July 19, 1955 E. J. TODOROFF 2,713,388

OIL BURNING SYSTEM

Filed April 22, 1952

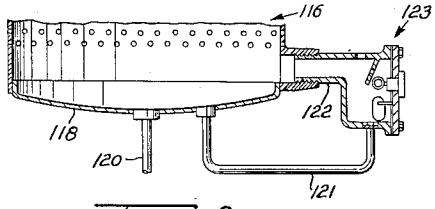


FIG. 2.

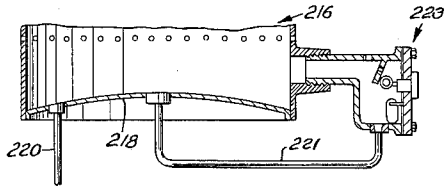


FIG. 3.

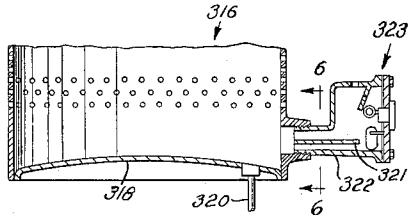


FIG. 4.

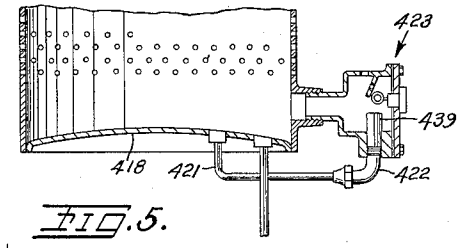


FIG. 5.

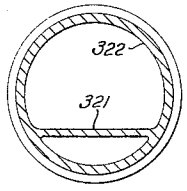


FIG. 6.

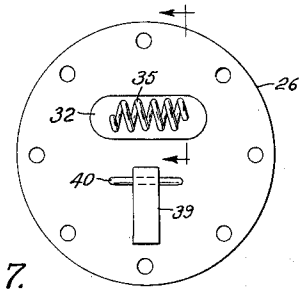


FIG. 7.

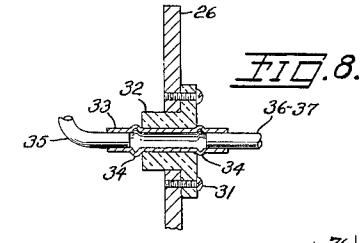


FIG. 8.

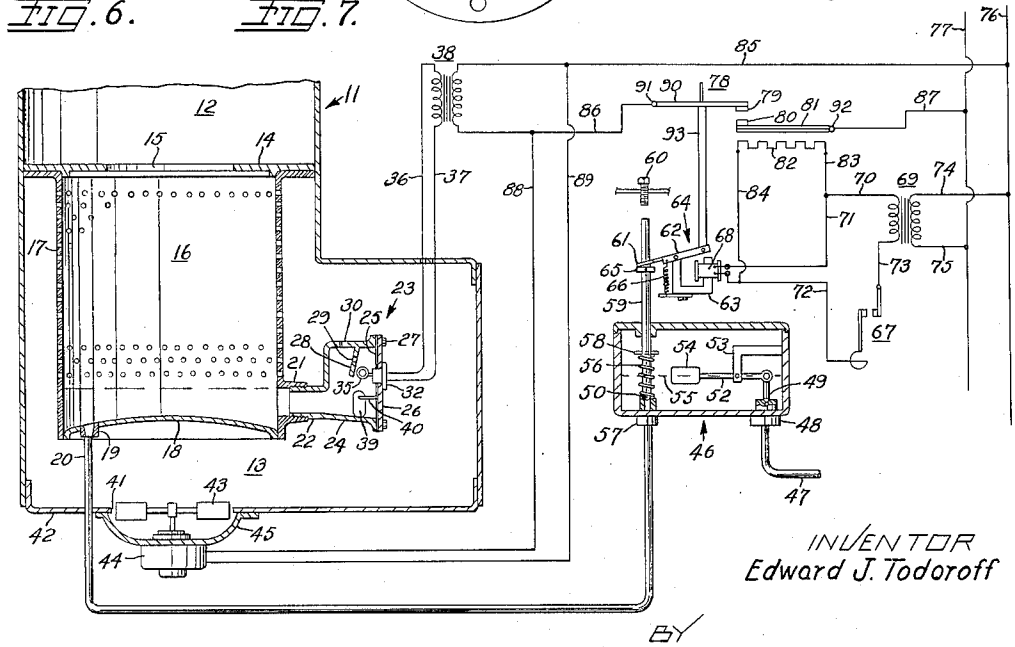


FIG. 1.

