July 21, 1942. A. P. OLCHES 2,290,350

ATOMIZING SYSTEM

Filed Sept. 18, 1939

Fig. 1

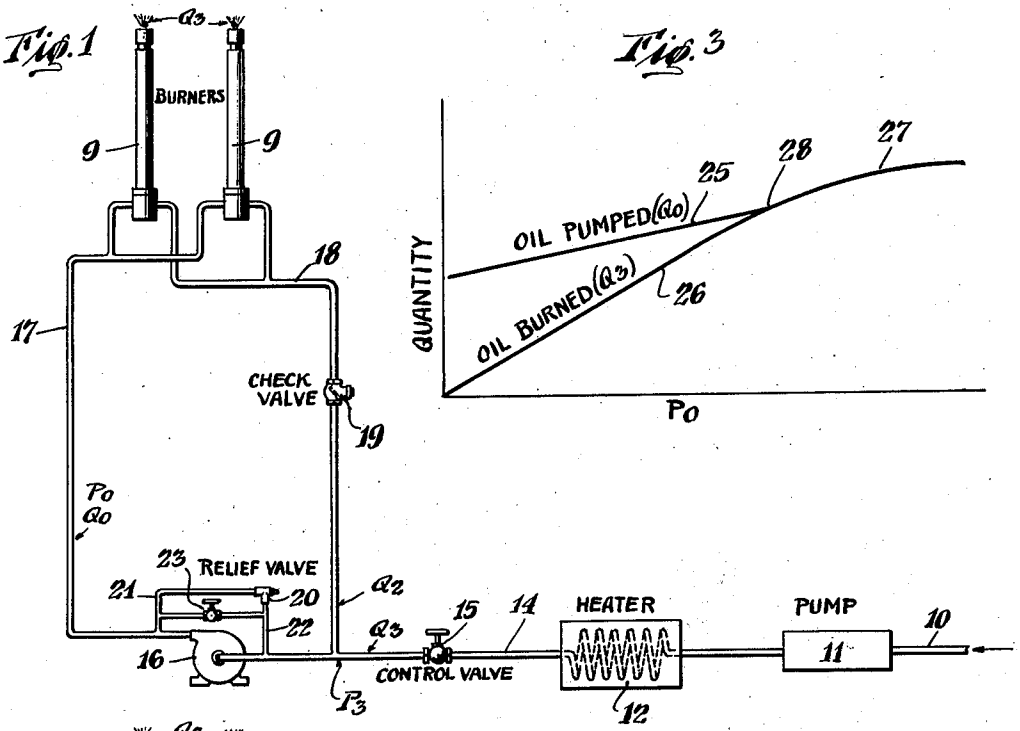


Fig. 3

Fig. 2

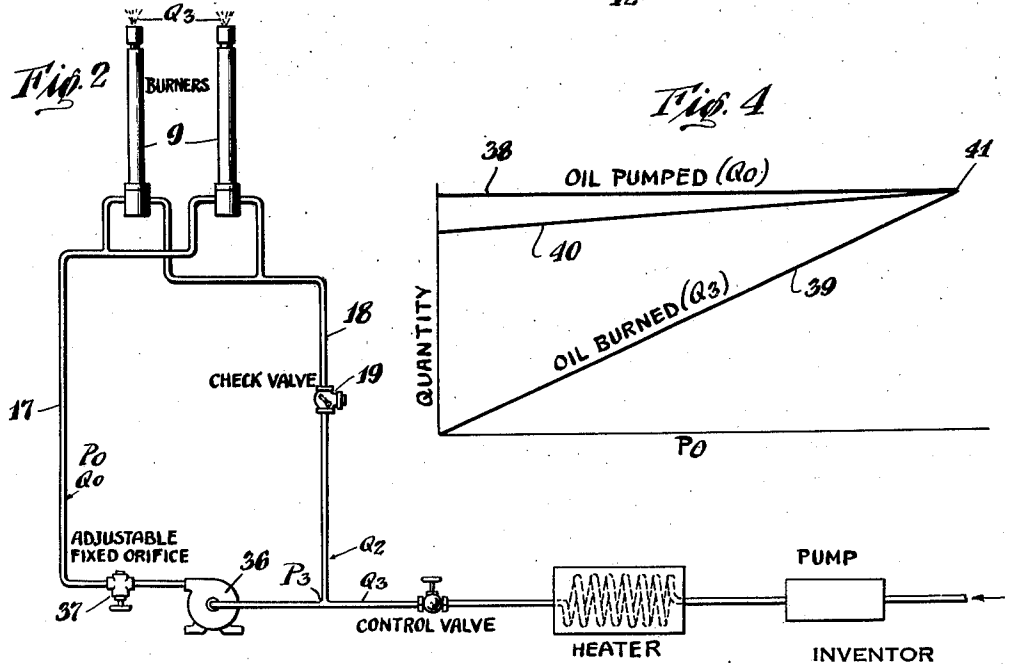


Fig. 4

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Patented July 21, 1942 2,290,350

