April 6, 1965 E. S. DOWNS 3,176,749

LIQUID FUEL-BURNING HEATER

Filed Feb. 25, 1963 3 Sheets-Sheet 1

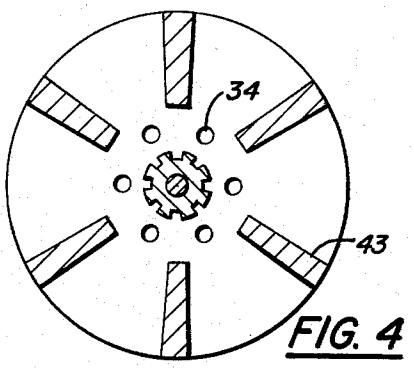


FIG. 4

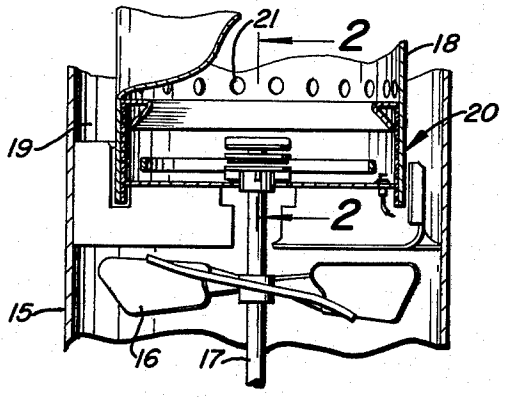


FIG. 1

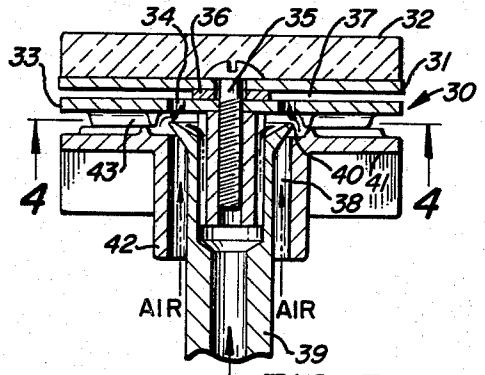


FIG. 3

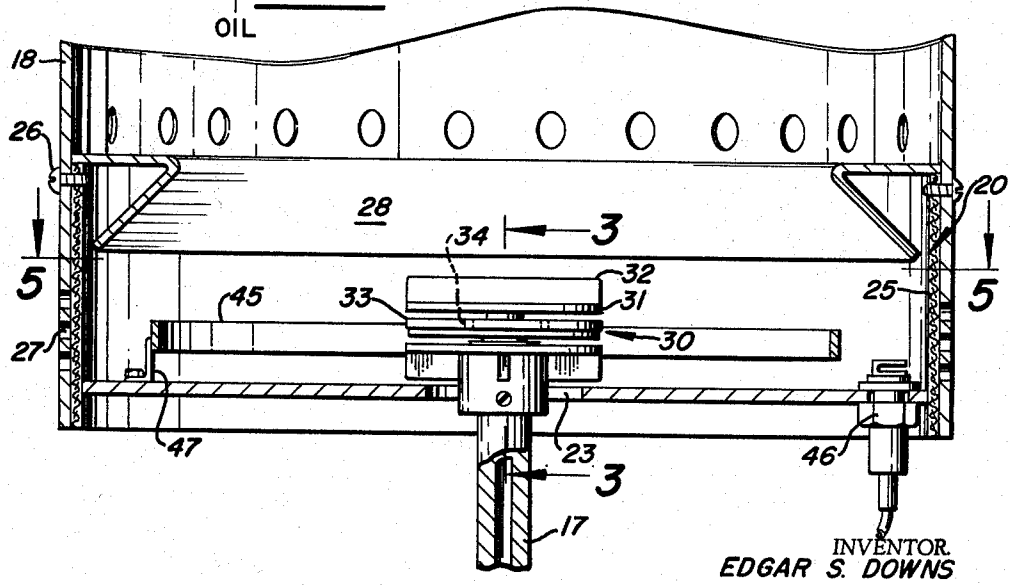


FIG. 2

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LIQUID FUEL-BURNING HEATER

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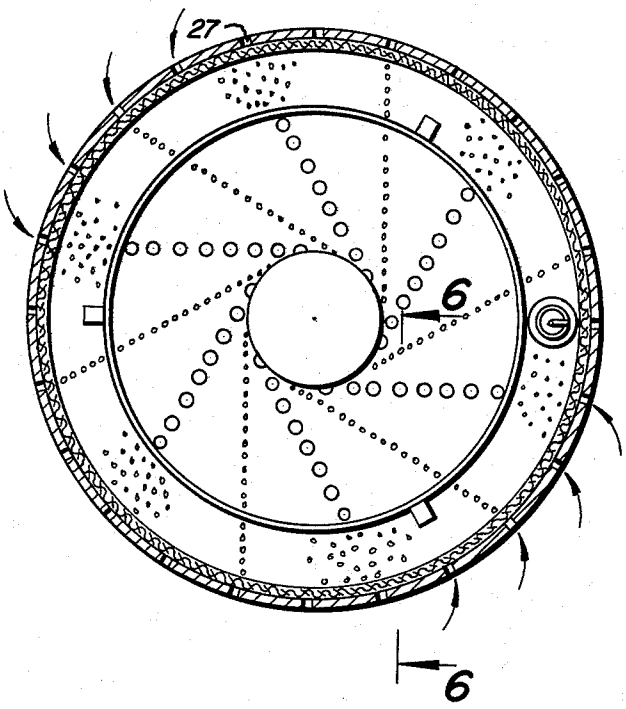


