be fed as a column over the hollow shaft by the feeding conveyor. It will furthermore be understood that gases other than air can be admitted to the hollow interior of the hollow shaft without departing from this invention.

A further embodiment of this invention comprises the feeding of the plastic fuel to a zone where combustion is limited so that gasification and vaporization may occur. For instance, I may feed a mixture of pulverized coal and oil containing some water. This mixture is in a plastic state and fed through the burner as hereinabove described. The heated air passing through the burner carries the steam, vaporized volatiles and fuel particles into the interior of the combustion chamber 1. I regulate the quantity of this air as well as the quantity of auxiliary air admitted through the auxiliary air inlet 14 so that conditions of combustion in the combustion chamber are so perfect that a low temperature distillation of the coal may be effected whereby only a portion of the generated gas and oil vapors are burned so as to distill the oil from the coal particles, which particles in this operation are not consumed. From the so-called combustion chamber, the coal particles and the gases may be collected in any well known manner. In other words, in this process combustion is rendered incomplete by controlling the amount of secondary or auxiliary air admitted to the chamber whereby large quantities of gases and vapors are produced at a low temperature.

Having thus described my invention, what I claim is:

1. A method of burning a fuel of a substantially plastic consistency, which consists in feeding fuel in a hollow form, in blowing heated air through the tube of fuel to vaporize volatiles contained therein, and in discharging the heated air, vaporized volatiles and fuel particles into a combustion zone for combustion.

2. The method of burning a fuel of a plastic consistency which consists in placing said fuel mass in a tubular shape, in heating the

tube to a temperature sufficient to vaporize the volatiles and to leave the residue in a form of carbonized particles, and in introducing such carbonized particles and the vaporized volatiles to a combustion zone.

3. The method of burning a fuel, consisting of pulverized coal and oil of a plastic consistency, consisting in feeding a column of such fuel toward a combustion zone, and in heating such column before it reaches the combustion zone to a temperature sufficient to vaporize volatiles and form a residue consisting principally of carbonized fuel particles, and in introducing such residue and the vaporized volatiles to the combustion chamber for consumption.

4. The method of burning a fuel, consisting of pulverized coal and oil of a plastic consistency, consisting in feeding a column of such fuel toward a combustion zone, and in heating such column before it reaches the combustion zone to a temperature sufficient to vaporize volatiles and form a residue consisting principally of carbonized fuel particles by passing a heated gas through such column, and in introducing to the combustion chamber the residue consisting of the carbonized particles in suspension in said gas with the volatiles removed from the fuel.

5. The method of burning fuel, consisting of pulverized coal and oil of a plastic consistency, which consists in directing a hollow column of such fuel toward a combustion chamber, in passing a heated gas into the interior of such column to pass therethrough and vaporize volatiles contained therein, such gas serving to disintegrate and to carry the released carbonaceous residue in suspension to a combustion chamber where such residue and the removed volatiles are consumed.

6. The method of burning fuel, consisting of pulverized coal and oil of a plastic consistency, which consists in directing a hollow column of such fuel toward a combustion chamber, in passing a heated gas into the interior of such column to pass therethrough and vaporize volatiles contained therein, such gas serving to disintegrate and carry the released carbonaceous residue in suspension to a combustion chamber where such residue and the removed volatiles are consumed, and in supplying auxiliaries to such fuel at its point of combustion.

7. The method of burning a fuel, consisting of pulverized coal and oil of a plastic consistency, consisting in continuously advancing a column of such fuel toward a combustion chamber, in feeding a highly heated gas through such column of fuel before it reaches the combustion chamber to remove volatiles from the fuel and to release the residue in the form of carbonized particles, in directing the heated stream of air to the combustion chamber to carry the released particles in suspension therein to said chamber where they are consumed with the released volatiles, and in introducing additional gas to the combustion chamber at the point of combustion of the fuel.

8. A burner comprising a casing, means for feeding a column of fuel through said casing to the combustion chamber, means for introducing preheated air to the casing to heat said column of fuel to vaporize the volatiles contained therein and to carry said volatiles with the released carbonaceous fuel particles to the combustion chamber.

