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H. T. DYER

1,738,176

FUEL BURNER

Filed April 28, 1926

2 Sheets-Sheet 1

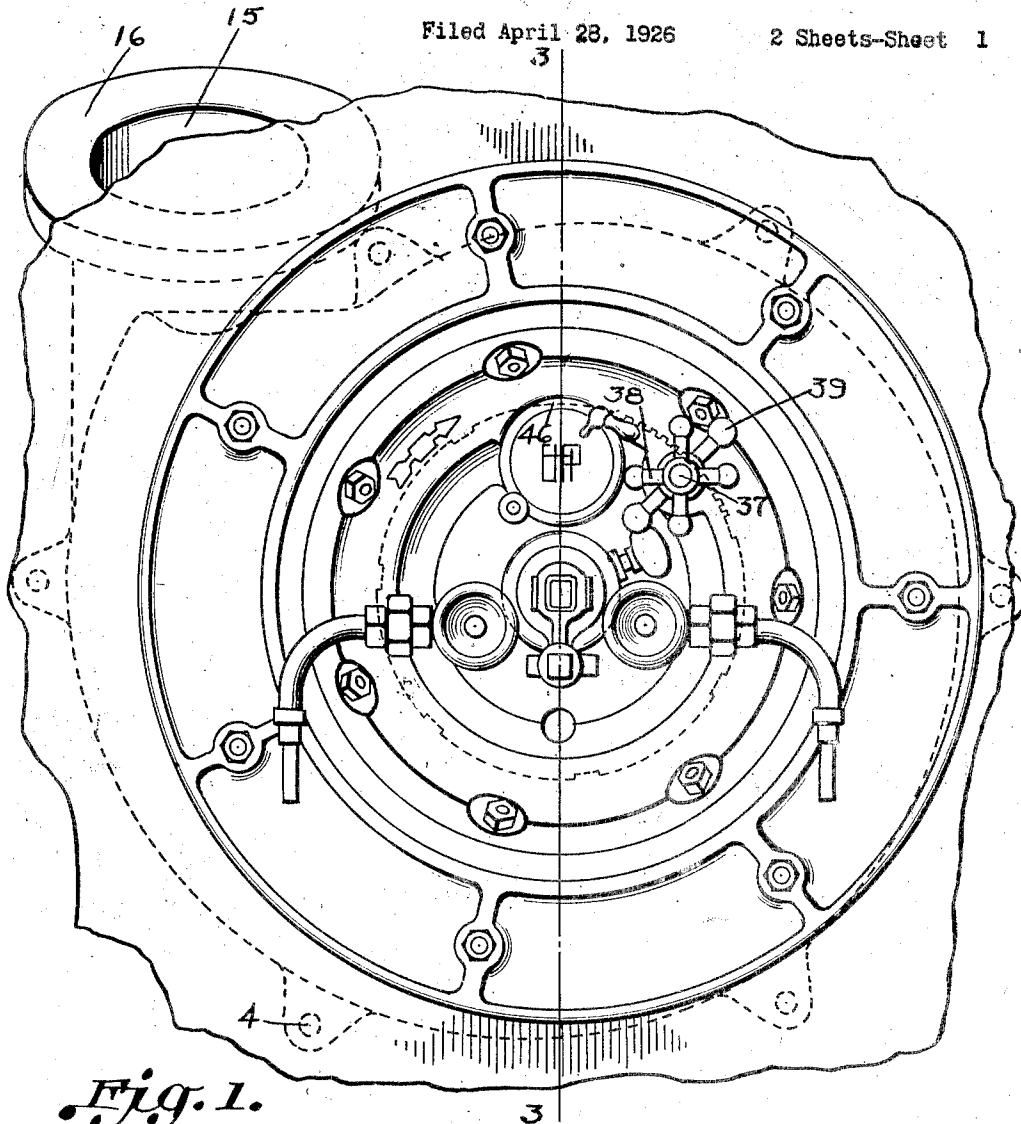


Fig. 1.

