Dec. 6, 1949 J. A. LOGAN 2,490,529

VARIABLE FIRING RATE OIL PRESSURE ATOMIZING BURNER

Filed March 8, 1947 5 Sheets-Sheet 1

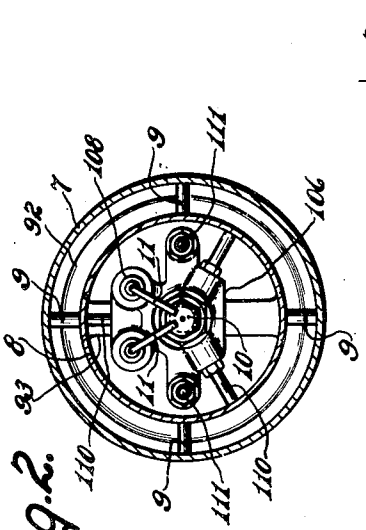


Fig. 2.

Fig. 1.

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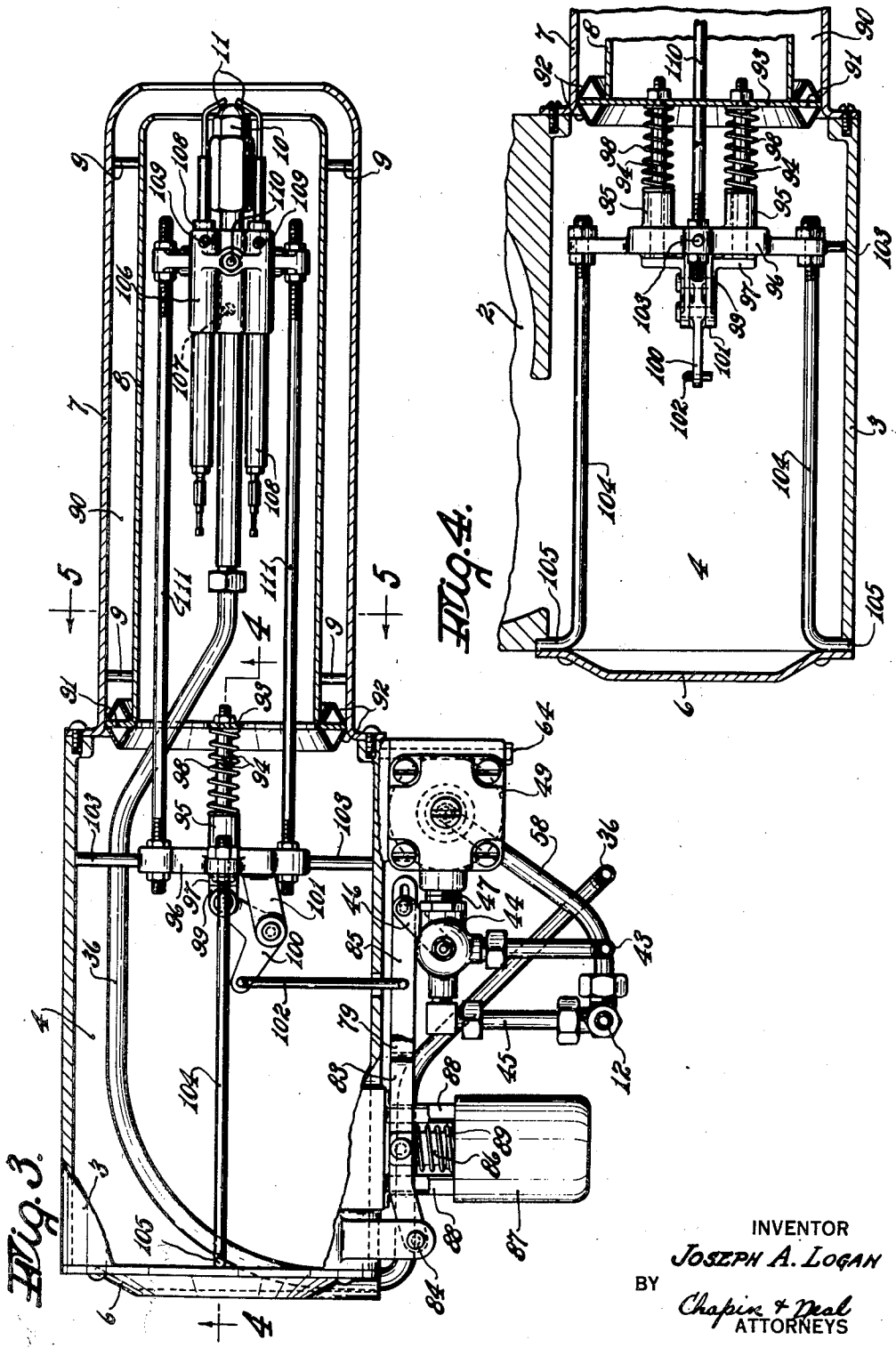


Fig. 3.

Fig. 4.