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United States Patent Office 2,713,388 Patented July 19, 1955

2,713,388

OIL BURNING SYSTEM

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Application April 22, 1952, Serial No. 283,620

8 Claims. (Cl. 158—91)

This invention relates generally to systems of oil burning as applied to residential heating systems and more particularly to vaporizing oil burning systems adapted for the automatic supply of heat in response to a requirement and adapted for automatic electric ignition of the oil fire whenever a new supply of heat is required.

It is a first object of this invention to provide an automatically controlled vaporizing oil burner with an automatic electric igniter which is self cleaning in operation, simple in construction, of relatively few parts, requires a minimum of service, and is of relatively low cost.

It is a second object to provide a first relatively larger combustion receptacle to which combustion oil is supplied at a pre-determined level of entrance of oil into the receptacle and a second separate relatively smaller combustion receptacle to which combustion oil is supplied by gravity from the first combustion receptacle after the oil in the first combustion receptacle has risen to a pre-determined level above its level of entrance into the first combustion receptacle.

It is a third object to provide a passage for combustion oil from said first combustion receptacle to said second combustion receptacle and a passage for flame from said second combustion receptacle to said first combustion receptacle.

It is a fourth object to provide means for supplying combustion air to both said receptacles.

It is a fifth object to provide electric ignition means within said second combustion receptacle.

It is a sixth object to provide said second receptacle with means for connecting or disconnecting it from said first receptacle.

It is a seventh object to provide said second receptacle with a removable cover on its side opposite its means for connection to said first receptacle.

It is an eighth object to provide means for carrying said electric ignition means on said removable cover.

It is a ninth object to provide an oil wicking means within said second receptacle said oil wicking means having one exposure to said oil in said receptacle and another exposure to said ignition means.

It is a tenth object to support said oil wicking means on said removable cover.

It is an eleventh object to provide alternate means for supporting said oil wicking means.

It is a twelfth object to provide exteriorly of said receptacles an oil storage receptacle with means for maintaining oil at a pre-determined level in said storage receptacle, a conduit from said storage receptacle to said first combustion receptacle and normally closed valve means adapted to admit oil from said storage receptacle to said conduit.

It is a thirteenth object to provide an electrically actuated means for releasing said valve to its open position and stop means for determining the maximum opening of said valve.

It is a fourteenth object to provide a normally open

switch adapted when closed to energize said ignition means.

It is a fifteenth object to provide means for closing said normally open switch and an electrically actuated means for opening said normally open switch with a predetermined time delay.

It is a sixteenth object to provide a condition responsive switch adapted to close at a pre-set value of said condition and energize said valve releasing means and switch closing means.

It is a seventeenth object to provide such an oil burning system in which at a pre-set value of a condition oil will flow to said first combustion receptacle and said electric ignition means will be energized, then after a first delay oil will flow from said first combustion receptacle to said second combustion receptacle, said oil in said second combustion receptacle will be ignited, flame from said second receptacle will flow to said first receptacle and ignite the oil in said first receptacle, oil in said first receptacle will burn down to a level insufficient to feed more oil to said second receptacle and oil combustion will continue in said first receptacle until said condition rises to another pre-set value at which said condition responsive switch will open, said valve will close, and after a second delay said ignition means will be de-energized.

How these and other objects are attained is shown in the following description referring to the attached drawing in which

Fig. 1 is a schematic drawing showing both the mechanical and electrical layout of one form of my system.

Figs. 2, 3, 4 and 5, show some of the possible variations in form of the oil combustion receptacles of my system and their connections.

Fig. 6 is a section along the line **6—6** of Fig. 4.

Fig. 7 is an interior view in elevation of the removable cover of my second combustion chamber with the electric ignition means and the oil wicking means supported thereon.

Fig. 8 is a fragmentary section along the line **8—8** of Fig. 7.

In the several figures of the drawing similar numerals of reference refer to similar parts.