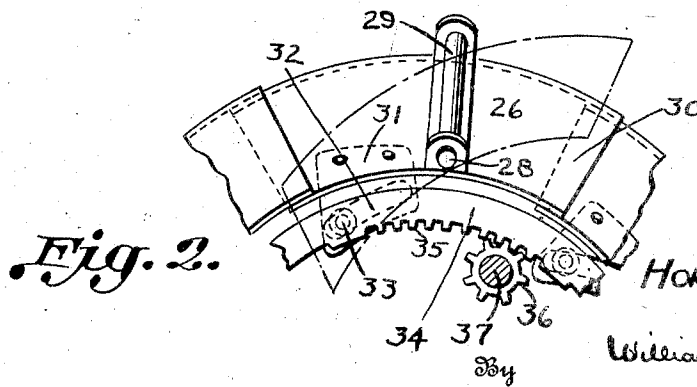


Fig. 2.

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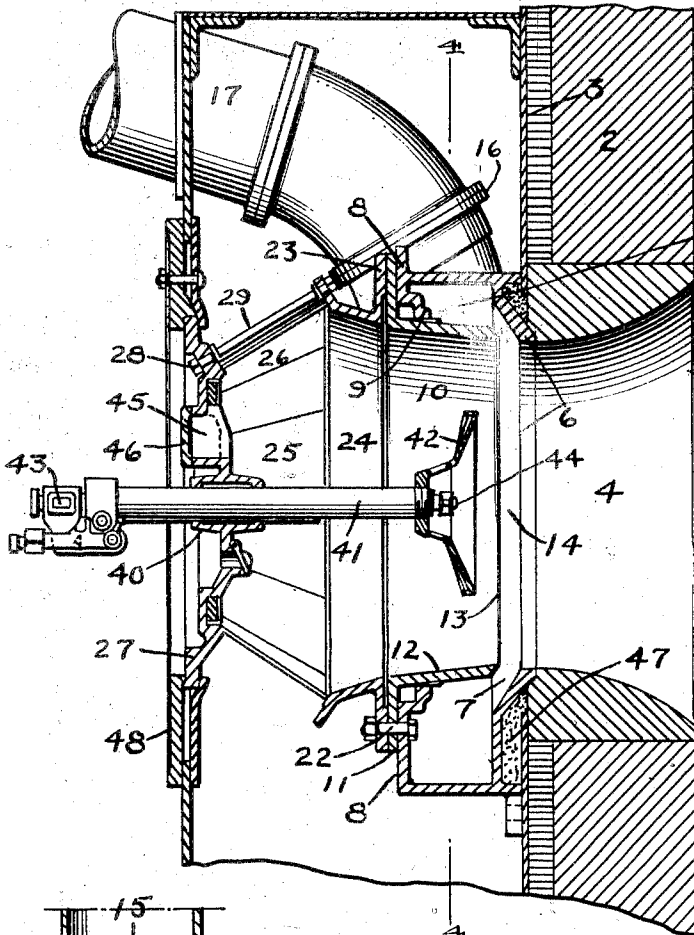


Fig. 3.

Fig. 5

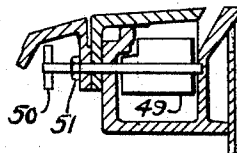
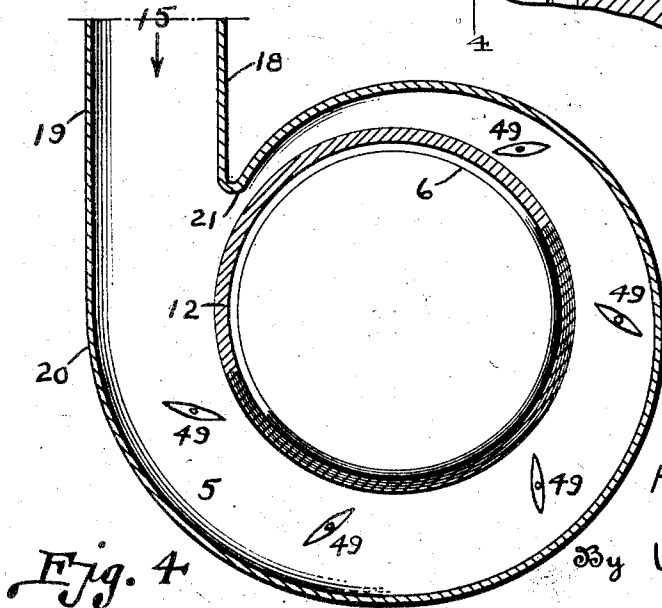


