May 14, 1940. H. W. HILL 2,200,671

FUEL OIL BURNER CONTROL DEVICE

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Fig. 1

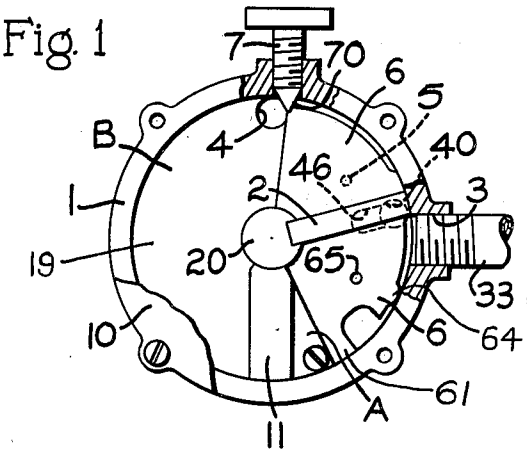


Fig. 3

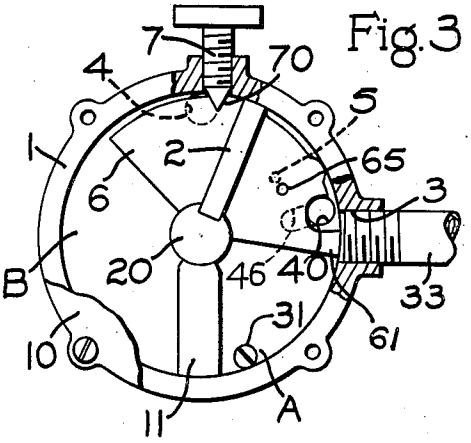


Fig. 2

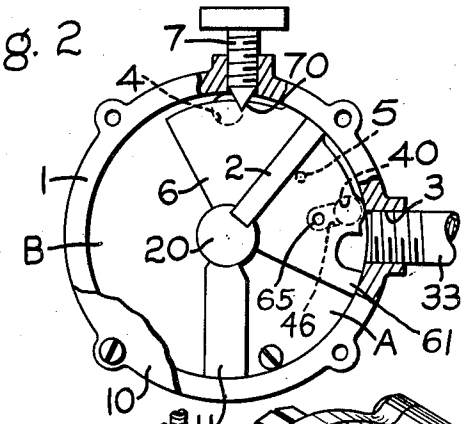


Fig. 4

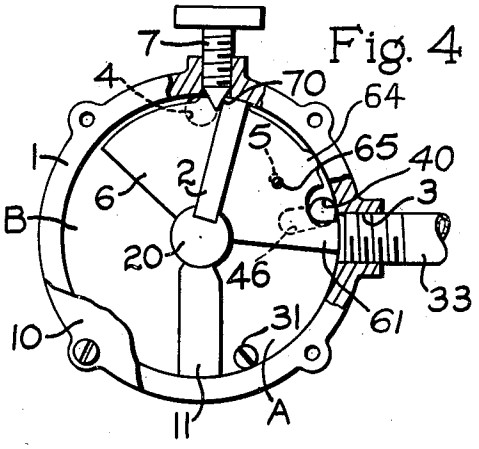
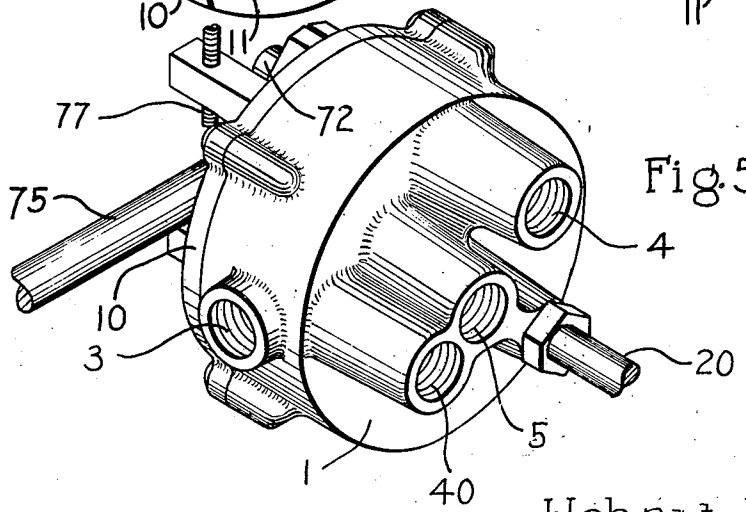


