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PRESSURE ATOMIZING OIL BURNER

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2 Sheets-Sheet 2

Fig. 4

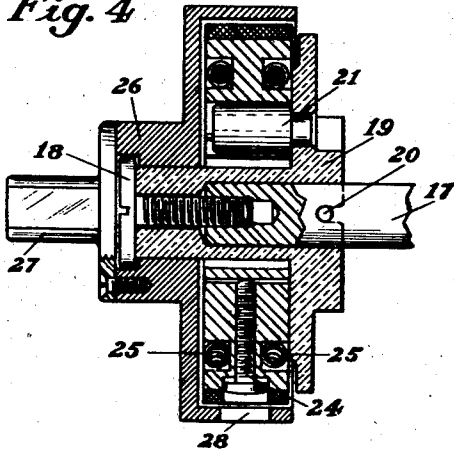


Fig. 5

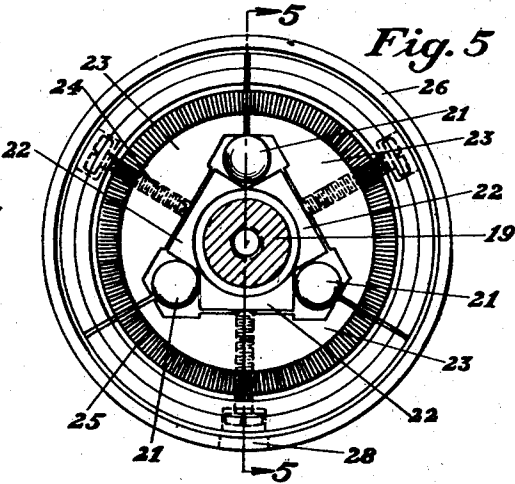


Fig. 6

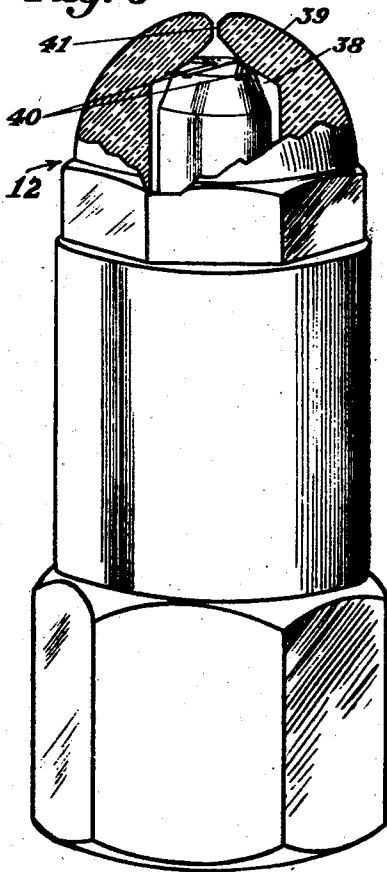
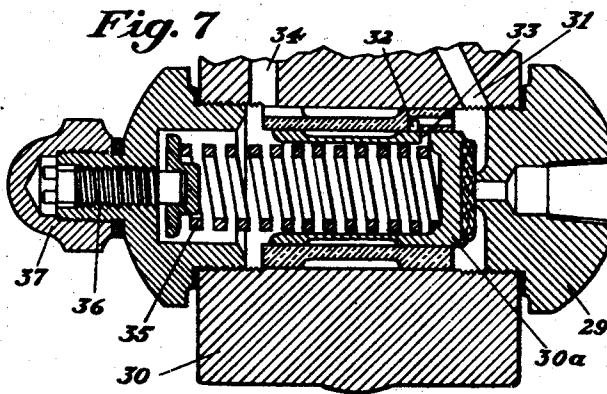


Fig. 7



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PRESSURE ATOMIZING OIL BURNER

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2 Claims. (Cl. 158—28)

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This invention relates to a new structure and mode of operation in gun type oil burners. The gun type burner is well known. It operates to pump oil under pressure through an atomizing nozzle, mix the spray with air supplied under pressure from a fan and to ignite and burn the carburetted air.

