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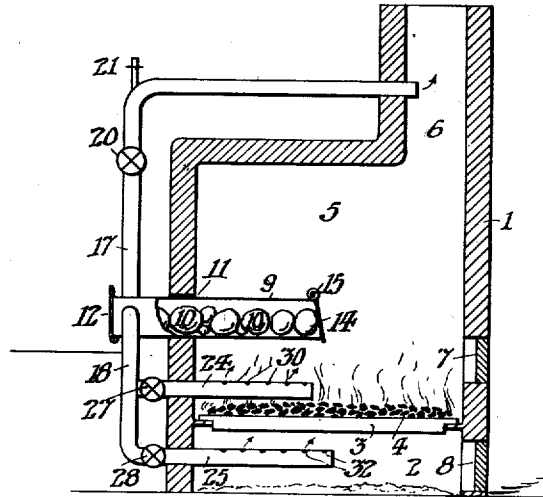
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FRACTIONAL COMBUSTION APPARATUS

Filed August 8, 1923

2 Sheets-Sheet 1

FIG. 1.



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UNITED STATES PATENT OFFICE.

PROSPER JEAN AUGUSTE MAIGNEN, OF PHILADELPHIA, PENNSYLVANIA.

FRACTIONAL COMBUSTION APPARATUS.

Application filed August 8, 1923. Serial No. 656,342.

My invention is particularly adapted for the combustion of fuels containing notable quantities of moisture, for instance, peat, lignite, wood, weeds, garbage and other vegetable refuse. However, it may also be advantageously employed for the economical combustion of non-caking coals and for fuel briquets made of peat mixed with combustible oil, mixtures of bituminous coal and peat; bituminous coal, peat and oil; or any other kind of fuel containing volatile combustible matter.

Briquets of the character above contemplated are the subject matter of my copending application Serial 325,049 filed September 20, 1919 for Letters Patent of the United States, and this application includes matter disclosed in that application.

As hereinafter described, apparatus of the character herein contemplated, is adapted to subject fuel to several distinct steps in the process of combustion of the same. For instance, first, a desiccating operation in which moisture is evaporated from the fuel. Second, a distilling operation in which volatile combustible matter is liberated from the fuel and consumed as gas. Third, the operation of burning the fixed carbon or carbonized matter of the fuel, in the form of incandescent coke.

In the above contemplated step by step process of combustion, the different elements of the fuel do not interfere with one another during combustion, as is the case in ordinary furnaces. Consequently, such step by step combustion renders available the entire energy of each element of the fuel, as hereinafter described. However, it is to be particularly noted that one of the most valuable features of my invention is that there is no loss of sensible heat at any stage of the combustion of the fuel.

My invention includes the various novel features of construction, arrangement and procedure hereinafter more definitely specified. However, it may be here noted that in its simplest form, my invention includes a container, with such openings as may be necessary for the introduction of fuel, for the escape of the non-combustible and combustible volatile matter, and for the expulsion of the carbonized matter, after it has been deprived of the volatile matter. Such a container, charged with fuel, may be placed in a furnace or in an oven-like chamber and subjected to heat. When the temperature

of the fuel in the container has been raised to about two hundred twelve degrees F., the moisture in the fuel is vaporized and expelled, before any of the combustible gases are liberated. The water vapor thus generated may be allowed to escape directly into the furnace, in small installations, but in large installations, I prefer to provide a conduit for such vapor with a valve, controlling the escape of the vapor into the chimney or other passageway to the outer air. When all the watery vapor aforesaid has escaped; continued heating of the fuel liberates hydrogen or light hydrocarbon gases. Thereupon, said valve controlling the escape of the watery vapor is closed, and the fuel container may be provided with another valve controlled conduit to direct the combustible gases aforesaid into the furnace, either above or below a flaming source of heat therein, if it is desired to thus effect combustion of such gases. However, such inflammable gases may be otherwise discharged from the container. When it is desired to separate the light from the heavy hydrocarbon gases, the container aforesaid may be provided with two outlets, preferably valve controlled, one arranged to deliver the light hydrocarbon gases to the furnace above the fire, and the other conduit arranged to deliver the heavy hydrocarbon gases below or into the fire. When all the volatile matter is expelled from the fuel, the carbonized residue of the fuel remaining in the container may be pushed out of the latter into the furnace, to be there consumed. As hereinafter described, more complex forms of my invention may include mechanical means for effecting such discharge.

In said drawings; Figs. I is a diagrammatic vertical sectional view of an apparatus embodying my invention, which may be used as a househeating furnace.

Fig. II is a diagrammatic vertical sectional view of a multiple form of apparatus embodying my invention, wherein the several steps of the process above contemplated are effected in successive portions of the apparatus.

Fig. III is a diagrammatic vertical sectional view of another multiple form of apparatus, including means for mechanically shifting the solid portions of the fuel from one region of the apparatus to another in succession.

Fig. IV is a diagrammatic vertical sectional view of apparatus of the multiple type indicated in Fig. V, but more simply and compactly arranged.