Referring now to the drawing at **11** is shown generally the lower part of the body of a residential air heating furnace with a combustion chamber **12** and an air plenum chamber **13** divided one from the other by a baffle **14** having large central hole **15** formed therein for the conduction into combustion chamber **12** of combusting gases from a first combustion receptacle **16** whose vertical cylindrical wall **17** is flanged at its upper end and sealed to the side wall of furnace body **11** under baffle **14**. Wall **17** is perforated in a desired pattern to admit combustion air from plenum chamber **13** to the interior of receptacle **16**. Receptacle **16** is closed at its lower end with upwardly convex bottom head **18** into which a fitting **19** is set to receive oil inlet pipe **20**. Internally pipe threaded boss **21** of receptacle **16** receives externally threaded nipple extension **22** of second combustion receptacle **23** which is generally circular in section in a plane perpendicular to the paper. Receptacle **23** is formed with a body **24**, of which nipple **22** is an extension, a gasket **25** and a cover plate **26** secured to body **24** by screws **27**. Baffle **28** is continuous from side to side in the interior of body **24** and is perforated by one or more air holes **29**. Body **24** has air hole **30** in the top thereof for the admission of ignition and flame propagating air.

Set into an oval shaped hole in cover **26**, as shown, and held in place by screws **31** is porcelain insulator **32** having two holes formed therein through each of which extends a metallic conducting sleeve **33** bulged as at **34**

to secure it in place. The two ends of ceramic coated resistance coil 35 are inserted into the inner ends of sleeves 33 and are held securely in place electrically and mechanically by crimping sleeves 33 tightly onto the ends of coil 35. Conductor wires 36 and 37 from the secondary winding of ignition transformer 38 are crimped into the outer ends of sleeves 33, thus completing the low voltage circuit from transformer 38 to igniter element 35.

Wick member 39 formed with a lateral hole through one end thereof is supported by bail 40 on cover 26 as shown. Member 39 may be made of any refractory, capillary or wicking material, of which I have experimented with many. I prefer to use either a wick made of loosely contacting stainless steel strips hanging on bail 40 or a lozenge shaped wick 39 as shown made by compacting to shape a heterogeneous tangle of relatively fine stainless steel wire, the latter of which I have found to be particularly good for the purpose.

Combustion air for the furnace can either be motivated by natural draft, in which case hole 41 in furnace body bottom plate 42 is left open, or a fan 43 mounted on the shaft of electric motor 44 can all be supported on armed bracket 45 secured to bottom plate 42 as shown. In either case furnace combustion chamber 12 is at a lower pressure than plenum chamber 13 and combustion air is forced into combustion receptacle 16 from plenum chamber 13 through the holes in wall 17 of receptacle 16. Also air for ignition and flame propagation is forced from plenum chamber 13 through hole 30, part of which air traverses hole 29 in baffle 28, mixes with oil vapor evaporated from wick 39 by the heat from igniter 35 and the resulting air and vapor mixture is ignited by the heat from igniter 35. The resulting small flame is led by the lower pressure in receptacle 16 from under baffle 28 where more air from hole 30 meets more vapor from wick 39 and a considerably larger flame is propagated and is led by the lower pressure in receptacle 16 into that receptacle and ignites the oil therein.

Mounted exteriorly of furnace 11, oil storage receptacle 46 includes an oil supply pipe 47, an inlet valve seat fitting 48, an inlet valve 49, an outlet valve 50, an outlet valve seat fitting 57 and an outlet pipe 20 leading to the first combustion receptacle 16 as shown. Lever arm 52 fulcrumed on bracket 53 as shown is operatively connected to valve 49 at one end and carries at its other end float 54 and adapts float 54 to control valve 49 to maintain in receptacle 46 a constant level of oil indicated at 55.

Compression spring 56 strained between the upper end of valve seat fitting 57 and pin 58 secured into valve stem 59 of valve 50 biases valve stem 59 guided in the case of oil receptacle 46 towards the open position of valve 50. Stop 60 is adjustable as shown to set the maximum position of opening of valve 50.

The bifurcated extension 61 of armature 62 pivoted to the magnetic frame 63 of electromagnet 64 rests against collar 65 pinned to valve stem 59 and is biased downwardly by tension spring 66 with a greater downwardly biasing force than the upwardly biasing force to spring 56.