In the prior art much attention has been given to the efficiency of the atomizing nozzle. An account of this is published in the Transactions of the A. S. M. E. of July 1939 under the title "Atomization of oil by small pressure atomizing nozzles." Reference to this publication will give a background to what is said about nozzles in disclosing this invention.

A main purpose of the invention is to provide a new gun type structure to burn oil from a relatively large nozzle at a low rate in the amount per hour. It is most useful in serving small heaters for domestic house and hot water heating.

In referring to the prior art, gun type burners are being considered. These are oil pressure atomizing burners.

Ordinarily the oil burning rate per hour is determined by the size of the atomizing nozzle. The small rate in present practice calls for a corresponding small nozzle size. Ordinarily the rate is not changed much in practice by changing the pressure for feeding oil to the nozzle. That pressure is commonly adjusted or determined in practice by what will give the most efficient kind of a nozzle spray; any change of rate due to oil pressure being incidental to that purpose of efficient spraying. All this is indicated in the above publication. It is seen that the rate is made primarily by the size of nozzle. And it is seen that the lowest rated nozzle of that published investigation is one gallon an hour. I know nozzles have been made for smaller rates than one gallon. But I know that as the nozzle sizes go below the size intended for one gallon, the expense of making them accurately for a desired smaller rate increases and there is a practical limit. There is another practical limit caused by the increasing liability of very small nozzles to clog up in use. The size for the one gallon rate has an orifice in the neighborhood of one hundredth of an inch in diameter.

According to one feature of my invention I provide for using a nozzle which would be altogether too large for the desired rate under the common practice and compensate for the oversize by cooperating structure to get the desired low rate when wanted. By way of example I

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provide for using in the new structure a practical dependable nozzle, sized to give a rate of one gallon an hour when used in the practice with prior art burner structures. The new structure will operate successfully with this nozzle at a rate substantially less than one gallon an hour, for example a rate of about one-half gallon an hour. The same structure will also operate successfully at the normal rate of one gallon per hour when such larger rate is wanted. Thus a substantial range of burner rates is available which is most useful in providing for the lower rates.

An example of specific structure for embodying the principles of the invention will be understood from the accompanying drawings, the description and mode of operation to be disclosed in the description.

Referring to the drawings:

Fig. 1 is a side and

Fig. 2 is a rear view of the new gun type burner to practice the invention; these views showing the casing partly broken away with some detail appearing in the assembled form;

Fig. 3 is a view looking at the front of the burner head of Fig. 1 but with an added element;

Fig. 4 is a sectional view on line 5—5 of Fig. 5, of a centrifugal clutch also seen assembled in side view with other burner parts in Fig. 2;

Fig. 5 is a face view with an end plate removed, of the clutch of Fig. 4 showing one way of adjusting it for a range of timing operations;

Fig. 6 is a sectional view of a conventional atomizing nozzle such as used in gun type burners, the scale being enlarged considerably in the drawing of this element; and

Fig. 7 is a sectional view of a conventional oil pump by-pass such as used in gun type burners, the view is taken on a horizontal plane through the pump output of Fig. 2, some oil passages not particularly pertinent here being omitted.

The burner assembly of Figs. 1 and 2 has a casing 1 for a multi-vane fan 2 to drive air into cylinder 3. The fan is driven by direct shaft connection with motor 4. The motor has a shaft transmission to oil pump 5. In this transmission there is a centrifugal clutch 6 and a coupling 7. A transformer 8, electrical conduit 9 and stand 10 are indicated and need no description.