Referring to the form of my invention shown in Fig. I; the furnace casing 1 incloses the ash pit 2, grate 3, base fire 4, and the combustion chamber 5, and the latter is provided with the chimney flue 6. Said casing 1 is conveniently provided with the door 7 opening into said combustion chamber 5 above said grate 3, and with the door 8 opening into said ash pit 2 below said grate. The base fire 4 upon said grate 3 may be formed of any suitable fuel, for instance, wood, coal or carbonized products of the process herein contemplated.

My fractional combustion apparatus applied to said furnace casing 1, includes the fuel container 9 for the fuel 10, fractional combustion of which is to be effected. Said container 9 is preferably removably secured in the opening 11 in said casing 1 so that its outer end projects exterior to said casing, where it is provided with the removable closure 12. The inner end of said container 9 overhangs said grate 3 and fire 4, and is conveniently provided with the closure 14, which may be a check valve pivoted at 15 to said container so as to normally close the inner end of the latter, by gravitation. Said container 9 is conveniently provided, exterior to said casing 1, with the conduits 17 and 18. Said conduit 17 extends into the chimney flue 6, and is adapted to discharge watery vapor and other incombustible volatile matter into said flue. Said conduit 17 is conveniently controlled by the valve 20; which is located between said container 9 and the indicator 21, which latter may be of any suitable character to manifest the nature or condition of the flue contained in the conduit 17 at any instant. For instance, said indicator 21 may be a pilot light, or a thermostat; such light serving to indicate whether the fluid contents of said conduit 17 are combustible or not, and such thermostat indicating the temperature of such contents. Said conduit 18 is conveniently provided with two burner branches 24 and 25; respectively independently controlled by the valves 27 and 28. Said conduit 24 extends into the combustion chamber 5 of the furnace, above the fire 4, and has a series of outlets 30 for hydrogen or light hydrocarbons which may be directed there-through, to effect their combustion in said chamber 5. Said conduit branch 25 extends into the ash pit 2, below the grate 3, and is provided with a series of outlets 32 for heavy hydrocarbons which may be directed there-through to effect their combustion by means of said base fire 4.

Said apparatus shown in Fig. I may be

operated to effect the step by step process of combustion above described by charging said container 9 with fuel 10 which is thus heated by the base fire 4. During the first step, of desiccation of said fuel 10, the container closures 12 and 14, and the conduit valves 27 and 28 remain shut, but the valve 20 remains open and the indicator 21 is in operative condition. Said desiccating operation is continued until all of the incombustible volatile matter is eliminated from the fuel 10. As above noted; the termination of that operation may be indicated either by the temperature or flame manifestation of the indicator 21. Thereupon, said valve 20 is closed and the valve 27 opened to permit the escape of hydrogen and lighter hydrocarbons into the furnace chamber 5 where they are ignited and consumed. As the fuel 10 continues to be distilled by the heat from said base fire 4 and from the burner branch 24; all of the more volatile combustible elements of said fuel are thus consumed. As soon as heavier hydrocarbons are distilled from said fuel 10; said valve 27 of the burner branch 24 is closed and the valve 28 of the burner branch 25 is opened, to deliver such heavier hydrocarbon distillates beneath said grate 3 through which they are drawn up by the draft through said base fire 4 and ignited by the latter. When all of the volatile constituents of said fuel 10 are thus successively eliminated and consumed; said closure 12 may be opened and the carbonized residue of the fuel 10 be discharged from said container 9 on to said base fire 4, through the inner end of said container 9 which is normally closed by said gravity check valves 14; so that such carbonized residue of the fuel 10 is thereafter consumed in said combustion chamber 5.

Referring to the form of my invention shown in Fig. II; the fuel container element of my invention is conveniently formed in three sections 46, 47 and 48; so constructed and arranged that the fuel 50 may be subjected to the three successive steps above contemplated, simultaneously, in said three sections of the container. To effect that result; said sections are respectively provided with valves 52, 53 and 54, controlling the introduction of fuel to said sections, and said sections are respectively provided with the conduits 56, 57 and 58 for the discharge of the volatile constituents of said fuel 50 under control of the respective valves 60, 61 and 62. Said fuel 50 is conveniently introduced to the apparatus of Fig. IV through the hopper 64, when the slide valve 52 of the container section 46 is withdrawn. After the first step of the fractional distillation process above contemplated has been effected with respect to that initial charge of fuel in said section

46; the slide valve 53 is withdrawn from the container section 47 and the fuel previously treated in the section 46 then discharged into the container section 47, where it is subjected to the second step of the process aforesaid, while a fresh charge of fuel is being treated in said section 46. After the completion of the second step in the treatment of said fuel 50 in said container section 47; the slide valve 54 is withdrawn with respect to the container section 48, and said fuel discharged into the latter, which is normally closed by the door 66 which is pivoted at 67. Thereupon, the charge of fuel 50 which has been treated in the section 46 is shifted into the container section 47 and a fresh charge of fuel 50 introduced to said section 46. Whereupon, the fuel 50 contained in the three container sections 46, 47 and 48 may be simultaneously subjected to the three steps of said process. Thereafter, the carbonized residue of the fuel 50 remaining in the container section 48 may be discharged from the latter upon the endless belt 68 carried by the drums 69 and 70, and be thereby transferred toward the place where it is to be consumed.