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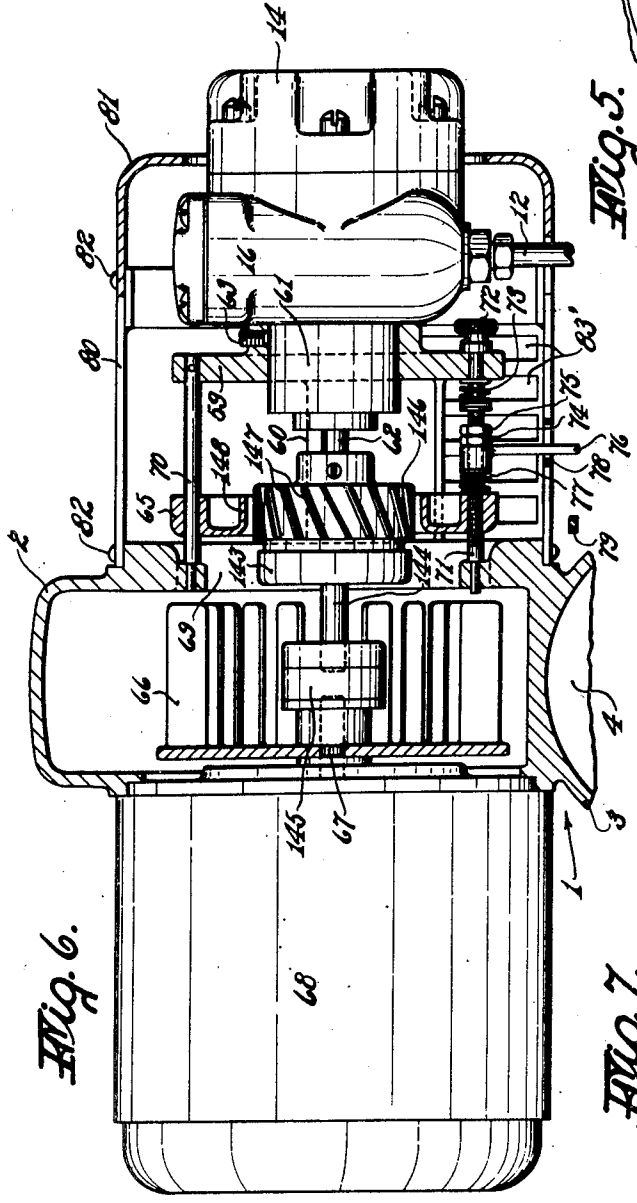


Fig. 6.

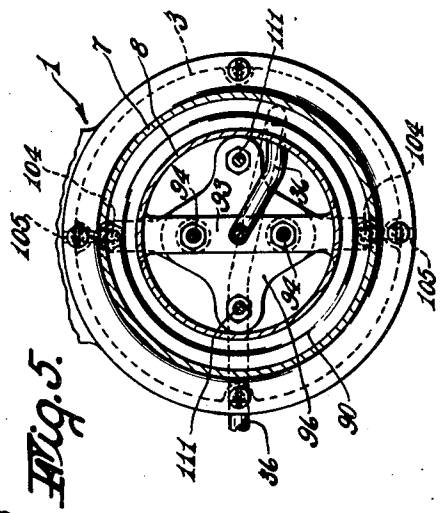


Fig. 5.

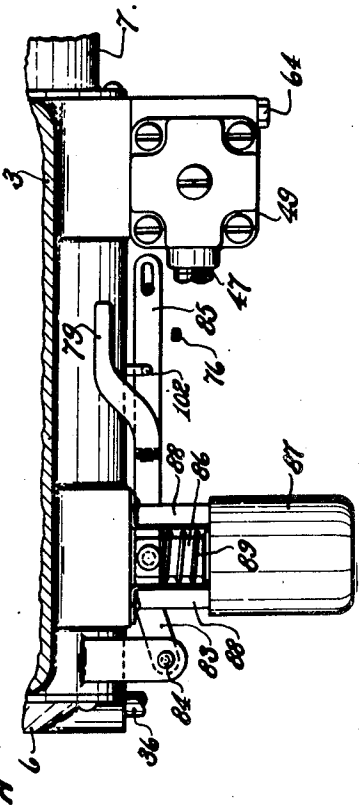


Fig. 7.

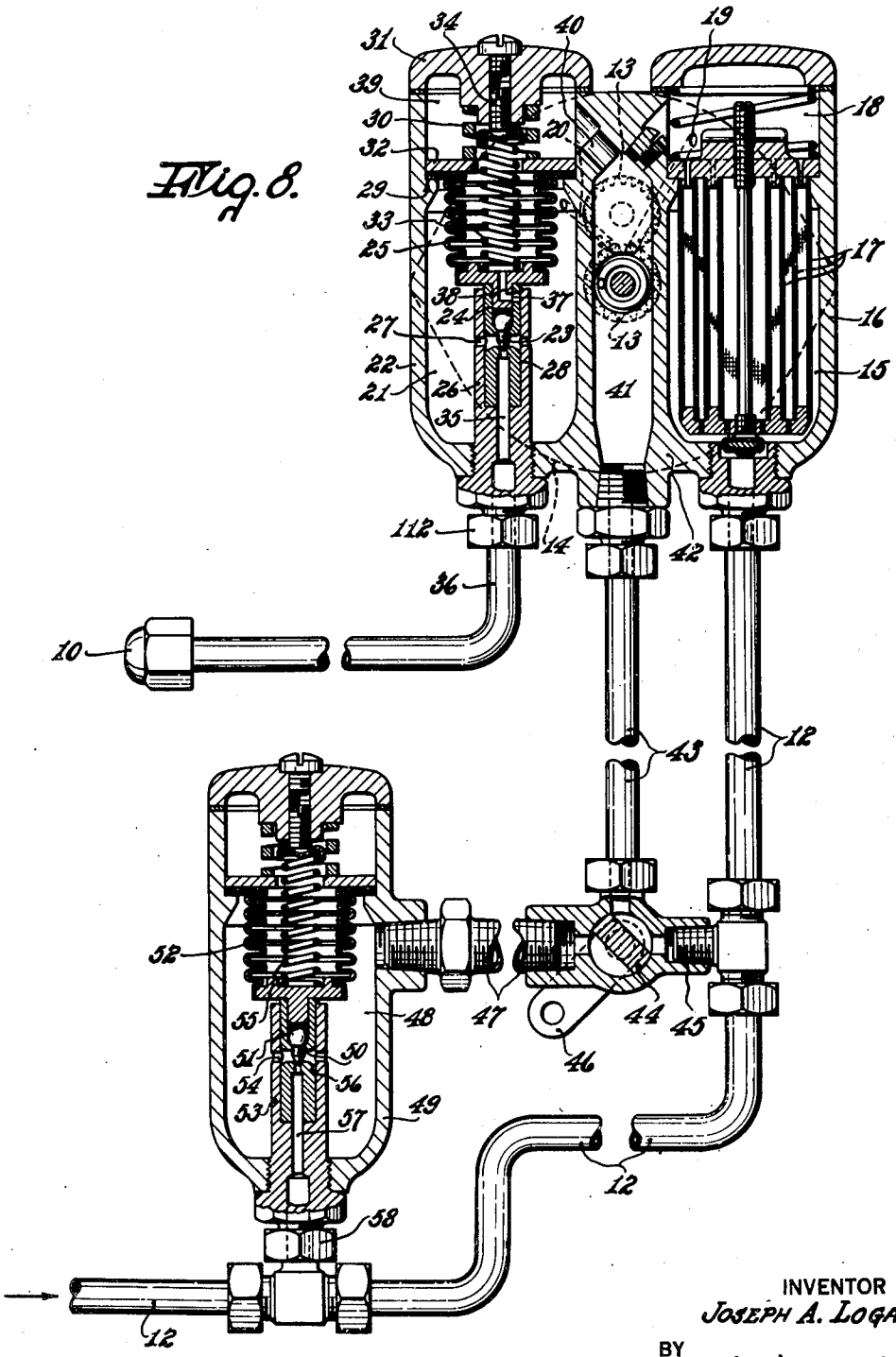
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VARIABLE FIRING RATE OIL PRESSURE ATOMIZING BURNER