Thermostat 67 connects operating coil 68 of magnet 64 to the secondary winding of transformer 69 by means of wires 70, 71, 72, and 73. Wires 74 and 75 connect the primary winding of transformer 69 to power lines 76 and 77.

Normally open delay switch 78 has movable contact 79 carried on conducting arm 90 pivoted at 91 and movable contact 80 positionable by the free end of bi-metallic leg 81 having end 92 fixed. Contact 80 is vertically positioned by bi-metallic leg 81 whose free end carrying contact 80 moves upward as the temperature of leg 81 increases. Contact 79 is vertically positioned by armature 62 of magnet 64 through insulating bar 93 pivoted on armature 62 as shown. The upper end of bar 93 is shouldered to support arm 90 through a hole in which the reduced upper end of bar 93 extends. When armature 62 is closed on magnet frame 63 due to coil 68 being energized contact 79 closes on contact 80. When coil 68 is not energized and armature 62 is away from the right hand leg of frame 63 and bi-metallic leg 81 is cold contact 79 is held away from contact 80 but if bi-metallic leg 81 is hot and concave upward contact 80 will be held upward against contact 79 and will support the free end of arm 90. The upward curvature of leg 81 is controlled by electric heater 82 energized by transformer 69 to which it is connected through wires 70, 83, 84, 72 and 73 when thermostat 67 is closed.

When closed, switch 78 connects the primary winding of transformer 38 to power lines 76, 77, through wires 85, 86, and 87. Motor 44 of fan 43, when used, is connected to lines 76, 77 through wires 85, 89, 88, 86, and 87.

The operation of my oil burning system as illustrated in Fig. 1 is as follows. Assuming that power lines 76, 77 are energized, oil is constantly available under a slight pressure in pipe 47 and oil is being maintained at level 55 in receptacle 46 by valve 49 controlled by float 54, then when condition sensitive instrument 67 closes its contacts coil 68 of magnet 64 is energized and armature 62 immediately rotates in a clockwise direction stretching spring 66 and allowing spring 56 to raise valve 50 until valve stem 59 comes to rest against high fire limit stop 60. Also the rotation of armature 62 in a clockwise direction lowers bar 93 allowing arm 90 to drop closing switch 78 through contacts 79, 80 and thereby energizing igniter coil 35 through transformer 38 and energizing fan motor 44. In the diagram valve 50 and valve seat 57 are shown only in elemental form where in practice as is well known in the art the rate of flow of oil through the valve seat is smoothly adjustable over a substantial range of vertical position of valve 50.

As valve 50 opens oil starts flowing through pipe 20 into first combustion receptacle 16 and slowly rises in chamber 16 until it moves into second combustion receptacle 23. In the meantime heater 82 connects in parallel with coil 68 is energized and bi-metallic leg 82 starts contact 80 moving upward carrying contact 79 with it. Thus, when the oil moving into receptacle 23 reaches wick 39, igniter 35 is incandescent, wick 39 is warm and getting warmer so that oil is immediately wicked up by wick 39 and begins to vaporize off its upper end where it mixes with air which has started to move under the influence of fan 43 from plenum chamber 13 through hole 30 into receptacle 23 and through hole 29 to the vicinity of igniter 35 where it mixes with the oil vapor and is ignited. Heat from this small ignition fire added to the heat from igniter 35 vaporizes oil from the wick at a more rapid rate and the oil rich burning mixture moves out from under baffle 28 where it mixes with more air from hole 30 and propagates a long clean flame which quickly extends through nipple 22 in the first combustion receptacle 16 causing direct evaporation of oil from the oil pool in receptacle 16. The oil evaporated in receptacle 16 mixes with air entering receptacle 16 through the holes in wall 17 and the mixture is ignited by the ignition flame entering receptacle 16 through nipple 22 from receptacle 23. Receptacle 16 rapidly heats up and the evaporation lowers the surface of the oil pool in receptacle 16 until the area of the pool surface is just sufficient to evaporate oil at the rate oil enters receptacle 16 from pipe 20 and at this balance the surface of the oil pool is too low to cause oil to flow from receptacle 16 to receptacle 23. The continued incandescence of igniter 35 and the continued flow of air through receptacle 23 combined with the gradual diminution of the oil supply to receptacle 23 causes the air and oil vapor mixture therein to become leaner and leaner of oil and therefore to burn with a brighter flame until the oil is entirely burned out of receptacle 23 and the inside thereof is clean and free of soot.