9. A burner comprising a casing, a hollow element disposed therein, means for advancing a column of fuel over said element, said element having a plurality of apertures near one end, means for feeding preheated gas to the interior of said element to pass through said apertures and the column of fuel surrounding the same to vaporize the volatiles contained therein and produce a residue in the form of particles, and means for admitting the gas, particles and the volatiles to a combustion chamber.

10. A method of burning fuel of a substantially plastic consistency which consists in feeding said fuel in a hollow form, in blowing heated air through the tube of fuel to vaporize volatiles contained therein and at a rate to disintegrate the plastic tubular column and in discharging the heated air, vaporized volatiles and fuel particles into a combustion zone for combustion.

11. A method of burning fuel of a substantially plastic consistency which consists in feeding said fuel in a hollow form and in blowing a heated oxygen containing gas substantially radially outwards through said column to vaporize volatiles contained therein and at a rate sufficient to disintegrate said column and carry the fuel particles thereof to a combustion zone for combustion.

12. A method of burning a fuel of plastic consistency which consists in feeding said fuel mass in a tubular shape, in passing an oxygen containing gas substantially radially outwards through said tube at a rate sufficient to disintegrate said plastic mass and to carry the particles thereof to a combustion zone for combustion.

13. A method of burning a fuel of plastic consistency which consists in slowly advancing a mass of said fuel towards a combustion zone and in applying a sufficient quantity of an oxygen containing gas to said mass prior to reaching said combustion zone at such a rate to disintegrate said mass and carry the particles thereof to said combustion zone.

14. A device for burning plastic fuel comprising a casing having a burner at one end thereof and an annular chamber therein, means to advance a mass of plastic fuel through said annular chamber towards said burner, means to introduce air to the center portion of said casing within said annular

chamber and to discharge air radially outwards through said plastic mass to carry fuel from the burner, and means for discharging an auxiliary supply of air from said burner at a point near its exit to commingle at said point with the discharging fuel to assist combustion thereof.

15. A device for burning plastic fuel comprising a casing having a burner at one end thereof and an annular chamber therein, means to advance a mass of plastic fuel through said annular chamber towards said burner, means to introduce preheated air to the center portion of said casing within said annular chamber and to discharge air radially outwards through said plastic mass to remove volatiles from said fuel and additional means to aid in the disintegration of the advancing fuel mass prior to its approach to said burner.

16. A method of burning a fuel containing pulverized coal, comprising feeding a stream of fuel through a burner, in blowing a heated gas through the advancing stream of fuel to substantially vaporize the volatiles contained therein while in said burner, in discharing heated gas, vaporized volatiles and fuel particles into a zone of combustion where combustion thereof occurs.

17. A method of burning a fuel containing pulverized coal, comprising feeding a stream of fuel through a burner, in blowing a heated gas through the advancing stream of fuel to substantially vaporize the volatiles contained therein while in said burner, in discharging heated gas, vaporized volatiles and fuel particles into a zone of combustion where combustion thereof occurs and in admitting an auxiliary supply of heated gas to said fuel charge substantially at the point it enters the zone of combustion to promote the combustion thereof.

18. A method of burning a fuel of plastic consistency, which consists in advancing such fuel through a burner, in feeding heated gas to the burner under pressure, in directing such heated gas through the advancing body of fuel to cause vaporization of the contained volatiles therein and to carry fuel particles in suspension, and in introducing such gas, vaporized volatiles and fuel particles into a combustion chamber where combustion thereof occurs.

19. A method of burning a fuel of plastic consistency, which consists in advancing such fuel through a burner, in feeding heated gas to the burner under pressure, in directing such heated gas through the advancing body of fuel to cause vaporization of the contained volatiles therein and to carry fuel particles in suspension, and in introducing such gas, vaporized volatiles and fuel particles into a combustion chamber where combustion thereof occurs and in supporting the combustion of such fuel mixture by injecting into the mixture substantially at the point it leaves the burner an auxiliary supply of heated gas.

20. A method of burning fuel containing pulverized coal consisting in advancing a hollow column of such fuel through a burner, in feeding heated gas to the burner and in discharging said gas radially through the column of fuel travelling through the burner to vaporize volatiles contained therein and to carry the fuel particles in suspension, and in discharging said gas with contained volatiles and fuel particles into a zone of combustion.

In testimony whereof I affix my signature.

WALTER E. TRENT