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Fig. 8.



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Fig. 9.

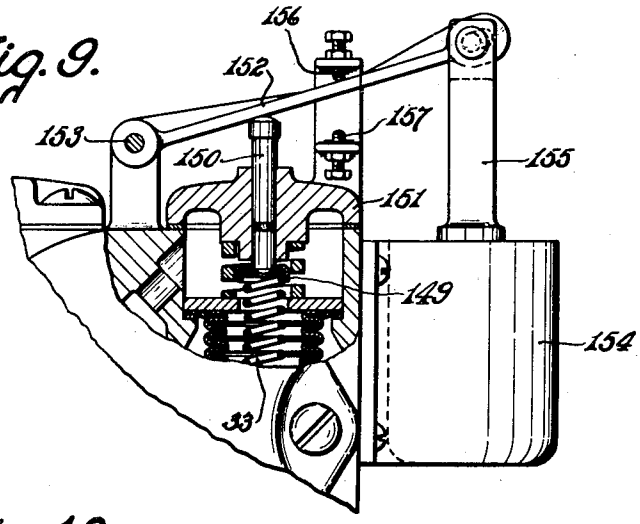


Fig. 10.

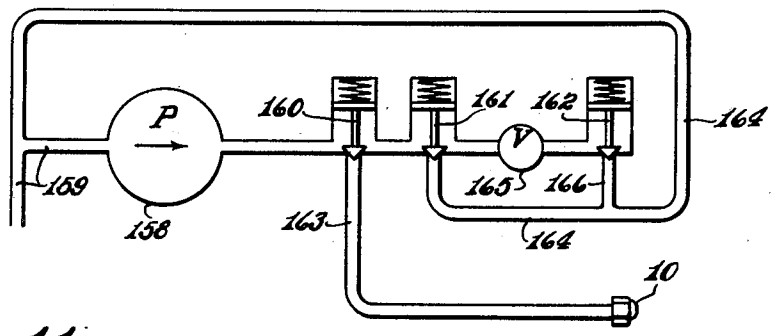


Fig. 11.

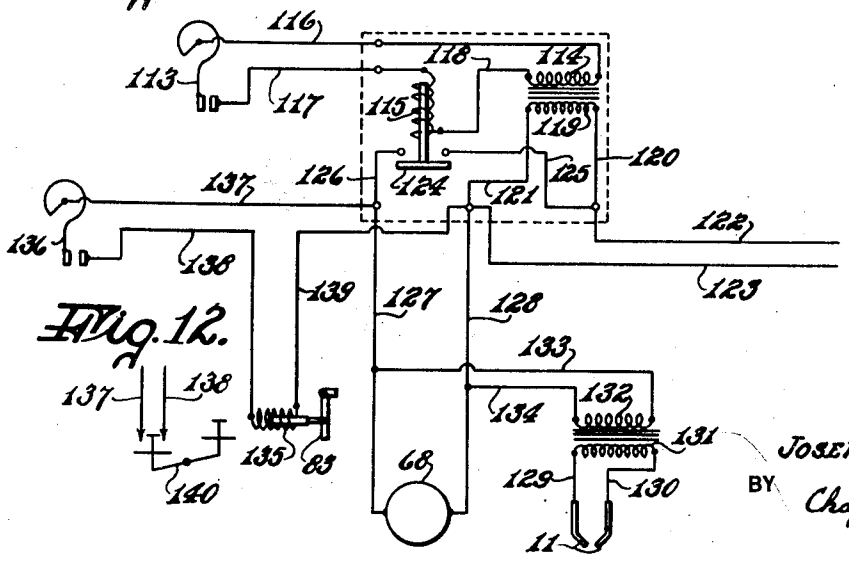


Fig. 12.

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2,490,529

UNITED STATES PATENT OFFICE

2,490,529

VARIABLE FIRING RATE OIL PRESSURE ATOMIZING BURNER

Joseph A. Logan, Hadley, Mass., assignor to Gilbert & Barker Manufacturing Company, West Springfield, Mass., a corporation of Massachusetts

Application March 8, 1947, Serial No. 733,271

5 Claims. (Cl. 158—28)

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This invention relates to improvements in oil pressure atomizing burners which are adapted for heating houses and for operation intermittently under the control of a room thermostat in heat supply cycles and at different firing rates, as may be selected manually or automatically by any suitable control in order to change the rate at which heat is supplied to the house for any of the cycles of burner operation as changes in weather conditions occur.

The object of the invention is to provide an oil burner of the oil pressure atomizing type, which may be operated throughout any of its heat supply cycles at either a relatively low rate or a relatively high rate, by changing the rate at which oil is atomized by varying the pressure of the oil supplied to the oil pressure atomizing nozzle and by correspondingly changing the rate of air supply, increasing or diminishing it accordingly as the rate of oil atomization is respectively increased or diminished.