Fig. 5



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FUEL OIL BURNER CONTROL DEVICE

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Fig.6

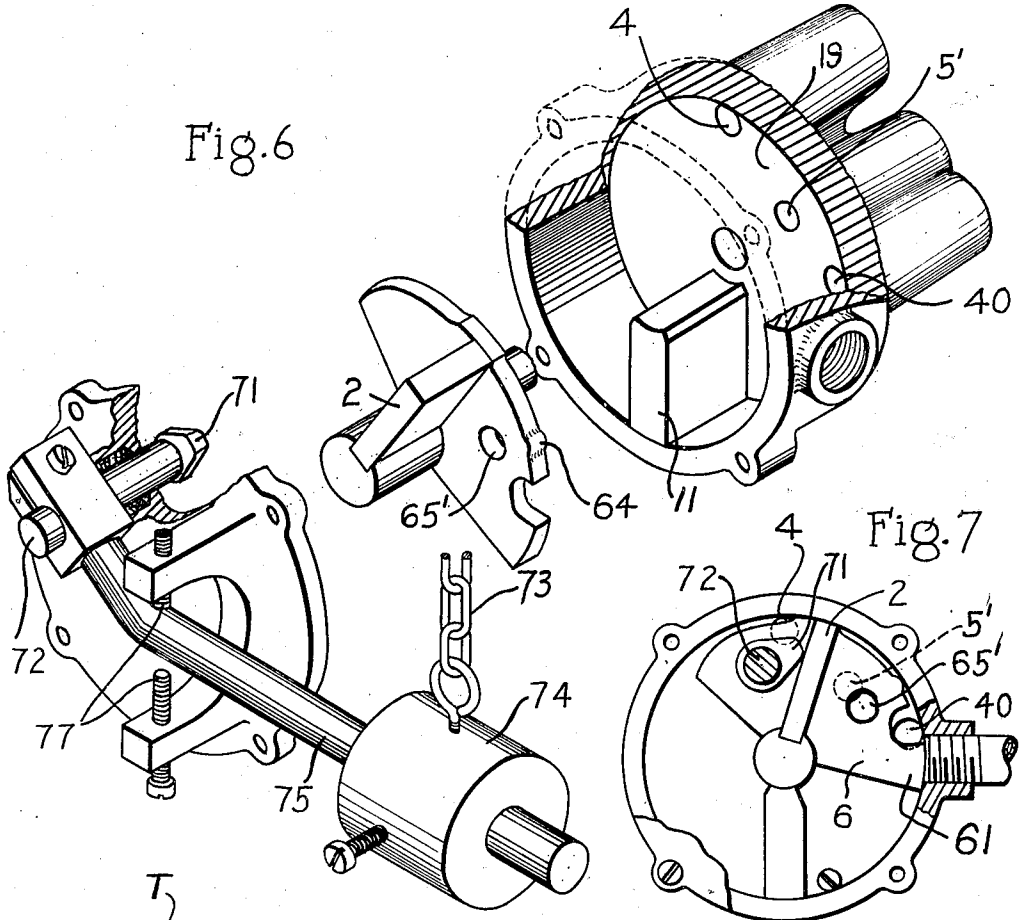


Fig.7

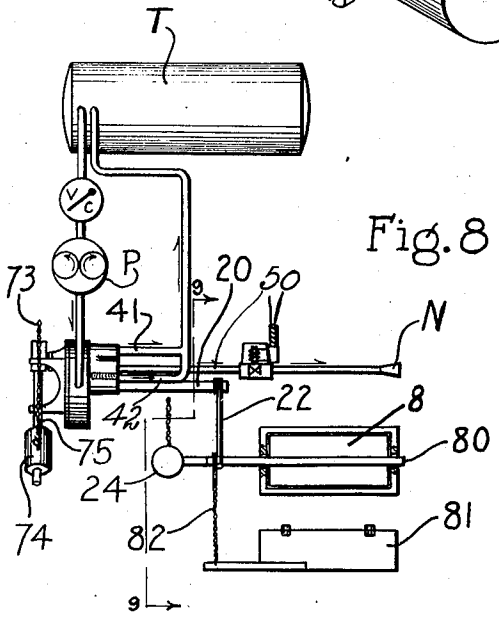


Fig.8

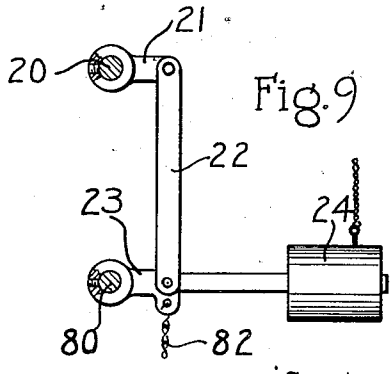


Fig.9

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Patented May 14, 1940 2,200,671