FIG. 5

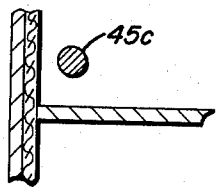


FIG. 9

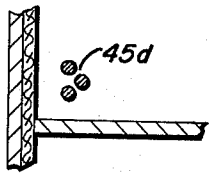


FIG. 10

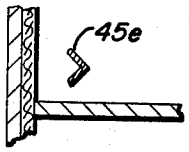


FIG. 11

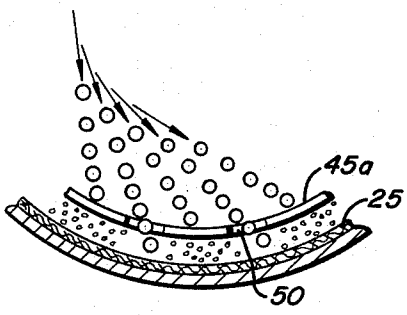


FIG. 7

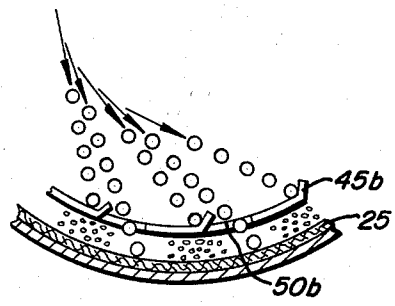


FIG. 8

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LIQUID FUEL-BURNING HEATER

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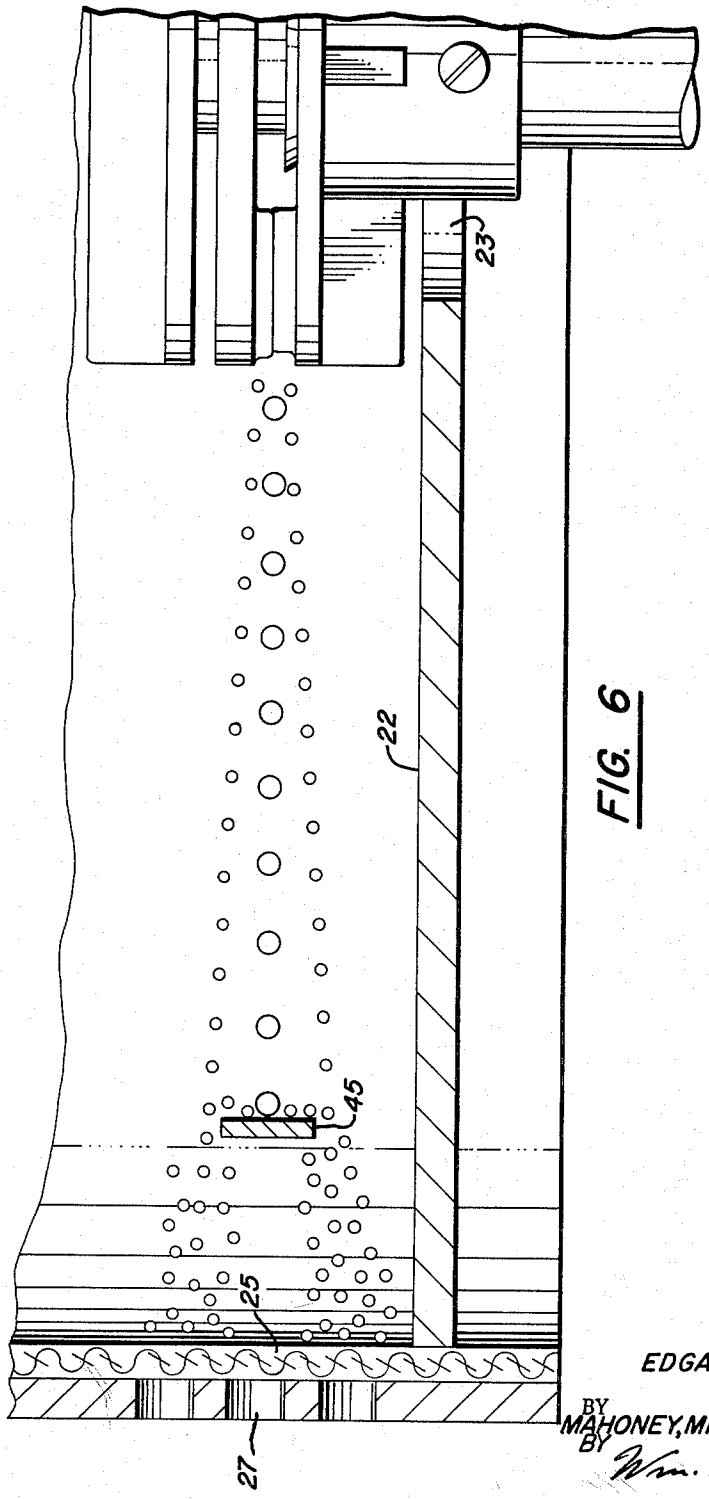


FIG. 6

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LIQUID FUEL-BURNING HEATER

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Filed Feb. 25, 1963, Ser. No. 260,627
5 Claims. (Cl. 158—4)

This application is a continuation-in-part of my copending application Serial No. 183,251, filed March 28, 1962, now Patent No. 3,127,924 dated April 7, 1964, and which, in turn, is a division of application Serial No. 37,874, filed June 22, 1960, now Patent No. 3,029,863, dated April 17, 1962.

My invention relates to a liquid-fuel-burning heater. It has to do, more particularly, with the burner of a heater of the oil-burning type. It relates to that general type of oil-burning burner which uses a mechanical spinner that receives the oil from a source of supply and throws it outwardly by centrifugal force through a surrounding combustion chamber so that it is directed onto an annular wall of high capillarity which receives and absorbs the droplets thrown off by the spinner and in which the droplets spread to provide a large area for rapid evaporation and burning of the oil.

More specifically, this invention relates to that type of burner disclosed in my Patent No. 3,029,863, issued April 17, 1962. The burner disclosed in said patent has gone into wide commercial use as a lightweight portable space heater, especially by building contractors and the like who need a smokeless burner that will develop a high heat at a relatively low cost. However, in adapting this burner to permanently installed commercial and residential heating equipment, it was found desirable to make certain improvements therein which would make the burner function even more efficiently in such equipment where the burner operates at a higher temperature. The present application relates to those improvements.