One example of how this object may be accomplished, together with some modifications are shown in the accompanying drawings, in which

Fig. 1 is a side elevational view of an oil burner embodying the invention;

Fig. 2 is a cross sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a sectional plan view taken generally in a plane through the center line of the air tube of the burner;

Fig. 4 is a fragmentary sectional elevational view taken on the line 4—4 of Fig. 3;

Fig. 5 is a cross sectional view taken on the line 5—5 of Fig. 3;

Figs. 6 and 7 are fragmentary sectional views taken on the lines 6—6 and 7—7, respectively, of Fig. 1;

Fig. 8 is a view showing the complete oil feeding system of the burner, including the pump, pressure regulating valves, firing rate control valve and the connecting pipes and passages;

Fig. 9 is a fragmentary sectional view of a pressure regulating valve, illustrative of a modification in the pressure changing means;

Fig. 10 is a diagrammatical view illustrative of another modification in the pressure changing means;

Fig. 11 is a diagram of electrical circuits for the burner control means; and

Fig. 12 is a diagram showing a modification of the control shown in Fig. 11.

Referring to these drawings in detail, the burner includes a hollow casing 1 (Fig. 1) having an upper portion 2, which forms a housing for

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an air supply fan, and a lower cylindrical portion 3, which has a cylindrical air passage 4, (Fig. 3) extending horizontally therethrough. This casing is supported from the floor in any suitable way, as by a pedestal shown in part at 5 (Fig. 1). The rear end of air passage 4 is closed by a cover 6. Communicating with the front end of passage 4 (Fig. 3) are two air tubes 7 and 8, arranged one within the other and both having their front ends open. The inner tube 8 is supported by studs 9 from and in spaced coaxial relation with the outer tube 7. The latter is fixed at its rear end to the front end of cylinder 3. Air from the fan is delivered into the rear end of passage 4 and passes forwardly to and through one or both of the tubes 7 and 8, according to whether a low or high firing rate is desired as will later be explained, and mixes with a spray of atomized oil emitted from a pressure atomizing nozzle 10, located coaxially of the tubes and near their outlets. The combustible mixture of air and oil is suitably ignited, as by a spark produced between the electrodes 11, and the flame issues from the outlet of the tubes into the combustion chamber (not shown) of the heating apparatus.

Oil is supplied to the nozzle 10 at either of two substantially different pressures in order to secure a relatively low and a relatively high rate of flow of atomized oil from the nozzle. One way in which this may be done is best shown in Fig. 8. Oil is drawn from the supply tank (not shown) through a pipe 12 by means of a pump comprising the intermeshing gears 13 located in a casing 14. Oil enters a filter chamber 15 in a casing 16 and passes through a filter 17 into an upper chamber 18 in the casing 16. From this upper chamber oil flows through a passage 19 to the inlet side of the pump gears 13. These gears force oil out through a passage 20 into a lower chamber 21 formed in a casing 22. In chamber 21 is a cut-off valve 23, mounted on the lower end of a cylindrical member 24, which is fixed to the lower and closed end of a bellows 25. The member 24 is slidable in a tubular member 26 which upstands from the base of chamber 21. Radial holes 27 in member 26, below member 24, enable oil to flow from chamber 21 into member 26 above the seat 28 of the cut-off valve 23. The upper and flanged end of the bellows 25 is held against an annular shoulder 29 by a spring 30, acting between the cover 31 and a washer 32, bearing on the flange of the bellows. Within the bellows 25 and bearing against the closed end thereof is a spring 33, which may be regulated by a screw 34 mounted in the cover 31. When the pressure of the pumped

oil reaches a predetermined value, say for example 90 pounds per square inch, the bellows 25 will rise upwardly enough to raise the cut-off valve 23 from its seat 28 and allow oil to flow out from chamber 21 through the radial holes 27 into outlet passage 35, and thence into a pipe 36, which extends to the pressure atomizing nozzle 10.

The bellows 25 also controls a by-pass valve consisting of the cylindrical member 24, the cylinder 26 and a recess 37 in one side of member 24. This recess is initially entirely covered by the inner wall of cylinder 26 as shown but, when the pressure of the pumped oil reaches another predetermined pressure, say 95 pounds per square inch the bellows 25 will have been compressed enough to lift the upper end of recess 37 above the upper end of cylinder 26. Some of the pumped oil will then enter the recess 37 and pass through a passage 38 in the member 24 into the interior of the bellows and thence into an upper chamber 39 in casing 22. Oil flows from chamber 39 through an outlet 40 into a chamber 41, formed in a casing 42 and located between the chambers 15 and 21. The by-pass chamber 41 is connected by a pipe 43 to the inlet of a two-way valve 44. One outlet of this valve is connected by a pipe 45 to the suction pipe 12 of the oil pump. When the valve 44 is turned by its lever 46 to interconnect pipes 43 and 45, the maximum pressure of the oil fed to nozzle 10 will be controlled by the by-pass valve described and maintained substantially constant at the second-named predetermined pressure. A relatively low rate of flow of atomized oil from nozzle 10 will then be obtained.

To secure the relatively high rate of flow of atomized oil from nozzle 10, the two way valve 44 is turned to connect its inlet to a second outlet which is connected by a pipe 47 to an inlet chamber 48, formed in a casing 49 and containing a second by-pass valve 50. This valve is mounted on a cylindrical member 51, carried by the lower and closed end of a bellows 52 and sliding in a cylinder 53 having radial inlets 54 from chamber 48. The bellows 52 is held in place in the same way as the bellows 25 and it is forced downwardly by an adjustable spring 55 to hold valve 50 on its seat 56. Valve 50 will open to allow oil from chamber 48 to flow through holes 54 and into the outlet passage 57 only after the pumped oil has acquired a substantially higher predetermined pressure, say 200 pounds per square inch. Then the valve 50 will open and oil will flow through passage 57 into a return pipe 58 connecting with the suction pipe 12. Thus, the second by-pass valve will maintain the pressure of the oil supplied to nozzle 10 substantially constant at the relatively high value necessary for the relatively high firing rate.