The oil discharge conduit 11 leads from the pump 5 to an atomizing nozzle 12. The oil is atomized by the pressure of the oil through a nozzle structure like that of Fig. 6. The nozzle is positioned axially of cylinder 3. It may be screwed on the end of pipe 11, the latter being

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held by a member 13. As shown the member is a closure at the rear end of a perforated cylinder 14 for which it serves as a support at that end, see Figs. 1 and 3. A spider held by screws through cylinder 3 supports the member 13. Electrodes 15 pass through the member 13 with spark gap terminals adjacent the orifice of the atomizing nozzle. The member 13 may have as shown in Fig. 3, two air feed openings 16 through it. These openings are not large. They serve with sliding covers, merely indicated, to let a supplementary air supply go through the member 13 when wanted and be completely closed when such supply is not wanted in any particular instance.

The perforated cylinder 14 provides a combustion chamber B. It is a cylinder having many perforations through which air is fed to meet the atomized oil spray. The air comes from the annular space A, the cylinder serving as a jacket around cylinder 14 to provide space A. The air fan will establish air pressure in jacket space A and the air will feed to space B in a great many air pressure jets or streams. The front end of space B is open. The front end of space A is shown closed by the spacing ring indicated there while the rear end is open as the annular space between member 13 and cylinder 3 is open, except for the spider support before mentioned. The purpose of the small shuttered openings 16 through member 13 is to adjust for a small supplementary air supply. The latter is always much less than the amount of air fed through the perforations in cylinder 14. The supplementary supply should never be enough to change the dominant character of the radially moving air forced through said perforations. The jacket receives substantially all the air fan supply, but this statement is to be understood as not excluding a minor supplementary supply through openings 16 directed parallel to the oil supply. One idea in the supplemental air supply is to have it meet the oil spray from the rear and break it up. For example at less than the best oil pressure for the best atomizing result per se, an operation involved in this invention to be explained, the tendency is for the oil spray to take a cup rather than a cone form. The supplemental air supply is directed at the cup form from the rear, breaks it up into a better condition to get mixed with the radially directed air jets from the air jacket. The supplemental air supply is also useful in locating, to some extent, the point where the flame begins. The air supply radially directed from the air jacket, however, is always enough greater than the supplemental supply to dominate the nature of the whole air supply to give the result as herein described from the radial feeding of air jets. The electrodes 15 and nozzle 12 may be adjusted from the positions shown and placed as a group at any desired position along the axis of chamber B. This is done by making slipping fits in the member support 13 for these parts.

Referring to clutch 6, suitable arrangements for it are indicated in Figs. 4 and 5. The motor shaft 17 has an end recess into which shaft screw 18 is threaded. The screw head holds a hub 19 on the shaft. Projecting ends 20 of a pin driven through a cross hole in the shaft engage opposite slots of hub 19 as indicated. The hub can be easily assembled on and taken off shaft 17 by the means described and a positive shaft drive for the hub is provided. The hub at its right side is fastened to the frame of fan 2, see Figs. 2 and 4. Thus the fan is positively driven and always turns

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when the motor shaft 17 turns. The latter is fast to the motor armature and the fan always turns with the armature. When the motor is switched off its armature having considerable momentum will turn the fan and the action is a gradual stopping of the fan after the motor current is cut off.

On the hub 19, Figs. 4 and 5, three clutch driving shoes are mounted as indicated. These are driven by pins 21 carried by the hub. Each shoe is made of two parts 22 and 23. A separate screw 24 is threaded through each part 23. It has a counterseat for its head in the outer face of part 23. It will be seen from Fig. 5, that with this construction, the parts 22 and 23 of each similar shoe can be held apart by adjusting screw 24. A pair of tensioned coil springs 25, each one arranged as a full ring in one of the opposite side face recesses, will tend to pull the parts 22 and 23 of the shoes together. But screws 24 will determine stopping points. When screws 24 are turned with tendency to go inwardly, parts 23 must move outwardly as the screw ends are always held against parts 22 by the springs. Such outward movement of shoe parts 24 will increase the tension of springs 25. When shaft 17 speeds up the tension of springs 25 will determine at what time or at what speed the mass of shoe parts 22 and 23 will be centrifugally moved out for the parts 23 to engage the driven part of the clutch.