UNITED STATES PATENT OFFICE

2,290,350

ATOMIZING SYSTEM

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Application September 18, 1939, Serial No. 295,400

10 Claims. (Cl. 299—58)

This invention relates to atomizer systems utilizing a mechanical atomizer which is controlled by withdrawing a controlled portion of the fluid from the atomizer tip through a fluid return line. For convenience, the invention is described herein as applied to a fuel oil burning system but it should be understood that the invention is not to be limited thereto but may be applied to various uses.

The Graham et al. Patent 1,824,952 shows a system of this general type utilizing a mechanical atomizer having a tip in which the oil is delivered under pressure to a central whirling chamber through tangential passages which impart a rapid whirling motion to the oil whereby it is discharged from the tip orifice in the form of a cone-shaped spray. The operating capacity of the atomizer is varied over a wide range by withdrawing from the whirling chamber a controlled portion of the oil from the atomizer tip through an oil return line. The total quantity of oil pumped to the atomizer equals the quantity sprayed plus the quantity returned, all of which passes through the tangential passages. Hence, the total quantity is dependent upon the pressure drop across the tangential passages. Both the quantity and pressure drop may be maintained substantially constant by regulating the oil supply pressure in accordance with the variations in pressure in the return line or vice versa as more fully disclosed in the Graham et al. patent, above mentioned. In this manner the speed of rotation in the atomizer, hence the fineness of atomization, are maintained substantially constant throughout a wide operating capacity range. The above described atomizer is referred to herein, for convenience, as an atomizer of the variable return type.

It is an object of the present invention to provide a novel and improved system of the general type above indicated.

Another object is to provide an oil burning system of the type above indicated having novel and improved means for automatically maintaining a substantially constant pressure differential between the inlet and return lines or across the atomizer tip.

Another object is to provide an oil burning system of the type above indicated, having novel and improved means for automatically regulating the quantity of oil pumped to an atomizer system.

Another object is to provide such a system in which the hot return oil is always maintained under positive pressure so that vapor locks or the like are eliminated.

Another object is to provide a system of the above type having improved operating characteristics.

A further object is to provide such a system which is simple and dependable in operation and requires a minimum of equipment.

Another object is to provide a system of the above type which is adapted to commercial oil burner operation.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

Although the novel features which are believed to be characteristic of this invention are pointed out more particularly in the claims appended hereto, the invention itself may be better understood by referring to the following description, taken in connection with the accompanying drawing, in which certain specific embodiments thereof have been set forth for purposes of illustration.

In the drawing:

Fig. 1 is a diagrammatic view illustrating an oil burning system embodying the present invention;

Fig. 2 is a diagrammatic view similar to Fig. 1 showing a different embodiment of the invention;

Figs. 3 and 4 are series of curves representing the operating characteristics of the system.

Referring to the drawing more in detail, the invention is shown in Fig. 1 as applied to a system for supplying oil to a plurality of atomizers 9 of the general type described in the Graham et al. patent above mentioned. The oil is supplied by a line 10 to the suction side of a pump 11 which is capable of raising the oil to a pressure in excess of any pressure at which it may be desired to operate the return line to be described. The oil is then passed through a heater 12 of any suitable construction by which its temperature may be raised so as to facilitate the operation of the atomizer. The pump 11 and the heater 12 comprise conventional auxiliary equipment for a fuel oil burning installation. Hence, the present invention may easily be added to existing pumping and heating sets.

From the heater 12 the oil passes through a line 14, its flow being regulated by a control valve 15, to the suction side of a pump 16, referred to herein for convenience as a hot oil pump. The control valve 15 regulates the quantity of oil in accordance with the atomizer re-

quirements and also regulates the pressure on the low pressure side of the pump 16 and in the return line. The pressure in the atomizer tip, which controls the quantity sprayed through the orifice, is dependent upon the pressure in the return line.

From the high pressure side of the hot oil pump 16, the oil passes through a supply line 17 to the atomizers 9. Return oil from the atomizers 9 is taken by a return line 18 through a check valve 19 and is returned to the low pressure side of the hot oil pump 16. Check valve 19 prevents back flow through line 18 should any unusual conditions arise which would tend to produce the same.