The pump casing 14, the filter casing 16, the casing 22 of the cut-off and first by-pass valve and the casing 42 are conveniently combined, as shown in Fig. 8, into a single unit, which is substantially the same as that shown in Patent No. 2,233,709, to Osborne, dated March 4, 1941, to which reference is made for a more complete disclosure if necessary or desired. This pump unit is mounted centrally in a cross bar 59 (Fig. 1), the ends of which are connected by spaced legs 60 to the fan housing 2. This cross bar is shown in section in Fig. 6 and one of the legs 60 is shown in the background. This pump unit has a rearwardly extending sleeve 61, surrounding its drive shaft 62, and this sleeve is mounted in the hub of the cross bar 59 and suitably fixed thereto, as by the set screw 63. The second by-pass valve is

mounted as shown in Fig. 7, its casing 49 being secured to the cylindrical part 3 by bolts 64. The two-way valve 44 is conveniently supported from the casing 49 by the short pipe or nipple 47, which connects it to the inlet chamber 48 of the second by-pass valve 50. The various pipe connections described are clearly shown as they actually are in Figs. 1, 3 and 4. In Fig. 8, such connections are shown merely conventionally and the valve 44 is turned at right angles to its actual location to secure clearness of illustration.

The rate at which air is supplied to the air passage 4 and its outlet tubes 7 and 8 is controlled by a shutter 65 (Fig. 6), which in this case is arranged on the inlet side of the fan. The fan is shown at 66, fixed to the shaft 67 of an electric motor 68, mounted on one end face of the fan housing 2. This shaft 67 is suitably connected as indicated to drive the pump shaft 62. In the opposite end face of the fan housing 2 and between the arms 60 is a circular inlet opening 69. The shutter is supported by and slidable on a shaft 70, which is mounted at its outer end in the cross bar 59 and at its inner end in the housing 2. This shaft is fixed at one end to the cross bar 59. Below this shaft is a screw 71, which has a threaded engagement with the shutter 65. This screw is mounted at its ends, one in the cross bar 59 and one in the housing 2 but, unlike the shaft 70, it can be rotated and also moved bodily in the direction of its axis. The screw has a knurled head 72 on its outer end and this head is held against the outer face of cross bar 59 by a spring 73. The screw 71 may be turned by the knurled head 72 and by this means the position of the shutter 65 may be adjusted with precision for the low firing rate. To shift the shutter to its high firing rate position, the screw 71 is bodily moved outwardly against the force of spring 73. For this purpose, there is provided an adjustable abutment, in the form of a nut 74 threaded on the screw, and a lock nut 75 for holding nut 74 in the various positions of adjustment to which it may be moved. Slidably mounted on screw 71 is a depending arm 76 which is yieldingly held by a spring 77 against nut 74. There is a sheet metal casing, which encompasses the shutter, the U-shaped bracket 59, 60 and the casing members 16, 22 and 42, and the arm 76 extends downwardly through a slot 78 in this casing, terminating below the casing in the path of an actuating member 79, Fig. 1. The arm 76 is prevented from turning by riding in this slot 78, Fig. 6. The sheet metal casing conveniently consists of two semi-cylindrical sections 80 indicated in Fig. 1, separable at the top and bottom, and an end bell 81 (see also Fig. 6) suitably held in place by screws 82. By removing the end bell 81, the sides 80 may be removed to gain access to the air shutter and its adjusting means. Air inlet opening 83' (Fig. 6) are provided in the casing sections 80. The high firing rate position of the shutter 65 may be adjusted with precision by turning nut 74 to move arm 76 toward or away from the arm 79. This arm 79 has a fixed amount of swinging movement. The movement of arm 76, imparted by arm 79, is variable by varying the amount of lost motion between these two arms, when they are in their low firing rate positions shown, decreasing or increasing the lost motion to respectively increase or decrease the axial movement of screw 71. After the screw 71 and shutter 65 have been bodily moved to high firing rate position, they may be returned by spring 73 accurately into the low firing rate position, which

is defined by the abutment of head 72 with cross bar 89.

For coordinating the means for varying the rate of air flow with the means for varying the rate of oil flow to the nozzle, both means are actuated by a single lever 83 (Figs. 1 and 7), which is pivoted at 84 to the part 3 of the burner casing. This lever extends horizontally along the part 3 for a short distance and is then forked, the upper arm being the actuator 79 for moving the air shutter 65 as described and the lower arm 85 having a pin and slot connection with the lever 46 of the two-way valve 44. When the lever 83 is moved outwardly from part 3 far enough to swing valve lever 46 ninety degrees and thus cause valve 44 to connect the pipes 43 and 47, the arm 79 will have engaged arm 76 and moved it and screw 71 and air shutter 65 into the high firing rate position. The lever 83 may be actuated in any suitable or desired way. As shown in Fig. 7, the lever is connected to the plunger 86 of a solenoid contained in a casing 87 which is supported by legs 88 from casing 3. When the solenoid is energized by any of the means later to be described for the purpose, the plunger 86 will be pulled outwardly to swing lever 83 outwardly and move the oil valve 44 and air shutter 65 from their low firing rate positions to their high firing rate positions. A spring 89 encompassing the plunger 86, acts between the casing 87 and lever 83 to return the latter to its low firing rate position. This will restore the lever 46 of valve 44 to low firing rate position. The air shutter 65 will be restored to its low firing rate position by its spring 73 when the latter is permitted to act.

It is desirable refinement to provide the two air tubes 7 and 8 shown in Fig. 3. All the air for combustion is supplied through the inner tube 8, when the burner is operating at the low firing rate. When the burner is operating at the high firing rate, both tubes 7 and 8 are used for conducting the air to the oil spray. With this arrangement, when the rate of air flow is reduced, the cross sectional area of the conduit, through which the air is forced, is also reduced in order to prevent a substantial reduction in air velocity, such as might prevent the desired efficient mixing of the air and oil. The cross sectional area of the tubes may be so proportioned that the air will have the same velocity whether the burner is operating at the high or at the low firing rate.