The driven clutch part consists in the drum 26 fast on hub 27. The latter is mounted for free running on hub 19. It is held against coming off axially by the head of shaft screw 18. This screw head is arranged in a recess, see Fig. 4, so it will not have any effective frictional contact tending to drive the driven part of the clutch. What friction occurs will tend to keep the screw in place, its having a thread direction for that purpose. This recess for thus pocketing the head of screw 18, is closed by a plate fastened to hub 27 to rotate with the latter. Such plate is part of the connector end 27 forming a part to join with the flexible shaft coupling 7 indicated in Fig. 2. This coupling positively connects the shaft of the oil pump 5 with the driven half of the centrifugal clutch above described. The result is that the motor is provided with a transmission to always drive the fan with its armature and a centrifugal clutch in the transmission to drive the oil pump only when the fan is at a desired high speed. The clutch can be adjusted for such speed by a screw driver by merely turning its drum 26 until an opening 28 through it registers with screws 24 one after the other and these screws turned suitable amounts. This adjusting operation does not call for taking down the assembly in any way.

A suitable means shown in Fig. 7 for adjusting the oil pump discharge will be described. Nut 29 has an opening connected to discharge conduit 11, see Fig. 2. The pump has a casting 30, as is usually provided with needed pump passages. The pressure regulating means or valve is mounted in this casting as in Fig. 7. Since the structure per se is generally known, it will be only very briefly described here. Outlet through nut 29 is normally closed by spring pressed valve 30a. The area of valve 30a is subject to the pump discharge pressure from passage 31. The valve does not open, being spring closed, until the pressure on its area is sufficient to overcome the spring. When opened the action is to by-pass through suitable passages, enough of the pump

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discharge to keep the pressure constant. The by-pass is through openings 32 and 33, when they register, to conduit 34. The latter connects to the suction side of the pump. The one by-pass indicated is merely by way of example. There may be others.

It will be clear that the quantity of oil bypassed is determined by the degree of pressure necessary to move the valve far enough against its spring to cause passages 32 and 33 to register more or less. Thus the discharge pressure is easily regulated by regulating the spring load on the valve. This is done by compressing spring 35 more or less by turning adjusting screw 36 one way or the other. Nut 37 is a sealing cap for the adjusting screw head. When adjusted the spring controlled by-pass device acts to automatically maintain the oil pressure of oil passing through nut 29, constant. The pump is generally slightly oversize. When it starts to operate, the burner feeding oil pressure is established practically at the same time as the pump starts. The tendency is toward excess pressure. This excess is prevented by the by-pass action. And the oil is delivered with an atomizing nozzle pressure easily determined between wide limits by hand adjusting of the by-pass valve device. The description of one such device is given with the idea of merely illustrating the well-known principles involved in adjusting the oil pressure discharge from the pump as a separate element per se, of the combination.

A conventional atomizing nozzle in considerably more than full size is shown in Fig. 6. Assume that this one has a rate of one gallon an hour, in which case the oil pressure under conventional practice would be around one hundred pounds per square inch. Its action is for oil to feed along passage 38 to frusto-conical surface 39. Then it feeds through small slots 40 in said surface. These are generally tangent to the upper circle of surface 39. They release the oil into the cone-shaped space above. This has an orifice 41. It is around one hundredth of an inch in diameter. The action is for the oil from slots 40 to spin in the space to which it is released. The oil pressure is converted largely to oil velocity. The tangent direction causes the spinning. The restricted orifice does not stop the spinning but it acts to center the stream in an extremely small thread-like whirling mass. The further release of the pressure from the oil in this stream as it expands beyond the orifice makes a second conversion of pressure to velocity. The angle of the opening above the orifice will give the action in a spray angle wanted in the burner. Reference to the aforesaid published article will show how much this nozzle art per se, is attended to up to a very recent time. The practice has been and it has been much emphasized, to have oil burners get the most efficient attainable form of atomized spray. The nozzles are usually marked individually by their rate per hour of oil discharge when used at high enough pressure for their best efficiency. The user or his installing agent understands what this high pressure is to be if the nozzles are not actually marked to indicate the oil pressure with which the nozzle is intended under prior practice to be used for such efficiency. Of course as the published article shows, the rate is affected by viscosity of oil, which depends on the oil grade, and temperature. The general principle is to adjust everything so as to use the nozzle to get

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the most efficient spray at the marked rate of oil consumption.