A relief valve 20 is shown as connected between the high pressure side and the low pressure side of the hot oil pump 16 by means of lines 21 and 22 respectively. This relief valve may be used for excess pressure protection or may be set to maintain a constant pressure differential across the pump 16. A manually controlled by-pass valve 23 may also be connected in parallel with relief valve 20 between the high and low pressure sides of the pump 16 for regulating the pump capacity as will be described.

In the operation of the present system, the atomizers and the hot oil pump constitute a closed system continually circulating oil. However, due to the fact that the atomizers continually spray oil into the furnace, thus removing a portion thereof from the circulating system, it is necessary to continuously make up this portion by supplying the same to the system from an outside source. It is thus obvious that the quantity of oil pumped to the atomizers by the hot oil pump (Q_0) is equal to the sum of the quantity of oil returned from the atomizers (Q_2) and the quantity of oil sprayed by the atomizers (Q_3). The pressure P_3 in the return line 18 and on the low pressure side of the pump 16 is controlled by the valve 15. The pressure P_0 in the line 17 is determined by the pressure P_3 and by the operating characteristics of the pump 16.

For purposes of explanation, the condition of no return through the line 18 may be considered ($Q_2=0$). This condition would occur if a valve in the line 18 were closed, or if such a valve were opened and the pressure P_3 made equal to the pressure which existed in the central chamber of the atomizer tip prior to the opening of the valve. Under these conditions, the entire quantity pumped is discharged at the atomizer tip ($Q_0=Q_3$) and the pressure drop across the tangential slots of the atomizer tip will equal the pressure differential across the pump (P_0-P_3), disregarding the pressure drop in the line 17.

If now the pressure P_3 is reduced, as by regulation of the valve 15, the pressure in the atomizer tip, which produces the flow Q_3 will be reduced, Q_3 will decrease, oil will flow in the return line 18 and the pressure P_0-P_3 will be slightly greater than the actual differential across the slots of the atomizer tip due to the pressure drop in the piping between the pump and the atomizers.

If the connecting conduits were frictionless, maintaining a constant differential P_0-P_3 across the pump would also maintain a constant pressure differential across the atomizer slots of an equal value, and as all of the oil pumped passes through these slots, the quantity of oil pumped at all capacities would be constant as indicated by curve 38 in Fig. 4. However, in practice, the connecting lines are not frictionless. Hence, maintaining a constant pressure P_0-P_3 across the pump results in a slightly lesser differential across the atomizer tip slots at reduced capacities when more oil is returned and the quantity of oil pumped will be less at reduced atomizer capacities as indicated by the curve 40 in Fig. 4.

The relief valve 20 may be adjusted to maintain a given pressure differential P_0-P_3 regardless of variations in load. Under these conditions, if the load is varied, as for example by cutting one or more atomizers out of service, the same pressure differential would be maintained and the atomizers still in service would continue to operate at the same individual capacities. This is an important feature in oil burning installations where the air supply must be adjusted in accordance with the individual atomizer capacity to effect efficient combustion and any change in individual atomizer capacity would require readjustment of the air supply.

In the system above described, the pump 16 may be of any commercial form but preferably is of the rotary type in order to avoid fluctuations in pressure such as would be obtained with a piston type pump. If of the rotary type, it may be a centrifugal pump or any type of positive displacement pump, such as a screw pump or a gear pump.

If the pump 16 is a positive displacement pump operated at constant speed, the system will operate as above described with the relief valve 20 in service. However, if the hot oil pump is of a positive displacement type and is so designed as to deliver exactly the maximum capacity required by the system, then if relief valve 20 is set at a slightly higher pressure than the maximum produced by the pump when delivering the maximum quantity, the pump will deliver a constant volume regardless of the pressure P_3 at the intake side of the pump, and the quantity of oil pumped Q_0 will be in accordance with curve 38 in Fig. 4, even though there is friction in the lines connecting the pump to the atomizers. In actual practice it would rarely happen that the pump would exactly conform to the capacity requirements and consequently it is usually necessary to provide an adjusting means such as the by-pass valve 23. The positive displacement hot oil pump 16 will then be designed to supply a quantity of oil in excess of the maximum quantity required to be pumped to the burners and Q_0 may be regulated by adjustment of the valve 23 which permits the excess oil to be by-passed to the low pressure side of the pump. In such a case, relief valve 20 may be set at a sufficiently high pressure so that it will not operate during actual service and will merely serve as a pressure protection in case the system should become disturbed, as by the closing of a valve and the pressure P_0 should rise to a value to endanger the pump casing. The system would then also operate in a manner above described and in accordance with the curves 38 and 39 of Fig. 4, the valve 23, however, permitting adjustments to be made to adapt the system to the required operating conditions.