Fig. 4

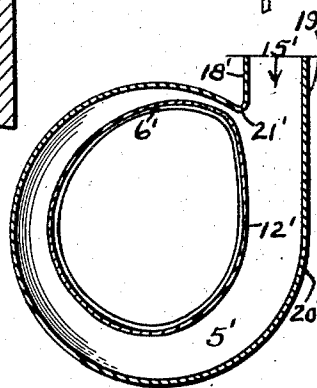


Fig. 6

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FUEL BURNER

Application filed April 28, 1926. Serial No. 105,170.

This invention relates to improvements in burning pulverized fuel and has for its object the combination of pulverized fuel with the necessary air for combustion in such a way as to produce a very intimate mixture of air and fuel, and the creation of a turbulent effect in the gases of combustion which still further promotes this mixture and hastens combustion.

Another object of the invention is to burn pulverized fuel with a short flame so that this fuel may be satisfactorily employed in furnaces of normal or moderate volume.

Another object of the invention is to provide a pulverized fuel burner—so arranged that by an adjustment of fuel and air the rapidity of combustion and consequently the flame length may be controlled. A still further object is to produce a pulverized fuel burner which may readily be used in connection with liquid fuel burners particularly burners of the mechanical atomizing type.

These and other objects of my invention will be apparent from the following description and accompanying drawings.

Figure 1, front elevation.

Figure 2, detail of mechanism for operating air doors.

Figure 3, vertical section on the plane of the line 3—3 of Figure 1.

Figure 4, cross section on the plane of line 4—4 of Figure 3.

Figure 5, detail of adjustable vanes.

Figure 6, sectional view of a modified form of the fuel conduit.

The furnace chamber 1 is provided with a wall 2 of refractory and insulating material backed by a casing plate 3 and provided with an opening or throat 4. Attached to the plate 3 by suitable bolts, there is a member 5, the special form of which is shown most clearly in the sectional view of Figure 4. It will be seen that there is a circular opening in one side of this member and that the circular rim 6 corresponds in diameter with the throat opening 4. The side 7 of the member 5 is flared at an angle toward the furnace so that it forms a frusto-conical surface in the side wall of the member 5, the axis of this frusto-

conical surface passing through the center of the circle formed by the rim 6.

The outer wall 8 of the member 5 is provided with a flange 9 which also contains a circular opening concentric with but somewhat greater in diameter than the circle formed by the rim 6. This circular seat 9 is made to interfit with and support a member 10 having a flange 11 and a frusto-conical or cylindrical wall 12 which extends toward the inclined wall 7 and is finished with a beveled circular face 13. The beveled face 13 corresponds with the inclined wall 7 and forms therewith a passage or outlet 14 which is of annular form and which can be made of any desired width and angle to the axis.

It will be obvious that when the two members 5 and 10 are assembled together and held by the bolts 22 which pass through the flange 11, they form an enclosed box or conduit around the central circular core formed by the wall 12 of the member 10. The annular opening 14 provides an outlet from this space. A hollow projection 15 in one side of the member 5 provides an inlet to this enclosed conduit. A flange 16 is provided to receive the fuel delivery pipe 17 by any suitable means. One plane of the side wall 18 of this inlet passage 15 is substantially tangential to the circle formed by the inner wall 12 of the member 10. The outer wall 19 of the inlet 15 is substantially parallel to wall 18 and is tangential to the outer wall of the member 5 at the point 20. This outer wall of the member 5 is, however, not a circle but a scroll or curve of gradually decreasing radius so that the outer wall gradually approaches the inner wall 12 until it practically touches it at the point 21. The combination of the members 5 and 10 therefore forms practically an enclosed box or conduit which is circular on the inside and of decreasing radius of curvature from the inlet on the outside, and which is provided with an annular outlet 14 and a tangential inlet 15.