Of course, the step by step operation above described with reference to Fig. IV may be continued indefinitely; the container section 46 being subjected to a temperature of two hundred twelve degrees F., so that watery vapor and other incombustible fluids may be discharged through the conduit 56 and valve 60; said container section 47 being subjected to a temperature approximately four hundred eighty degrees; so that hydrogen and the lighter hydrocarbons may be discharged through the conduit 57 and valve 61; and said container section 48 being subjected to a temperature of seven hundred degrees F., or more; so that the heavier hydrocarbons may be discharged through the conduit 58 and valve 62.

In the form of my invention shown in Fig. II; the above contemplated intermittent movement of the fuel 50 through the apparatus may be effected by manually operative tools such as pokers and slice bars. However, I prefer to provide such multiple apparatus with mechanical means, for automatically effecting the intermittent movement of the fuel which is undergoing fractional distillation, as indicated in Fig. III.

Referring to the form of my invention shown in Fig. III; the fuel container comprises sections 72, 73 and 74 respectively provided with outlet conduits 76, 77 and 78 controlled by respective valves 79, 80 and 81. Said fuel container sections 72, 73 and 74 are respectively provided with the rotary screw conveyers 83, 84 and 85 which may be simultaneously rotated to progress the fuel 86 through the apparatus, when the slide valves 88, 89 and 90, which normally serve

as closure for the forward ends of said sections 72, 73 and 74 are raised from the position shown in Fig. III. Said fuel 86 may be thus discharged from said container section 74 on to the endless belt 92 and conveyed thence by rotation of the drums 98 and 94 which support said belt.

The form of my invention shown in Fig. IV is a simpler and more compact embodiment of the multiple type of apparatus above contemplated. In that figure; the furnace casing 96 incloses the combustion chamber 97 containing the grate 98 for the base fire 99 and provided with the chimney flue 100. In Fig. IV the fuel container includes the sections 102, 103, 104 and 105 which are similar cylindrical tubular elements disposed in coaxial relation and having the common axial shaft 107 carrying respective screw conveyers 108, 109, 110 and 111. Said container sections 103, 104 and 105 are respectively provided with outlet conduits 113, 114 and 115, respectively controlled by valves 117, 118 and 119, and said conduits 113, 114 and 115 may have respective burner branches 121, 122 and 123, with series of openings arranged to discharge into the combustion chamber 97, the volatile matter distilled from the fuel 125 in said container sections. As indicated in Fig. IV, I find it convenient to support the endless belt 126 upon the drums 127 and 128, so that the carbonized residue 130 of said fuel 125 may be conveyed to or from said grate 98. It may be observed that as indicated in Fig. IV; some of said carbonized fuel residue 130 is supported by said belt 126 in cooperative relation with the respective burner branches 121, 122 and 123.

Therefore, it is to be understood that various modifications may be made in the construction, arrangement and operation of my invention, without departing from the essential features thereof, as defined in the appended claims.

I claim:

1. In fractional combustion apparatus, the combination with a furnace casing provided with a vent chimney; of means arranged to maintain a base fire in said casing; a hollow fuel container; means arranged to conduct volatile products of distillation of fuel from said container; including separate conduits respectively for incombustible and for combustible matter; burner branches extending from the latter conduit and provided with respective controlling valves; said burner branches being disposed respectively above and below said base fire.

2. In fractional combustion apparatus, the combination with a furnace casing provided with a vent for products of combustion; of means arranged to maintain a base fire in said casing; a hollow fuel container; means arranged to conduct volatile products of dis-

tillation of fuel from said container, including a conduit; burner branches extending from said conduit and provided with respective controlling valve; said burner branches being disposed respectively above and below said base fire.

3. In fractional combustion apparatus, the combination with a furnace casing provided with a chimney vent; of means arranged to maintain a base fire in said casing; a hollow fuel container; means for the introduction

of raw fuel, and for the discharge of carbonized matter; means for the escape of the incombustible volatile matter; and means for the escape of the combustible gases including a valve controlled conduit directing said gases into the furnace, in cooperative relation with the base fire.

In testimony whereof, I have hereunto signed my name at Philadelphia, Pennsylvania, this sixth day of January, 1923.

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5 branches being disposed respectively above and below said base fire.

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Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,592,281, granted July 13, 1926, upon the application of Prosper Jean Auguste Maignen, of Philadelphia, Pennsylvania, for an improvement in "Fractional Combustion Apparatus," an error appears in the printed specification requiring correction as follows: Page 3, line 29, for "Fig. IV" read *Fig. II*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3d day of August, A. D. 1926.

[SEAL.]

M. J. MOORE,
Acting Commissioner of Patents.

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