With the hot oil pump 16 of the constant displacement type and operating without control by the relief valve 20, it is obvious that if one or more atomizers were cut out of service, the remaining atomizers would not operate at their same capacities unless some means were provided to compensate for the changed conditions. For

this purpose the relief valve may be set to operate in response to a limited pressure rise above the normal operating pressure. If the pressure should then rise, due, for example, to cutting out an atomizer, to the point at which the relief valve 20 is set to operate, the valve would serve to maintain this constant pressure across the pump and the system would operate as a constant differential system as represented by the curve 40 of Fig. 4 until the pressure again falls below the above mentioned point.

The above described method of operation in which the operating capacity of the atomizer is varied by regulating the oil return Q_2 through control valve 15 may be termed "wide range" operation in contrast to a method of operation termed "straight mechanical," in which there is no return and the supply pressure only is varied. In certain instances, however, it may be desired to operate this system over a part of the range as a "straight mechanical" system in which no oil is returned through return line 18. This may be accomplished by setting the relief valve 20 to produce a pressure differential across the pump ($P_0 \rightarrow P_3$) equal to that obtained with a given supply pressure P_0 when there is no flow through return line 18. If the oil pressure P_3 is then increased by actuation of the control valve 15, oil would tend to flow to the atomizer through the return line 18. This, however, is prevented by check valve 19. Hence, there will be no oil returned through the return line and the entire quantity of oil pumped by the hot oil pump will be discharged through the atomizer tip. When thus operating in the straight mechanical range, that is above point 28 in Fig. 3, the burner may have the characteristics represented by the curve 27 in Fig. 3. When the pressure on the return line is reduced by the control valve 15 below point 28, the system automatically changes over to the wide range operation. The burner characteristics will then be represented by curves 25 and 26 of Fig. 3, the point 28 corresponding to the point 41 of Fig. 4. It will be noted that the changeover between straight mechanical and wide range operation takes place automatically when the oil supply pressure to the atomizers passes through the point represented at 28 in Fig. 3.

The relief valve 20 may of course be connected across the lines 17 and 18 at or near the atomizers, if desired, so as to eliminate from consideration any variations in pressure in the lines themselves. In general, the connection of the relief valve between points near the atomizer will cause the curve 25 or 40, representing the oil pumped to be more nearly horizontal, approaching curve 38 of Fig. 3. Connection of the valve at a point directly across the hot oil pump causes the operating curve 25 of Fig. 3 or 40 of Fig. 4 to be inclined due principally to the variation in pressure drop in the return line as the different quantities of oil are withdrawn therethrough.

The system shown in Fig. 2 is similar to that described above and corresponding elements have been given corresponding reference numbers. In this embodiment, the hot oil pump 36 is of the type delivering a constant head regardless of the quantity. A valve 37 is shown as connected between the high pressure side of the hot oil pump 36 and the supply line 17. This valve constitutes, in effect, an adjustable fixed orifice which reduces the pressure in the line 17. The purpose of the valve is to permit the system to be adjusted to maintain a given pressure differential between the supply and return lines without varying the hot oil pump itself should it not deliver the exact head required.

In operation, the hot oil pump 36 will be designed to maintain a pressure differential greater than that desired between the supply and return lines. The pressure in the supply line is then reduced by means of the adjustable fixed orifice valve 37 so that the total pressure across the pump and the valve 37 becomes equal to that which it is desired to maintain between the supply and return lines. The system will then operate in accordance with the curves of Figs. 3 and 4 as above described.

It will be noted that the above described systems are simple to operate and require a minimum amount of equipment. They are adapted to the operation of single atomizers or of a plurality of atomizers in parallel. Of course, if a source of high pressure oil supply is available, the pump 11 may be omitted. The preheater 12 may likewise be omitted, if desired, without changing the operation of the present system.

The pump 11 maintains a positive pressure on the low pressure side of the pump 16 and in the return line 18. Hence, the hot oil is maintained under a head at all times and the tendency for a vapor lock to form and interfere with the operation of the system is avoided.

Although certain specific embodiments of the invention have been shown for purposes of illustration, it is to be understood that the invention is capable of various uses and that various changes and modifications may be made therein as will be readily apparent to a person skilled in the art. Certain specific terms have been used herein for convenience in referring to various details of the invention. These terms are, however, to be given as broad an interpretation as the state of the art will permit. The invention is only to be limited in accordance with the following claims.