It is obvious that the construction just described is but one of many forms which may be used to provide a predetermined amount of fuel and carrier medium to each section of the annular throat. That is, the walls of the

chamber may be as shown in Figure 4, or as two concentric or excentric circles, or as shown in Figure 6 where the wall 20' is a part of a circle and the wall 12' a curve of varying radius, the chamber being provided with an inlet 15' and annular outlet, or the walls may be of various curves so arranged to produce the desired cross-sectional area of chamber.

The bolts 22 which fasten the members 5 and 10 together are made long enough to pass through the flange 23 of the member 24 which forms the back plate of an air register 25 having inlet doors 26. The front plate 27 of the register is fastened to the back plate 24 by means of the pipe spacers 29 and the bolts 28 which hold the two plates in fixed relation. These pipe spacers also serve as supports for the doors 26 which are hinged thereon and which are overlapped as illustrated at the point 30, Figure 2. The doors, when simultaneously rotated, thus provide air passages of such form that the air on passing through the register is given a whirling motion. The means for rotating these doors is shown on Figure 2 as follows: On each door there is a clip 31 provided with a recess 32 to receive the pin 33. The number of pins corresponds with the number of doors and the pins are carried on a ring 34 provided with a circular rack 35 which meshes with the pinion 36 carried on the shaft 37. Thus when the ring 34 is rotated in one direction or the other, it simultaneously opens or closes all the doors. The shaft 37 is rotated by means of the handle 38 and may be locked in any desired position by the lock nut 39, Figure 1. Supported on the bearing 40 of the front plate 27, there is provided a pipe 41 which carries on its inner end a diffuser 42, and on the outer end, a special yoke coupling by means of which a liquid fuel burner 43 is held in position so that the tip 44 of the liquid fuel burner is so located that it will deliver a spray of liquid fuel in the form of a diverging cone through the throat or opening 4. An opening 45 (see Fig. 3) is provided in the front plate for inspecting the burner and for the insertion of a torch for lighting, and is normally covered by a swinging cover plate 46.

The member 5 is provided with a recess 47 which may, if desired, be filled with insulating material to protect the member against any heat which may be transmitted through the refractory wall 2.

It will be noted that the edge 13 of the member 10 is so designed as to conform with the conical face 7 of the member 5, and thus provide a passage which is inclined toward the center of the opening 4. Each of these two surfaces is substantially a frustum of a cone. It is obvious that the side 7 instead of being in the form of a frusto-conical surface, may be curved.

It is entirely possible to operate this burner

by drawing air for combustion through the register by natural draft. Should it be desired, however, to use forced draft, I provide a housing, which in combination with the plate 3 and the front plate 27 of the air register and the finish ring 48 forms an air tight closed box surrounding the air register and fuel burner, and to which air under pressure is admitted through a suitable opening, not shown. The removable plate or finish ring 48 is provided for closing in the space between the front housing plate and the front plate 27 of the air register. Upon the removal of this plate 48, the air register 27 may be removed through an opening in the plate without disturbing the remainder of the housing.

If desired adjustable guide plates or vanes 49 may be pivotally mounted within the scroll, for the purpose of guiding and controlling the stream of fuel. The pivotal supports for the vanes 49 are extended through the wall of the members 5 and 8 between the bolts 22 and are provided on their outer ends with a handle 50 and lock nuts 51 as shown in Figure 5 by which they may be adjusted and locked in any desired position. Access may be had to the handle 50 and lock nuts 51 through the opening in the front housing plate when the finish ring 48 is removed. As shown in Fig. 1, the plate 48 is held to the front housing plate by means of bolts and dogs. When the bolts are loosened the dogs may be rotated and the plate 48 removed.

In operation: Pulverized fuel in suspension in air or a combustible gas is forced through the pipe 17 under suitable pressure to the inlet 15 of the burner, filling the scroll chamber and passing out through the annular outlet 14 to the throat 4 and so to the furnace 1.