A valve (Figs. 3 and 4) is provided to open and close the annular space 90 between the tubes 7 and 8. This valve consists of an annular ring 91, to opposite faces of which are fixed stampings 92 of triangular cross section. The ring 91 has a diametrical part 93 (see also Fig. 5) to which are fastened at their inner ends two studs 94 arranged in spaced parallel relation. These studs are mounted to slide in a direction parallel with the common axis of tubes 7 and 8 in bearings 95 provided on a supporting member 96. At their outer ends the two studs 94 are suitably fixed to a cross bar 97. Springs 98, one encompassing each stud 94, act between the end face of its bearing 95 and the diametrical part 93 with a tendency to hold the valve 91, 92 in the closed position illustrated. Fixed centrally to the cross-bar 97 are a pair of ears 99 which receive between them the outer end of one arm of a bellcrank lever 100 and to which such arm is pivotally connected. The bellcrank 100 at its central portion is received between, and pivotally connected to, a pair of ears 101 on the support 96. The other arm of the bellcrank 100 is connected by a link 102 to arm 85 of the lever 83, above described. When lever 83 is swung outwardly to move the oil valve 44 and air shutter 65 to their high firing rate positions, the air valve 91, 92 will be moved rearwardly (to the left as viewed in Figs. 3 and 4) and the annular passage 90 will be opened to receive air from tube 4. The parts 92 of the valve approximate streamlining so that when the valve is in open position, the air will flow past it without creating undue eddies.

The support 96 (Figs. 3 and 4) is provided with a plurality of radial pins 103 the outer ends of which bear against the peripheral wall of air passage 4 and hold it in coaxial relation with this passage 4. Two rods 104 are secured to the support 96 at diametrically opposite points and extend rearwardly in the passage 4, terminating with outwardly bent ends 105 which are received in recesses in the outer end face of member 3 and which are retained in such recesses by the cover 6.

The nozzle 10 (Fig. 3) has a portion of its feed pipe mounted in a support 106 and held thereto by a set screw 107. The electrodes 11 are supported by insulating tubes 108, which are also mounted in support 106 and held in place by set screws 109. The support 106 has radial legs 110, (Fig. 2), the outer ends of which engage the peripheral wall of tube 8 and locate the support 106 and the nozzle 10 in coaxial relation with the tube. The two supports 96 and 106 are interconnected by two tie rods 111 (Fig. 3), whereby the nozzle 10 and electrodes 11 are held in proper axial position, relatively to the air tubes. When the cover 6 is removed, one can reach into tube 4 and disconnect the link 102 from lever 100. Then, the link is disconnected from lever 83 and removed from the air passage 4. The oil pipe 36 is disconnected by unscrewing the union 112 (Fig. 1) which holds it to the casing 22. Then the unit comprising nozzle 10, electrodes 11, air valve 91, 92, oil pipe 36 and associated parts may be removed from the air passages by pulling outwardly (to the left as viewed in Fig. 3) on the rods 104. When this unit is partially removed, access may be had for disconnection of the wires (not shown) which connect with the ignition electrodes 11.

The burner is arranged for intermittent operation under the control of a room thermostat switch. The electrical connections are shown conventionally in Fig. 11. The room thermostat switch 113 is arranged to close on a demand for heat from the burner and close a low voltage circuit, which is supplied from the secondary 114 of a transformer and which includes a relay coil 115, the thermostat switch 113, the secondary 114 and the wires 116, 117 and 118 that connect these elements in series. The primary 119 of this transformer is connected by wires 120 and 121 to supply wires 122 and 123, respectively. The relay coil 115 when energized, operates a switch 124 to close a circuit to the motor 68 and to the ignition means. The motor circuit may be traced as follows, from supply wire 122, wire 125, switch 124, wires 126 and 127, motor 68, and wire 128 to supply wire 123. The ignition electrodes 11 are connected by wires 129 and 130 to the secondary 131 of an ignition transformer, the primary 132 of which is connected by wires 133 and 134 to wires 127 and 128, respectively, and thus in parallel with the motor 68 so as to be energized and deenergized simultaneously therewith.

The solenoid, which serves to shift the lever 83 and adapt the burner for operation at the high

firing rate is shown at 135. It may be controlled automatically or manually as desired. As an illustrative example of automatic control, a thermostat switch 136 is arranged in a circuit which includes in series the solenoid 135 and the relay switch 124, this circuit being traced as follows, from supply wire 122, wire 125, switch 124, wires 126 and 137, thermostat switch 136, wire 138, solenoid 135 and wire 139 back to supply wire 123. The thermostat switch 136 may be responsive to outdoor temperature or to the temperature at any other location, such as will evidence a need for operation of the burner at the high firing rate. For example, the switch 136 may be set to close when the outdoor temperature falls to some selected value, say 20° F. Then when the relay switch 124 is closed by the room thermostat 113 on a demand for heat from the burner, the solenoid 135 will be energized to shift the lever 83 and adapt the burner for operation at the high firing rate. For manual control, a push button switch 140 (Fig. 12) may be substituted for the thermostat switch 136 and connected to the wires 137 and 138 so as to open and close the circuit to the solenoid 135. This switch may be located at any convenient point in one of the living rooms of the house and it will then enable the burner to be changed over for high rate firing without going into the cellar to reach the burner. It is, however, obvious that the change over for high rate firing may be effected by means of a hand lever (not shown) located at the burner.

It has been stated that the oil pump is driven by the motor 68. Preferably, this drive is effected through the intermediary of a speed-responsive coupling or clutch after the manner disclosed in my prior Patent No. 1,985,934, granted January 1, 1935. This form of drive is indicated in Fig. 6, wherein the driving element of the clutch is indicated at 143 as fixed to a shaft 144, which in turn is connected to the motor shaft 67 by a flexible coupling 145. The driven element of the clutch is shown at 146 as fixed to the inner end of the pump shaft 62. With this arrangement, the pump will not be driven by the motor 68 until the latter and the fan 66 have acquired considerable speed so that air will be flowing past the oil nozzle 10 at a velocity sufficient for efficient mixing with the oil spray before any oil is emitted from the nozzle. Also, the oil pump will stop almost immediately after the motor switch is opened, while the motor 68 and fan 66 continue to turn for a while longer to scavenge the products of combustion from the combustion chamber of the heater. The burner preferably also includes the improvements disclosed in my copending application Serial No. 672,106, filed May 24, 1946, whereby the area of the air inlet is increased during the starting and stopping intervals of the burner. For this purpose, the driven element 146 of the clutch carries fan blades 147 on its outer periphery. These are located within a sleeve 148 on the air shutter 65. The fan 147 is stationary, when the pump is stationary, and the spaces between its blades then afford additional inlets or air to enter to the fan 66, during the starting and stopping intervals while the fan 66 is turning but not the pump. When the pump is turning, the fan 147 operates to draw air outwardly from the space around fan 66 and thus decrease the rate at which air is supplied to the burner. A lean mixture may thus be had during the starting and stopping intervals to avoid smoky operation and the deposit of soot on the heat transfer surfaces of the heater, and yet during the normal running intervals of operation of the burner, the ratio of air to oil may be cut down to secure higher efficiency of combustion.