What is claimed is:

1. A fluid atomizing system comprising an atomizer of the variable return type having a tip provided with a whirling chamber in which a rotary movement is imparted to the fluid and having an orifice from which part of the rotating fluid is discharged for atomization, a supply conduit connected to suply fluid to said whirling chamber, a return conduit connected to withdraw a portion of the rotating fluid from said whirling chamber, constant pressure differential pump means connected to receive fluid from said return conduit and to discharge said fluid to said supply conduit at a predetermined constant increase in pressure to thereby maintain a constant pressure differential between said supply and return conduits, a feed conduit connected to supply to said return conduit fluid to be atomized and to control the fluid pressure in said return conduit, and means to control the fluid pressure in said feed conduit to thereby vary the capacity of said atomizer while maintaining by means of said pump means a predetermined pressure differential between said supply and return conduits.

2. In a fluid atomizing system as set forth in claim 1, a control valve connected between the high and low pressure sides of said pump, said valve maintaining a substantially constant pressure differential therebetween.

3. A fluid atomizing system as set forth in claim 1 in which said pump is of the positive displacement type.

4. A fluid atomizing system as set forth in claim 1, in which said pump is of the positive displacement type, and an adjustable by-pass means is provided between the high and low pressure sides of said pump suited to adjust the maximum capacity of said pump to the maximum capacity of the atomizer tip.

5. A fluid atomizing system as set forth in claim 1 in which a pump is included in said feed conduit to maintain a positive pressure on the low pressure side of said constant pressure differential pump suited to avoid vapor lock and a valve is provided in said feed line to control the pressure of the fluid supplied to said return line.

6. In a fluid atomizing system as set forth in claim 1, a check valve in said return conduit to prevent reverse flow of fluid therein to said atomizer tip, whereby straight mechanical operation without fluid return is obtained when the pressure in said feed conduit is higher than the pressure in said tip.

7. The method of controlling the capacity of a variable return atomizer of the type having an atomizing tip provided with a whirling chamber in which a rotary movement is imparted to the fluid and having an orifice from which part of the rotating fluid is discharged for atomization and having a fluid supply conduit to and a fluid return conduit from said whirling chamber and constant pressure differential pump means connected therebetween to recirculate the returned fluid, which method comprises supplying the fluid from a source to the low pressure side of said pump and varying the atomizer capacity by controlling the pressure of said source while maintaining, by means of said pump means, a constant pressure differential between the supply and return conduits.

8. The method of controlling the capacity of a variable return atomizer of the type having an atomizing tip provided with a whirling chamber in which a rotary movement is imparted to the fluid and having an orifice from which all or a part of the rotating fluid is discharged for atomization and having a fluid supply conduit to and a fluid return conduit from said whirling chamber and a pump connected therebetween to recirculate the returned fluid, which method comprises limiting the pressure differential across said pump to a predetermined amount, supplying the fluid from a source to said pump and varying the pressure of said source to thereby obtain straight mechanical operation without return from said whirling chamber when the pressure drop across said atomizing tip is greater than the pressure differential access said pump and to obtain wide range operation with fluid returned from said whirling chamber when the pressure drop across said atomizing tip is equal to the pressure differential across said pump.

9. The method of controlling the burner output of a mechanically atomizing oil burner forming part of a closed oil circulating system including the said burner, a pump for pumping oil to said burner, an oil supply line from said pump to said burner and an oil return line from said burner to said pump, comprising, utilizing a constant volume pump having a capacity greater than that required, by-passing around said pump a predetermined portion of the oil pumped, supplying to the said burners the constant volume of oil not by-passed, returning excess oil not burned through an unrestricted return line, supplying oil to said system to make up the quantity of oil burned, and controlling the quantity of oil burned by regulating the quantity of make-up oil supplied.

10. Method of controlling the liquid sprayed by a mechanical atomizer of the type wherein liquid is supplied to the atomizer tip at a flow in excess of that at which said liquid is atomized, which comprises, establishing a constant volume flow from a pump to said atomizer at a value in excess of that at which liquid is atomized by said atomizer, recirculating excess flow back to said pump in a closed circulating system, supplying make-up liquid from a source of liquid to said circulating system, and controlling the quantity of liquid atomized by regulating the flow of make-up liquid to said circulating system at a point intermediate said source and said circulating system.

ALBERT P. OLCHES.

CERTIFICATE OF CORRECTION.

Patent No. 2,290,350. July 21, 1942.

ALBERT P. OLCHES.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 50, for "suply" read --supply--; page 4, second column, line 10, claim 8, for "access" read --across--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of September, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)