Due to the tangential inlet and varying volume form of the chamber, certain predetermined quantities of carrier medium and fuel which may or may not be equal, as desired, will pass out of each equal section of the annular outlet in a thin sheet with a whirling motion relative to the axis of the throat. Upon passing out of the annular outlet, this thin sheet of combustible material is mixed with a whirling column of air which is entering through the air register and passage formed by the wall 12 of the member 10. These two whirling columns, whose direction of rotation may be the same or opposite impinging upon each other at an angle produce very great turbulence of the mixture and consequently complete mixing of the fuel and air. This turbulent effect is carried on into the furnace so that rapid combustion of the fuel is secured.

It will be obvious from the construction that the amount of fuel and also of carrier medium such as air, admitted through the inlet 15 may be varied through wide limits, as can also the air admitted through the regis-

ter, so that any proportions may be maintained. Consequently the total amount of air may be readily controlled and the resulting atmosphere in the furnace may be reducing, neutral or oxidizing as may be desired.

Although for any given condition it may be desirable to maintain constant the proportions of carrier medium and air through the air register, it may be required for modifying the character of combustion to vary the velocity of the air through the throat 12, which will increase or decrease the turbulence of the final mixture. As will be seen from the construction this may be readily accomplished by opening or closing the air doors on the air register, which will decrease or increase the velocity of the air through them, but by a proper adjustment of furnace pressure and wind box pressure will not change the quantity of air passing through the register. By locating the liquid fuel burner practically concentric with the air register and throat and adjustable therein, liquid fuel may readily be burned in the manner usual with such burners. Also for modifying the combustion as may be desired, additional air or fuel may be admitted at the same time through the pulverized fuel burner, so that the combination is suitable for operation with either fuel alone, or both together at the same time. Furthermore, the pulverized fuel is usually more difficult to ignite than the liquid fuel, particularly if the furnace is cold; consequently this combination provides a ready means for lighting off the pulverized fuel, for by inserting a torch through the opening 45 in the air register the liquid fuel may be readily lighted, thus supplying a conical sheet of flame to the throat 4. Upon starting the flow of pulverized fuel, it passes out of the annular opening 14 and immediately impinges upon the conical sheet of flame from the liquid fuel burner and cannot escape into the furnace without passing through this flame. Therefore the fuel is immediately ignited. If desired, the liquid fuel burner may then be shut off and the operation continued with the pulverized fuel burner. Other means may, if desired, be used for igniting the pulverized fuel.

What I claim is:

1. A burner comprising a fuel chamber provided with a tangential inlet and an annular outlet, the chamber being in the form of an involute scroll.

2. A burner comprising a fuel chamber in the form of an involute scroll and provided with a slot in the annular wall of the chamber on the side nearest the center.

3. A burner comprising a fuel chamber in the form of an involute scroll provided with an annular outlet for the fuel in the central annular wall of the chamber at an angle to the axis of the chamber.

4. A burner comprising a fuel chamber

in the form of an involute, the annular wall on the side nearest the center being frusto conical.

5. A burner comprising a fuel chamber in the form of an involute surrounding an air passage and having a slot in the inner wall of the chamber communicating with said air passage.

6. A burner comprising a fuel chamber in the form of an involute surrounding an air passage and having a slot in the inner wall of the chamber communicating with said air passage, said slot being formed at an angle to the axis of said passage.

7. A burner comprising a fuel chamber provided with a tangential inlet and an annular outlet, the chamber being in the form of an involute scroll, the walls of said outlet being at an angle to the axis of the chamber.

8. A burner comprising a fuel chamber in the form of an involute scroll and provided with a tangential inlet, the inner wall of said chamber being frusto-conical and having an annular outlet therein, the walls of said outlet being at an angle to the axis of the chamber.

9. A burner comprising a fuel chamber in the form of an involute surrounding a passage for air for combustion, a wall of said chamber having an outlet to discharge the fuel into the combustion air flowing through said passage.

10. A burner comprising a fuel chamber provided with a tangential inlet and an annular outlet, the chamber being in the form of an involute scroll, an air register secured at the front of said chamber, and means for giving the air a whirling motion.