In the accompanying drawings, a burner which is particularly designed for domestic heating is disclosed and in these drawings:

FIGURE 1 is an axial sectional view through a burner embodying the present invention.

FIGURE 2 is an enlarged axial sectional view taken along line 2—2 of FIGURE 1 through the burner, showing the non-absorbent baffle ring and associated annular absorbent wall.

FIGURE 3 is an enlarged, axial, sectional view taken along line 3—3 of FIGURE 2 through the spinner.

FIGURE 4 is a transverse, sectional view taken along line 4—4 of FIGURE 3.

FIGURE 5 is a transverse, sectional view taken along line 5—5 of FIGURE 2.

FIGURE 6 is an enlarged, sectional, diagrammatic view taken at the position indicated by line 6—6 of FIGURE 5.

FIGURE 7 is a diagrammatic, transverse, sectional view illustrating a modification of the baffle ring.

FIGURE 8 is a diagrammatic, transverse, sectional view illustrating another modification of the baffle ring.

FIGURE 9 is a diagrammatic, sectional view showing a baffle ring of different cross section.

FIGURE 10 is a view similar to FIGURE 9 but showing the ring made of a plurality of wires or the like.

FIGURE 11 is another view similar to FIGURE 9 but showing a baffle ring of another cross section.

The burner of this invention in its general structure is similar to that disclosed in my Patent No. 3,029,863 but includes the improvements to be disclosed hereinafter which make it particularly suitable for permanently installed heating equipment which operates at higher temperatures. It is shown in the drawings as having its spinner axis upright but it is to be understood that the burner will function equally as well with the spinner axis in a horizontal position.

The burner is shown in FIGURE 1 disposed within a tubular outer casing 15 which may be suitably connected to a stack or vent when incorporated in a domestic furnace. A fan 16 is disposed within the casing 15 coaxial therewith at the lower inlet portion thereof being mounted on a shaft 17 which is preferably driven by an electric motor.

Disposed within the casing 15 in spaced concentric relationship therewith upwardly toward the outlet thereof is the combustion chamber 18 which is mainly of tubular form. Since it is of smaller diameter than the casing 15 an annular air-passageway 19 is provided between the wall of the combustion chamber and the casing 19. The fan 16 is of suitable form to draw air upwardly into the casing 15 and force it upwardly toward the outlet of the casing through the annular space 19 and the combustion chamber 18.

The burner is indicated generally at 20 and is concentrically disposed within the combustion chamber 18 at the lower or inlet end thereof. Just above or beyond the burner 20, the wall of the combustion chamber is provided with a row of angularly spaced openings 21 extending therethrough and disposed at closely spaced angular positions around the combustion chamber. These openings are for supplying secondary air for combustion, which comes from the fan 16 through the annular space 19.

The lower or inlet end of the combustion chamber is provided with a disc or back plate 22 which substantially closes it except that it is provided with an air inlet opening 23. This opening 23 serves as the primary air metering opening through which the main supply of primary air is supplied to the burner 20 by the fan 16. The shaft 17 extends forwardly through the opening 23 and it will be noted that this shaft is hollow for conducting the fuel oil to a supply of which it may be suitably connected.

The burner 20 includes the annular absorbent ring or burner wall 25 fitted snugly within the combustion chamber wall at the lower or inlet end thereof as shown best in FIGURE 2. It may be suitably fastened in position as by means of the screws 26. As disclosed in my prior patent, the wall 25 is made of a suitable liquid-absorbent, heat-resistant material of high capillarity. It may be of various materials such as ceramic paper or felt but I prefer to use a ceramic woven cloth. For supplying part of the primary air for combustion, through the porous cloth wall, one or more rows of angularly spaced openings 27 are provided extending through the wall of the combustion chamber 18 at the wall 25. However, it will be noted that these openings do not extend through the absorbent porous cloth wall 25. Between the primary air openings 27 and the primary air openings 21 in the wall of the combustion chamber, is a flame-constricting, inwardly flared ring or collar 28.