The invention is not limited in all its aspects to the particular means described for varying the oil pressure to change the firing rate. Other means may be used for the purpose. For example, the pressure variation may be effected by changing the tension of the spring of a pressure regulating valve. A cut-off valve and a single by-pass valve, similar to that in the described casing 22 may be used, the by-pass valve opening to allow oil to return always to the suction side of the pump. In Fig. 9 there is shown the upper portion of such a valve unit together with means for varying the tension of the spring 33 that tends to hold the cut-off valve and by-pass valve in closed position. The upper seat 149 for the spring is carried by the lower end of a plunger 150, which is mounted to slide in the cap 151 and may be moved downwardly by a lever 152, pivoted at 153 adjacent the cap 151 and suitably actuated, as by a solenoid 154. This solenoid may be connected in parallel with the solenoid 135 and energized coincidentally therewith. The plunger 155 of the solenoid 154 is pivotally connected to the outer end of the lever 152. There are adjustable stops 156 and 157, mounted on the cap and located in the path of lever 152, for respectively limiting the movement of the latter for low and high rate firing. The spring 33 tends to raise lever 152 and press it against stop 156. This is the low firing rate position in which the spring 33 has the lesser tension. When the solenoid 154 is energized, lever 152 will be pulled downwardly until it engages stop 157. This is the high firing rate position in which spring 33 has the greater tension.

Another arrangement for varying the oil pressure is shown diagrammatically in Fig. 10. Here, an oil pump 158 draws oil from a suction pipe 159 and forces it successively into three casings, the first containing a cut-off valve 160, the second containing a by-pass valve 161, and the third containing a second by-pass valve 162. The cut-off valve 160 may open when the pressure of the pumped oil reaches, say 90 pounds per square inch and allow flow through pipe 163 to the nozzle 10. The by-pass valve 161 is, however, set to open at the high pressure, say 200 pounds per square inch and allow oil to return through pipe 164 to the suction side of pump 158. This is the arrangement for high rate firing. The second by-pass valve 162 receives oil from the pump only when a valve 165 is opened. This by-pass valve 162 is set to open at the low pressure, say 95 pounds per square inch, and allow oil to return by pipes 166 and 164 to the suction side of pump 158. Of course, when valve 165 is opened, the second by-pass valve 162 will open and the first by-pass valve 161 will remain closed. This reduces the pressure to nozzle 10 for low firing rate operation. The valve 165 may be operated by arm 85 of lever 83 as before and the air valve 91, 92 and the air shutter 65 may be used as before under the control of the solenoid 135.

In operation, the burner is started up automatically by the room thermostat 113 on a demand for heat from the burner. Oil will be supplied to the nozzle 10 by the pump 13 at a relatively low rate or a relatively high rate depending on whether the firing rate control switch is open or closed. If this control switch is open, oil will be supplied to the nozzle at the low rate while if it is closed oil will be supplied at the high rate.

The change in rate is effected by changing the pressure of the oil supplied to the nozzle and this may be done by the use of the two differentially-set pressure-regulating valves shown in Fig. 8 and the control valve 44, which renders one or the other effective for the purpose, or by the two pressure regulating valves 161 and 162 and the control valve 165, which renders one or the other of them effective, or by varying the spring pressure of a single pressure regulating valve, as shown in Fig. 10, or by any other suitable means. Whatever the means used, the pressure is changed by a substantial amount sufficient to produce an appreciable change in the rate of atomization of the oil. For example, with a change in oil pressure from 95 to 200 pounds per square inch, it is contemplated that the firing rate will vary from 0.9 gallon per hour to 1.35 gallons per hour. Coincidentally, with the variation in the rate of oil supply, the rate of air supply will be varied by movement of the shutter 65 to increase or decrease the area of the air inlet to fan 66, accordingly as the rate of oil supply is respectively decreased or increased. Also, the air valve 91, 92, if used, will be held closed, when the burner is operated at the low firing rate so that all the air for combustion will be supplied through the inner tube 8. When the burner operates at the high firing rate the valve 91, 92 will be opened, so that the air will be supplied through both tubes 7 and 8. By the provision of the two tubes 7 and 8 and the air valve 91, 92, the velocity of the air supplied to the oil spray may be maintained substantially the same whether the air is supplied at the high or at the low rate. The air mixes with the oil spray and the combustible mixture of air and oil is ignited by a spark from the electrodes 11. Combustion continues until the burner is stopped, usually when the demand for heat is satisfied by the opening of the room thermostat switch 113.

The burner of this invention is adapted for the work of heating houses and operates intermittently under the control of a room thermostat in heat supply cycles. The burner starts and stops many times during each day of the heating season. It remains stopped when no heat is needed. It starts up, when heat is needed, and may operate during all of its heat supply cycles at a low rate if the weather is mild or at a high rate if the weather is severe. The firing rate needed for any one heat supply cycle may be predetermined automatically by the second thermostat 136 or by hand if desired, as by switch 140, or otherwise, and an electrical circuit will be opened or closed accordingly as low or high rate firing is needed, so that when the room thermostat 113 starts the burner the air and oil will be supplied at the low or high firing rate for the whole cycle of operation.

The dual firing rate arrangement enables the house to be heated with more comfort and better economy. The high rate may be such as is required for heating the house in the most severe days of the heating season. These days are relatively few. For the greater part of the heating season, the burner may be fired at a substantially less rate with the result that the burner will be on for a larger part of the time during each day than it would if operated at the high rate. Greater heating comfort is derived when the burner is operated for a longer total time at a lower rate during the milder days of the heating season that when it is operated for shorter times at the high rate. And high rate firing except during the few severe days of the heating season, is likely to be wasteful of heat and to result in low efficiency of operation of the heating plant from the standpoint of oil consumption.