According to one of the ideas in my invention I deliberately use a nozzle in a way contrary to the general principle just referred to. By doing this I get a result which so far as I know is new. In order to do this, I have provided the structure disclosed. The result is to make a gun type burner adapted for a low rate of oil consumption with an oversize nozzle. The particular field of use is where under the prior art practice referred to, a nozzle size small enough to theoretically get the low burning rate wanted for a particular use such as heating hot water, would give too much nozzle trouble under general prior art burner practice.

Referring to my example, I will explain the principles involved in the structure and mode of operation. In Fig. 1, a conventional nozzle 12 such as shown in Fig. 6 by way of example, sized for a one gallon rate according to prior practice can be used with advantage in my combination for a much lower oil consumption rate.

The structure shown will accomplish my main purpose. The mode of operation with the size of atomizing nozzle already given for the example, is as follows: The motor is switched on and off by the usual means. When it starts, the fan always starts the air stream at about the same instant, but the oil pump is idle in the beginning. After the air stream is fully underway, the oil pump is started and the atomizing nozzle starts spraying at practically the same instant. The clutch element 6 causes this timed relation of air and oil feed. The delayed oil spray starts from the rear portion or some intermediate portion along the axis of the space B, Fig. 1. The air is forced in jets, from space A, into space B at all radial angles and meets the oil spray for mixing. The mixture, or carburetted air in space B, is ignited by spark gap indicated. The flame is made and the air and oil of the mixture for the flame support, continues to be supplied in the fashion described. The flame will start in the space B as the air fed is radially pressed in toward the axis of this space. This holds the flame in a compact mass form for burning mixture. The conditions are all specially provided with the purpose of receiving the oil spray in such a way as to maintain a satisfactory fire even though the atomizing nozzle per se is working substantially below its known efficiency as a spray producing device. The nozzle size is deliberately chosen and the oil pressure to feed it from the pump is deliberately chosen, in the example given at about twenty-five pounds per square inch, so that the efficiency of the spray per se is substantially less than normal. The normal pressure in prior art practice is about one hundred pounds per square inch for full spray efficiency. This change is made from one hundred to twenty-five pounds pressure to get a lower volume of oil delivered to the flame during the time of burning and in lieu of meeting the troubles of a smaller nozzle orifice worked with much higher pressure to give commonly sought nozzle spray efficiency, the change of pressure now being arranged to give the low volume of oil in the same time with less than full spray efficiency. My structural arrangement substantially compensates for the lack of efficiency in the spraying operation per se, and gives the advantage of being able to use a more practical nozzle size, i. e. an inexpensive one and large enough to avoid the clogging tendencies of smaller ones. The result is that it be-

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comes practical to operate a gun type burner at a rate of about one-half gallon per hour in oil consumption and with a satisfactory and dependable flame under the example given. The result avoids the specific prior art troubles of expense of making and troubles in using undependable very small nozzle sizes. As before stated these troubles have been known and they are the cause of generally rating gun type burners as beginning at about one gallon for oil consumption rate as in general practice today. I know that gun type burners are advertised with nozzles rated lower than one gallon per hour but they are not used much on account of the nozzle troubles referred to and the tendency in actual use is to avoid nozzles less than the one gallon ratio as I have stated.