11. A burner comprising a fuel chamber in the form of an involute, the annular wall on the side nearest the center being frusto-conical and having an outlet for the fuel, an air register secured at the front of said chamber, and means for giving the air a whirling motion.

12. A burner comprising a fuel chamber in the form of an involute surrounding a passage for air for combustion, a wall of said chamber having an outlet to discharge the fuel into the combustion air flowing through said passage, an air register in front of said chamber, and means for giving the air a whirling motion.

13. A burner comprising a fuel chamber in the form of an involute and provided with a tangential inlet, a wall of said chamber being frusto-conical for directing air for combustion and having an outlet for the fuel converging toward the axis of the chamber, an air register in front of said chamber, and means for giving the air a whirling motion.

14. A burner comprising a hollow fuel chamber having one wall in the form of a scroll and another wall in the form of a frustum of a cone whereby said chamber is an-

nular and of decreasing cross sectional area, said chamber having a tangential inlet and a discharge outlet, the walls of said outlet being inclined to the axis of the chamber, an air register secured to said chamber at the front thereof, and means for giving the air a whirling motion.

15. A burner comprising a fuel chamber with a tangential inlet, one wall of said chamber being in the form of a scroll and another wall in the form of a frustum of a cone, whereby said chamber is annular and of decreasing cross-sectional area from said inlet, said chamber surrounding an air passage and having a discharge outlet to direct the fuel into said passage in the form of a converging cone, an air register secured to said chamber in front thereof, and means for giving the air a whirling motion.

20 16. In combination, a furnace having a wall with an opening therein constituting the furnace throat, said throat increasing in diameter from the front to the rear thereof, a fuel burner secured to the furnace wall in front of the throat, said burner being in the form of an involute scroll having a tangential inlet and an outlet, the walls of said outlet being inclined to the axis of the burner, an air register secured to said burner at the front thereof, and means for giving the air a whirling motion.

25 17. In combination, a furnace having a wall with an opening therein constituting the furnace throat; said throat increasing in diameter from the front to the rear thereof, a fuel burner secured to the furnace wall in front of the throat, said burner being in the form of an involute scroll and having a tangential inlet, the inside wall of said burner being frusto-conical and having a discharge outlet, the walls of said outlet being inclined to the axis of the burner to thereby discharge the fuel in the form of a converging cone, an air register secured to the front of the burner, and means for giving the air a whirling motion.

30 18. Apparatus of the type described which comprises a conduit for air and finely divided suspended fuel, having a portion of involute curvature about a central passage to rotate said air and finely divided fuel passing there- through and having a rear wall provided with an annular opening about said central passage to form an annular fuel jet, means for directing a blast of air rearwardly through said central passage and means for giving said central blast of air a rotation reverse to that of the air issuing from said involute conduit.

35 19. Apparatus of the type described which comprises a cylindrical passage, means for supplying a blast of secondary air through said passage, a conduit for primary air and suspended fuel particles having an outer wall curving in the form of an involute about said

cylindrical passage to form a curving passage of decreasing width, and a rear wall having an annular opening about and adjacent said cylindrical passage.

20. Apparatus of the type described which comprises a secondary air box having an opening in one wall, a door closing said opening, a primary air and fuel conduit mounted on the opposite wall and converging and curving in the form of an involute about a central passage and having an annular outlet through said wall about said central passage, a surface curved inwardly and rearwardly from the outer edge of said outlet, means for controlling the passage of air and fuel through said outlet and means for controlling the passage of air through said central passage.

21. Apparatus of the type described which comprises a secondary air box, a primary air and fuel conduit mounted within and at one wall of said box and converging and curving in the form of an involute about a central passage to give said primary air and fuel a movement of rotation in passing there- through and having an annular outlet through said wall about said central passage, means to direct air from said outlet inwardly and rearwardly, means for rotating air passing through said central passage reversely to that leaving said outlet, means for controlling the passage of air through said outlet and means for controlling the passage of air through said central passage.

In testimony whereof I affix my signature.

HORACE T. DYER.