Located centrally within the burner chamber formed by the annular wall 25 is a mechanical spinner 30. This spinner in its general construction is like that disclosed in said patent but is improved to make it function even more efficiently. It is carried by the shaft 17 and is coaxial with the absorbent burner wall 25. The spinner is located directly forward or above the plate 22 in association with the opening 23 therein as shown best in FIGURE 2.

Although this spinner is of the general structure disclosed in my patent, I have found that in some instances, as in a residential furnace where temperatures are higher, it is necessary to provide for a reduced temperature at

the oil spinner or slinger so as to prevent evaporation of the oil before it leaves the surface of the spinner. If oil leaves the surface of the spinner in the vaporized state, it does not travel far from the spinner due to its low inertia as compared to the liquid oil, thus causing an overly rich area in the vicinity of the spinner which causes excessive carbon formation on the spinner.

As one means of preventing overheating of the spinner, the front or upper surface of the forwardmost or uppermost metal spinner disc 31 is completely covered with a thick disc or lamination 32 of thermal insulating material. This has been found to reduce very sharply the temperature at the rear or lower portion of the spinner due to the fact that metal at the forward side and which is attached to the rear side of the spinner is not exposed directly in the flame produced by the burner.

Another means of reducing the temperature of the spinner is in providing openings in the plate or disc 33 which is directly behind or beneath the plate 31 and in spaced relationship thereto. These openings 34 may be in spaced angular relationship around the center of the plate 33 concentric with a bolt 35 which holds the plate 31 on the plate 33, a spacer washer 36 spacing the two plates apart to provide the air space 37 therebetween. This allows air from the fan 16 to flow forwardly through the holes 34 and outwardly through the space 37 between the two plates 31 and 33 to further aid in keeping the forward part of the spinner cooler and make the plates more effective as radiation shields. The holes 34 may be of various size and shapes but are preferably aligned with the air passageways 38 around the oil-slinging tube 39. The tube 39 communicates with the hollow shaft 17 and its structure and the structure of associated cooperating parts is the same as disclosed in said patent. Thus, the forward or upper end of the tube 39 is flared and provides a knife edge or lip 40 from which the oil is thrown in the form of droplets upon high-speed rotation of the tube. These droplets pass between the plate 33 and the flange or plate 41 of the spinner hub 42. Between these plates 33 and 41 cooperating baffles 43 are arranged to aid in directing the droplets outwardly after they are thrown off the tube lip 40 as described in my patent.

I have found that under certain high temperature conditions, the main transverse planar stream of fuel droplets strike the wall or pad 25 in such heavy concentration that a band of carbon builds up at the surface of the wall in the transverse plane of the travel of the heavier droplets which is in the plane of the outlet space between the spinner plates 33 and 41. This is only true along a narrow band intermediate the axial extent of the absorbent wall 25. To prevent this build-up, I provide a ring 45 of non-absorbent material, such as metal, in the path of the main stream of heavy droplets thrown off by the spinner. However, this ring must be of a limited extent in an axial direction so that the satellite droplets will contact directly with the absorbent wall 25.