With any nozzle construction, as the orifice size is decreased, and thus the oil spray volume is decreased, so far as it is practical size nozzle according to any prior practice it can be used by my combination at a lower rate. For example the specific nozzle size I have referred to is one rated at one gallon an hour. With that one I have reduced the oil rate to about a half gallon an hour. According to the same principles, when a practical nozzle appears for satisfactory use in prior art gun type burners, I can use that smaller one and yet continue to get a substantially smaller rate as compared to the prior art practice or mode of operation.

The apparatus shown in Fig. 1 will work with the nozzle and its ignition terminals positioned further to the left than the position shown. I prefer now to have a position far enough back of the forward end of cylinder 3 to have the flame start well within space B for this reason. The flame then begins as a flame in a retort. It is at least partially within the space B. When this is so the radially directed air jets act on that portion of the flame to condense it somewhat. I believe that the flame emerges from the front end of space B surrounded by an envelope of air which goes out with the flame. The preferred way of running is with a part of the flame burning well within space B as a retort and part of it burning outside as an extension of the flame inside such space.

With regard to the closures at the front end of space A and the rear end of space B there is no objection to providing openings through these closures but they should not be large enough to spoil the effect of the radial openings through cylinder 14. The radial supply of air through this cylinder is a most desirable feature of the combination.

The combination in one aspect is arranged for the apparently foolish purpose of decreasing the efficiency of the prior art atomizing nozzle. But by doing that the rate of oil consumption is substantially lowered. This effect alone would not be useful if the result were to substantially decrease the efficiency of the burner. Such result does not follow, however, because the structure and mode of operation prevents it. The actual result is a good heating flame at the low rate of oil consumption in the gun type burner. And the oversize nozzle used avoids all the trouble which

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attends the attempt to get a corresponding low rate of oil consumption well below one gallon an hour by merely proportioning the nozzle orifice in the prior burner constructions for such a rate.

Having disclosed my invention I claim:

1. In an oil pressure atomizing burner of the kind having an oil pressure atomizing nozzle, adjacent ignition means, power mechanism to pump the oil through the nozzle at a predetermined constant pressure, a fan to supply air, means to hold back the oil supply automatically unless the air supply fan is in substantially full operation, an air tube to direct air from the supply fan to meet the oil adjacent the nozzle, the combination of a tubular cylinder, provided with many perforations closely spaced both circumferentially and axially and generally distributed over substantially the whole cylindrical surface, said cylinder being positioned inside and spaced from the air tube to form a jacket, the jacket being connected to the fan, for receiving substantially all of the air supply to be directed through the cylinder perforations in many small pressure jets, said nozzle being positioned axially to discharge directly into the rear portion and generally lengthwise of the cylinder across such jets, the perforated part of said cylinder extending from the place of oil discharge and far enough inside the air tube to substantially complete oil and air mixture inside the cylinder for both starting and continuing a substantial part of the fuel combustion in said cylinder before the mixture leaves the cylinder.

2. In an oil pressure atomizing burner of the type having an oil pressure atomizing nozzle with an orifice of a size to deliver at the rate of about one gallon an hour when the oil pressure is around one hundred pounds per square inch, an air supply fan, an air tube to direct the air from said fan to the oil, mechanism to pump the oil through the nozzle at a predetermined constant pressure which is adjustable, and means to hold back the oil supply automatically whenever the air supply fan is not running at substantially full speed, the combination of a tubular cylinder provided with many perforations closely spaced both circumferentially and axially and generally distributed over substantially the whole cylindrical surface, said cylinder being positioned inside and spaced from the air tube to form a jacket for receiving substantially all of the air around the cylinder, said jacket being adapted to direct the air through the cylinder perforations in many jets, said oil nozzle being positioned to discharge directly into the rear portion and generally lengthwise of the cylinder across such jets, the perforated part of said cylinder extending from the region of oil discharge and forwardly far enough to substantially complete oil and air mixture inside the cylinder, said burner combination being adapted to operate satisfactorily at an oil consumption rate substantially as low as one-half gallon an hour when said mechanism is adjusted to provide an oil atomizing pressure as low as about twenty-five pounds per square inch.

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