When due to the operation of the burner condition sensitive instrument 67 opens its contacts the energy sup-

ply to heater 82 and coil 68 is immediately stopped and spring 66 overcomes the upward bias of spring 56 and valve 50 is immediately closed thus shutting off the oil supply to the burner. Bi-metallic element 81 of switch 78 gradually cools off and after a time delay pre-set by the design of switch 78, switch 78 opens and the energy supply to igniter 35 and fan motor 44 is stopped. The design of switch 78 is such that it has a sufficient delay in opening to allow the oil in receptacle 16 to burn completely out before fan 43 stops.

In Fig. 2 is shown a variation of my invention in which the bottom head 118 of first receptacle is concave upward and oil supply pipe 120 is connected at a low point in the bottom. At a higher point in the bottom, a separate pipe 121 connects receptacle 116 with a modified second combustion receptacle 123. The operation of this form of device is substantially the same as previously described except that no oil traverses nipple extension 122 of receptacle 123.

Fig. 3 illustrates a variation of my invention similar to that of Fig. 2 except that the bottom head of first receptacle 216 is convex upward, thus requiring different locations for the connection into receptacle 216 of pipe 220 and pipe 221 connecting first receptacle 216 to second receptacle 223.

Fig. 4 illustrates a variation only slightly different from the form shown in Fig. 1. In Fig. 4 the oil supply pipe 320 is shown connected to bottom head 318 of first combustion receptacle 316 on the side nearest the second combustion receptacle 323 and nipple extension 322 is seen to be divided horizontally and laterally by barrier 321 so that oil flows from receptacle 316 to receptacle 323 beneath barrier 321 and flame flows from receptacle 323 to receptacle 316 above barrier 321.

In Fig. 5 is shown a variation of my invention the principal difference from that shown in Fig. 3 being the wick 439 adapted to stand in a recess formed in the bottom of second combustion receptacle 423 and the fitting 422 is tapped into the bottom of the recess and adapted to connect pipe 421 to receptacle 423.

Having thus explained the objects of my invention and described the construction and operation of several forms thereof, I claim.

1. In an oil burning system, a first combustion receptacle, means adapted to supply combustion oil to said first combustion receptacle at a first level of entrance into said first combustion receptacle and gradually to increase the oil level in said receptacle, means adapted to supply combustion air to said first combustion receptacle, a second combustion receptacle, an oil conduit means adapted to connect said second combustion receptacle with said first combustion receptacle at a second level above said first level, whereby as oil is supplied to said first combustion receptacle and said oil in said first combustion receptacle rises to said second level oil will flow through said oil conduit means from said first combustion receptacle to said second combustion receptacle, means adapted to supply combustion air to said second combustion receptacle, electric ignition means within said second combustion receptacle, said electric ignition means being adapted to heat said oil in said second combustion receptacle whereby part of said oil in said second combustion receptacle will be vaporized, mixed with said combustion air, and ignited in said second combustion receptacle, a flame conduit means separate from said oil conduct means adapted to connect said second combustion receptacle with said first combustion receptacle above said second level whereby flame from the burning oil in said second combustion receptacle will traverse said flame conduit means and ignite said oil in said first combustion receptacle.

2. The oil burning system of claim 1 in which said second combustion receptacle is formed with an open side opposite said flame conduit opening and includes a cover plate for said open side, said cover plate being adapted to support said electric ignition means.

3. The oil burning system of claim 1 including an oil wicking means in said second combustion receptacle, said oil wicking means having one side adjacent the second combustion receptacle end of said oil conduit means and another side adjacent said electric means.

4. The oil burning system of claim 2 including an oil wicking means in said second combustion receptacle, said cover plate being adapted to support said oil wicking means separate from said electric ignition means.