Studies of this burner have shown that the spinner throws off the oil as a concentration of droplets in the transverse plane of the outlet space of the spinner and that this center stream contains a relatively large percentage of the total volume of the discharged oil but that it is restricted to a quite narrow band. The same studies have also shown that in diverging transverse planes to either side of the main transverse planar stream of oil droplets, there are quite a number of less concentrated oil droplets which I call satellite droplets. The principle I use and which has proven very beneficial in actual operation, is to use a non-absorbent ring or band 45 which is fairly narrow in the axial direction radially between the spinner and the wall 25 so as to intercept the droplets in the main stream of droplets, to break them up and then to direct them onto the absorbent wall 25. The ring may be located and supported in various ways such as by the attaching clips 47 (FIGURE 2) between it and the plate 23. This non-absorbent band may be 1/16 to 1/2 the exposed width, in an axial direction, of the wall 25 but is so located that a portion of the wall 25 extends below or behind the band and a portion extends forwardly or upwardly of the band. Also, the non-absorbent ring or band is disposed radially closer to the wall 25 than to the periphery of the spinner to provide a sufficient radial path for the oil droplets before they strike the non-absorbent band 45. I prefer to have the band 45 closer to the wall 25 than to the spinner and have found that the distance between the band 45 and the wall 25 should be about 1/16 to 1/4 the radius from the center of the spinner to the surface of the absorbent wall 25. Then when the heavy droplets strike the ring 45, they will be broken up into smaller droplets and be directed axially forwardly and rearwardly onto the surface of the porous wall 25 which extends axially forwardly and rearwardly to a substantial extent relative to the ring band 45.

Thus, it will be apparent from the diagrammatic illustrations in FIGURES 5 and 6 that by using a band 45 of the type indicated and located as indicated, the main stream of droplets thrown off by the spinner in the transverse plane of the lip 40 is broken up and dispersed and directed onto the absorbent wall, while at the same time the satellite droplets which are in streams in forwardly and rearwardly diverging planes on axially opposite sides of the main stream travel directly onto the wall 25 and will spread axially, as well as circumferentially, in both directions in the absorbent wall. Similarly, when the droplets bounce off the band 45, they contact the absorbent wall forwardly and rearwardly thereof and spread axially in both directions, as well as circumferentially, in the wall 25. Thus, formation of carbon on the absorbent wall by the concentrated droplets is prevented but at the same time, the lighter droplets are allowed to contact directly with the absorbent wall to provide for smooth quick starting or lighting of the burner as well as more efficient sustained burning without carbon formation. Tests have shown that interception of the total body of droplets thrown off by the spinner would make it practically impossible to light the burner since it is very difficult to evaporate fuel from a cool metal or other non-porous surface. Furthermore, with a non-porous surface only, with which the droplets would contact, oil would run off such surface to the bottom of the burner and the burner could not be lighted in the horizontal position which it does so easily when the droplets strike the absorbent wall 25. Any suitable lighting means may be employed. For example, an ignition spark device 46 may be provided in the burner directly adjacent the exposed surface of the wall 25.

The non-absorbent surface which interrupts the travel of the main stream of droplets may take various forms in addition to that of the continuous band or ring 45 shown in FIGURES 2, 5 and 6 and described above. For example, as shown in FIGURE 7, the band or ring instead of providing a continuous surface may be formed as indicated at 45*a* in FIGURE 7 where it is provided with angularly spaced openings or spaces 50 that permit a certain portion of the droplets of the main stream to contact directly with the wall 25. In FIGURE 8, a similar arrangement is shown except that adjacent the openings 50*b*, the material from the openings formed in the ring 45*b* is upturned about 45° and extends in the direction of rotation of the spinner so as to provide baffle tabs which effectively engage the droplets from the spinner which are thrown off at approximately 45° from a strictly radial direction.

In FIGURE 9, I show the ring 45*c* in the form of a heavy wire whereas in FIGURE 10 the ring 45*d* is formed of several wires arranged in a triangular cross section. In FIGURE 11, the ring 45*e* is of angular cross section with its angle facing toward the spinner. In each case, a non-absorbent surface is provided as a baffle for preventing all of the droplets from striking directly on the wall 25. Other baffle arrangements may be provided.

It will be apparent that according to this invention means is provided for preventing overheating of the spinner and resulting excessive carbon formation thereon. Also, according to this invention, means is provided for preventing at least a portion of the droplets thrown off by the spinner from contacting directly with the absorbent wall but for permitting a certain portion thereof to contact that wall. With this arrangement, excessive carbon formation on the absorbent wall is prevented but quick and easy lighting and sustained burning is insured.