It is contemplated that the burner will be used with all the various accessories and the various safety devices customarily used with burners of the general type disclosed. Such controls, as have been described, have been illustrated merely schematically to indicate their function.

It is required in every burner of the type herein referred to, to provide a safety device which will automatically stop the burner in case of failure of combustion, occurring either at the start or during a cycle of operation of the burner. These safety combustion controls will also operate to stop the burner on a substantial decrease in temperature in the heating apparatus. Depending on the difference between the high and low firing rates, the change back to a low firing rate may result in a sufficient decrease in temperature in the heating apparatus to cause the combustion safety device to stop the burner. In view of this possibility, it is intended that the safety combustion control used will be of the recycling type, which will enable the burner to automatically start up again a short time after it has stopped the burner. For example, on a shift from high to low firing rate, the burner may in some cases be stopped by the safety combustion control but, if it is, the burner will be off for only a short interval, say 90 seconds, when the recycling control will start the burner. Meanwhile, the heat responsive element of the combustion control will have cooled enough to allow continued operation of the burner at a new temperature level at the low firing rate.

The temperature settings of the various thermostats herein described will naturally vary according to conditions and the particular temperatures named herein have been given as illustrative examples and not as limitations.

The oil pressure control means per se, such as is shown in Fig. 8, is not claimed herein. Such means forms the subject matter of a divisional application, Serial No. 75,592, filed February 10, 1949.

From the foregoing description, it will be clear that the invention provides a burner which can be used with any of the usual types of heating plants, without requiring changes therein for the purpose of firing the heating plant at different rates in different kinds of weather in order to secure greater heating comfort in the home and better efficiency of operation of the heating plant, so far as oil consumption is concerned.

I claim:

1. A variable-firing rate oil burner of the oil pressure atomizing type for house heating systems having in combination, an oil pressure atomizing nozzle, an oil pump, a conduit connecting said pump and nozzle, pressure-regulating means connected to said conduit and operable to maintain the pressure of the oil supplied to said nozzle constant at either of two predetermined values to vary the rate at which oil is atomized by the nozzle and thus the firing rate of the burner, a fan for supplying air to mix with the atomized oil emitted from said nozzle, means for varying the rate at which air is supplied by said fan to correspond with the rate at which oil is supplied, conduit means receiving air from the fan and through which the air is conducted to said nozzle, and a valve to vary the effective area of the conduit means, increasing or decreasing such area accordingly as the rate of air supply is increased

or decreased; and interrelated means for raising and lowering the pressure of the oil supplied to the nozzle, increasing and decreasing the rate of air supply and for actuating the last-named valve to increase and decrease the effective area of the air conduit means.

2. A variable-firing rate oil burner of the oil pressure atomizing type for house heating systems, having in combination, a motor-driven air fan and oil pump, a pair of air conduits arranged one within another and both connected to receive air from said fan, an air valve movable to control the connection of the outer air conduit to the fan, an oil conduit connected to receive oil from said pump and arranged to end within the inner air conduit in an oil pressure atomizing nozzle, pressure regulating means for controlling the pressure of the oil supplied by said pump to said nozzle, means for varying the setting of the pressure regulating means to change the pressure of the oil supplied to the nozzle from a relatively low to a relatively high value and thus vary the rate at which oil is atomized by said nozzle from a relatively low to a relatively high firing rate, means for varying the rate at which air is supplied by said fan to correspond with the rate at which oil is atomized; and means interrelating the air rate varying means, the oil pressure varying means and air valve so that the air supply is respectively increased and decreased and supplied through both or only the inner one of said conduits accordingly as the oil pressure is increased or decreased to effect high rate or low rate firing.

3. A variable-firing rate oil burner of the oil pressure atomizing type adapted to start and stop under the control of a room thermostat and operate intermittently in cycles, said burner having in combination an air fan, an oil pump, a motor for driving the fan and pump, an air conduit connected to receive air from said fan, an oil conduit connected to receive oil from said pump and arranged to end within said air conduit with an oil pressure atomizing nozzle, pressure-regulating means connected to said oil conduit and operable to maintain the pressure of the oil supplied by said pump to said nozzle constant at either of two predetermined pressures, and a control for said pressure-regulating means operable at any time independently of the operation of the motor to set said pressure-regulating means for either of said pressures and thereby select the firing rate at which the burner will operate, whereby the burner may start up at either the high rate or the low rate and may operate throughout a complete cycle at either rate.

4. A variable-firing rate oil burner of the oil pressure atomizing type for house heating systems, having in combination, an air fan, an oil pump, a motor for driving the fan and pump, an air conduit connected to receive air from the fan, an oil conduit connected to said pump and arranged to end within said air conduit with an oil pressure atomizing nozzle, pressure-regulating means connected to said oil conduit and operable to maintain the pressure of the oil supplied by said pump to said nozzle constant at either of two predetermined pressures, means for setting said pressure-regulating means for one or the other of said predetermined pressures to thereby vary the rate at which oil is atomized by said nozzle, means for varying the rate at which air is supplied through said air conduit, and means interconnecting the setting means and the air-rate-varying means to proportionately increase or decrease the oil rate as the air rate is respectively increased or decreased.

5. In a variable-firing rate oil burner of the type wherein a motor driven fan and pump respectively supply air and oil to an air conduit and an oil conduit and the oil conduit terminates in the air conduit with a nozzle of the oil pressure atomizing type, first and second pressure regulating valves connected with said conduit and set for relatively low and relatively high pressures, a control valve movable from one position to another to render one or the other of the pressure regulating valves effective to control the pressure of the oil supplied to said nozzle, whereby to vary the rate at which atomized oil is emitted from said nozzle, an air valve for varying the rate at which air is supplied through said air conduit, and means interconnecting said air valve and control valve so that when the air valve is positioned for a relatively low or a relatively high rate the first or the second regulating valve respectively is rendered effective to control the pressure of the oil supplied to said nozzle.

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