5. In an oil burning system, a first combustion receptacle, an oil supply means adapted to supply combustion oil to said first combustion receptacle at a first level of entrance into said first combustion receptacle and gradually to increase the oil level in said receptacle, a second combustion receptacle, an oil conduit means adapted to connect said second combustion receptacle with said first combustion receptacle at a second level above said first level whereby as oil is supplied to said first combustion receptacle and said oil in said first combustion receptacle rises to said second level oil will flow from said first combustion receptacle to said second combustion receptacle, an air supply means adapted to supply combustion air to both said combustion receptacles, an electric ignition means within said second combustion receptacle, a flame conduit means separate from said oil conduit means adapted to connect said second combustion receptacle with said first combustion receptacle above said second level, an electric means adapted to actuate said air supply means, a delay switch adapted simultaneously to energize said electric ignition means and said air supply actuating electric means, an electric means adapted after a pre-determined delay to open said delay switch, a magnetic means adapted to control said oil supply means and close said delay switch, an electric means adapted to actuate said magnetic means, and a second switch means adapted to energize said last mentioned electric means and said delay switch opening electric means.

6. In an oil burning system, a first combustion receptacle, an oil supply means adapted to supply combustion oil to said first combustion receptacle at a first level of entrance into said first combustion receptacle and gradually to increase the oil level in said receptacle, a second combustion receptacle, an oil conduit means adapted to connect said second combustion receptacle with said first combustion receptacle at a second level above said first level whereby as oil is supplied to said first combustion receptacle and said oil in said first combustion receptacle rises to said second level oil will flow from said first combustion receptacle to said second combustion receptacle, an electric ignition means within said second combustion receptacle, a flame conduit means separate from said oil conduit means adapted to connect said second receptacle with said first receptacle above said second level, a delay switch adapted to energize said ignition means, a magnetic means adapted to control said oil supply means and close said delay switch, an electric means adapted after a pre-determined delay to open said delay switch, an electric means adapted to actuate said magnetic means, and a second switch means adapted to energize said last mentioned means and said delay switch opening means.

7. An electric igniter for an oil burner of the type which comprises a combustion receptacle in which oil is vaporized for combustion by the heat of said combustion, said igniter comprising a hollow body including a hollow neck means adapted for removable connection between the interior of said combustion receptacle and said hollow body to form an ignition flame conduit therebetween, said combustion receptacle being formed with a combustion oil inlet therein at a lower level than the floor of said flame conduit, said body being formed with an open side opposite said flame conduit means whereby

said flame conduit can be cleaned and the interior of said combustion receptacle inspected through said open side and said flame conduit, said body being formed with a closed top upward extension at the end of said flame conduit away from said receptacle, said upward extension including a transverse barrier therein adapted to divide said extension into an open bottomed forward chamber adjacent said open side and an open bottom rearward chamber adjacent said flame conduit, means for admitting combustion air to the interior of said rearward chamber, a cover plate adapted to close said open side of said body, an electric igniter, means adapting said cover plate to support said igniter in said forward chamber, an oil wick, means adapted to support said oil wick within said body separate from said igniter, said oil wick being adapted to extend from the floor of the interior of said body to near said igniter, means adapted to admit oil for ignition to the interior of said body adjacent said wick, and means adapted to admit to said forward chamber from said rearward chamber an amount of combustion air less than the amount of air required for complete combustion of the oil vaporized from said wick by the heat of said igniter and the heat of the flame ignited thereby.

8. A pilot burner adapted for the ignition of an oil burner of the type having a combustion receptacle in which oil is vaporized for combustion by the heat of combustion therein, said pilot burner being adapted for electric ignition and comprising a hollow body including a hollow neck extending from one side of said body

near the bottom thereof, said body being formed with an open side opposite said neck, means adapted to connect the free end of said neck to said receptacle to form an ignition flame conduit from the interior of said body to the interior of said receptacle above the bottom thereof, means adapted to separate the interior of said body transversely of said neck and above the level thereof into an open bottomed air chamber adjacent the end of said neck away from said receptacle and an ignition chamber adjacent said open side of said body, a hot wire ignition means, a cover plate for said open side of said body, means adapted insulatedly to support said hot wire ignition means in said ignition chamber on said cover plate, an oil wick, means adapted to support said oil wick separate from said ignition means, said wick being adapted to extend from the floor of said hollow body to adjacent said ignition means, and means adapted to supply ignition oil to the bottom of said wick.

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