Having thus described my invention, what I claim is:

1. A liquid fuel burner comprising a combustion chamber having a peripheral wall, a spinner rotatably mounted on its axis within the combustion chamber in radially spaced relationship to the surrounding peripheral wall of the combustion chamber and in a transverse plane relative thereto, means for supplying liquid fuel to the spinner, means for supplying air for combustion to the spinner in cooperative relationship with the liquid fuel supplied thereto, means for rotating the spinner so as to throw off the liquid fuel supplied thereto in the form of droplets in a main transverse planar stream, a liquid fuel absorbent wall surrounding said spinner and spaced radially outwardly therefrom between the spinner and the peripheral wall of the combustion chamber, said absorbent wall being of material of high capillarity for receiving droplets of the liquid fuel thrown off by the spinner and spreading it throughout the area thereof to provide a large area for rapid evaporation and burning of the fuel, said absorbent wall extending axially in both directions relative to the transverse plane of the spinner and the main transverse plane of the stream of droplets created thereby, and a baffle means of nonabsorbent material located in said main transverse plane radially between said spinner and said absorbent wall so that part of the droplets thrown off by said spinner will first contact said baffle means and be broken up and then be directed onto said absorbent wall, said nonabsorbent baffle means extending axially only a portion of the axial extent of said absorbent wall to expose said absorbent wall to direct contact of some of the droplets thrown off by the spinner, said nonabsorbent baffle means extending axially 1/16 to 1/2 the axial extent of the absorbent wall and the radial spacing of the nonabsorbent baffle means from the absorbent wall being about 1/16 to 1/4 the radius from the axis of the spinner to the surface of the absorbent wall.

2. A liquid fuel burner according to claim 1 in which the nonabsorbent baffle means is in the form of an annular band of flat cross-section in a direction parallel to the axis of the spinner which is concentric with the absorbent wall which is in the form of a ring which is also flat in the direction parallel to said axis.

3. A liquid fuel burner comprising a combustion chamber having a peripheral wall, a spinner rotatably mounted on its axis within the combustion chamber in radially spaced relationship to the surrounding peripheral wall of the combustion chamber and in a transverse plane relative thereto, means for supplying liquid fuel to the spinner, means for supplying air for combustion to the spinner in cooperative relationship with the liquid fuel supplied thereto, means for rotating the spinner so as to throw off the liquid fuel supplied thereto in the form of droplets in a main transverse planar stream, a liquid fuel absorbent wall surrounding said spinner and spaced radially outwardly therefrom between the spinner and the peripheral wall of the combustion chamber, said absorbent wall being of material of high capillarity for receiving droplets of the liquid fuel thrown off by the spinner and spreading it throughout the area thereof to provide a large area for rapid evaporation and burning of the fuel, said absorbent wall extending axially in both directions relative to the transverse plane of the spinner and the main transverse plane of the stream of droplets created thereby, and a baffle means of nonabsorbent material located in said transverse plane radially between said spinner and said absorbent wall so that part of the droplets thrown off by said spinner will first contact said baffle means and be broken up and then be directed onto said absorbent wall, said nonabsorbent baffle means extending axially only a portion of the axial extent of said absorbent wall to expose said absorbent wall to direct contact of some of the droplets thrown off by the spinner, said nonabsorbent baffle means being provided with angularly spaced, substantially radial openings through which some of the droplets will pass from the spinner directly onto said absorbent wall, and baffle tabs extending angularly inwardly over said openings in the direction of rotation of the spinner.

4. A liquid fuel burner comprising a combustion chamber having a peripheral wall, a spinner rotatably mounted on its axis within the combustion chamber in radially spaced relationship to the surrounding peripheral wall of the combustion chamber and in a transverse plane relative thereto, means for supplying liquid fuel to the spinner, means for supplying air for combustion to the spinner in cooperative relationship with the liquid fuel supplied thereto, means for rotating the spinner so as to throw off the liquid fuel supplied thereto in the form of droplets in a main transverse planar stream, a liquid fuel absorbent wall surrounding said spinner and spaced radially outwardly therefrom between the spinner and the peripheral wall of the combustion chamber, said absorbent wall being of material of high capillarity for receiving droplets of the liquid fuel thrown off by the spinner and spreading it throughout the area thereof to provide a large area for rapid evaporation and burning of the fuel, said absorbent wall extending axially in both directions relative to the transverse plane of the spinner and the main transverse plane of the stream of droplets created thereby, and a baffle means of nonabsorbent material located in said transverse plane radially between said spinner and said absorbent wall so that part of the droplets thrown off by said spinner will first contact said baffle means and be broken up and then be directed onto said absorbent wall, said nonabsorbent baffle means extending axially only a portion of the axial extent of said absorbent wall to expose said absorbent wall to direct contact of some of the droplets thrown off by the spinner, said spinner being provided with an outer wall covered with insulation, said wall being spaced axially from an inner wall to provide a space which receives some of the air supplied for combustion, said inner wall being provided with openings leading therethrough for supplying said air into said space, and an additional wall spaced axially inwardly of said inner wall to provide a space for receiving the liquid fuel and to permit it to be thrown radially outwardly in the form of droplets, said means for supplying liquid fuel comprising a passage means around the spinner axis leading into said last-named space and said means for supplying air for combustion comprising a passage means surrounding said liquid fuel passage means leading into said last-named space.

5. A liquid fuel burner comprising a combustion chamber having a peripheral wall, a spinner rotatably mounted within the combustion chamber in radially spaced relationship to the surrounding peripheral wall of the combustion chamber and in a transverse plane relative thereto, means for supplying liquid fuel to the spinner, means for supplying air for combustion to the spinner in cooperative relationship with the liquid fuel supplied thereto, means for rotating the spinner so as to throw off the liquid fuel supplied thereto in the form of droplets in a transverse planar stream, a liquid fuel absorbent wall surrounding said spinner and spaced radially outwardly therefrom between the spinner and the peripheral wall of the combustion chamber, said absorbent wall being of material of high capillarity for receiving droplets of the liquid fuel thrown off by the spinner and spreading it throughout the area thereof to provide a large area for

rapid evaporation and burning of the fuel, said absorbent wall extending axially in both directions relative to the transverse plane of the spinner and the main transverse plane of the stream of droplets created thereby, said spinner comprising an innermost wall and an intermediate wall spaced axially outwardly therefrom to provide a fuel space for receiving the liquid fuel to permit it to be thrown outwardly in the form of droplets upon rotation of the spinner, said means for supplying liquid fuel to the spinner comprising a passage means around the spinner axis leading into said fuel space, said means for supplying air for combustion comprising a passage means surrounding said liquid fuel passage means leading into said fuel space, and means for providing for a reduced temperature at said fuel space in the spinner to prevent evaporation of the oil before it leaves said space so that the fuel will be thrown outwardly from that space in the form of droplets which will reach said absorbent wall, said last-named means comprising an outermost wall spaced axially outwardly of said intermediate wall to provide a thermal insulating air space therebetween and a lamination of thermal insulating material carried on the outer surface of said outermost wall, said insulating lamination preventing direct exposure of the outermost wall to the flame produced in the combustion chamber of the burner and said insulating lamination and said air space reducing heat transmitted from the flame to the fuel space between said intermediate and said innermost walls, and means for mounting all of said walls for rotation together about the spinner axis as a unit.

References Cited by the Examiner

UNITED STATES PATENTS

Re. 20,939	12/38	Meikle	158—4
1,497,829	6/24	Allen et al.	158—77
1,949,260	2/34	Schenck et al.	158—4
2,058,196	10/36	Washburn	158—4
2,062,633	12/36	Appel	158—4
2,112,888	4/38	Greenawalt	158—77
3,029,863	4/62	Downs	159—4
3,053,314	9/62	McGillis et al.	158—77

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