UNITED STATES PATENT OFFICE

2,200,671

FUEL OIL BURNER CONTROL DEVICE

Hobart W. Hill, Seattle, Wash.

Application February 15, 1937, Serial No. 125,730

30 Claims. (Cl. 137—153)

My invention relates to a control for an oil burner, and is designed as a means to afford suitable control for burners handling heavy fuel oil, such, for example, as American Petroleum Institute specifications 4, 5, and 6, particularly the two latter.

This oil, though considerably cheaper than Diesel oil (American Petroleum Institute specifications 1, 2, and 3), is more difficult to handle through valves, and the control devices normally employed include as separate elements a viscosity valve, a modulating fire control whereby the fire may be brought from an initial low fire to a high fire, a maximum fire control, a high-low fire control, sometimes a boiler pressure control, and air controls. Each such control is usually a separate element, and a fuel oil burner is thereby made complicated and expensive.

It is an object of the present invention to provide a control device for such a burner which will incorporate all necessary controls in a simple, compact, and convenient control device, thus greatly simplifying the manufacture and control of such a fuel oil burner, and lessening the cost thereof.

It is a further object of my invention to provide an automatic low fire starting control whereby the fire may be started with a low flame, thus avoiding any so-called "puff" or miniature explosion within the furnace, and built up gradually, say over a period of thirty seconds, to its maximum flame.

It is a further object to provide a simple means to regulate the maximum fire, and to make such means responsive, if desired, to boiler pressure variations, or to other automatic controls.

It is a further object to incorporate in such a device a viscosity control whereby the same amount of oil is delivered regardless of the viscosity of the oil, which may vary in accordance with change in temperature.

It is a further object to devise a control having the several characteristics indicated, which shall be simple and convenient, and which, because of its inherent characteristics, requires no close fitting or careful manufacture, and hence can be made at low cost.

It is also an object to devise a control of this character any single unit of which will be suitable for installations having widely varying requirements—for instance, installations requiring delivery of, say, three gallons an hour, or of forty-five gallons an hour, with a pump delivering, say, fifty gallons an hour.

With these and other objects in view, as will appear hereafter, my invention comprises the novel parts, and the novel combination and arrangement thereof, as shown in the accompanying drawings, and as will be hereinafter more fully disclosed in this specification and pointed out by the claims which terminate the same.

In the accompanying drawings I have shown my invention embodied in a form which is now preferred by me, certain views, however, being diagrammatic in character.

Figure 1 is a diagram in the nature of an elevation, with the cover broken away, showing parts in the inoperative position.

Figures 2, 3 and 4 are similar views, showing parts in successive positions to the final operative position of Figure 4.

Figure 5 is a perspective view, showing the control device assembled.

Figure 6 is a perspective view, showing certain parts of the control device separated.

Figure 7 is an elevation with the cover broken away, showing a preferred form of the control.

Figure 8 is a diagram of the essential parts of the fuel oil burner system, showing the same connected to a furnace, and Figure 9 is a view on the line 9—9 of Figure 8.

The invention comprises, in essence, a casing defining a closed space, within which space is movable a diaphragm, vane or similar member, which divides the space into two chambers of mutually variable size, and certain ports or passages in one or more walls of the space admitting to one or the other of said chambers, together with a plate or valve element movable with the vane and cooperating to partly or wholly mask or control the ports or passages referred to. It is largely immaterial what shape the chamber takes, or in which wall the ports are formed, or whether ports are actual openings in and through the cooperating members, or merely edges properly formed to be cut by a cooperating edge in the other member, and the device which will now be described is one of several forms which may be employed.

The casing 1, in the form illustrated, is generally cylindrical, and is provided with a cover 10 enclosing a substantially cylindrical space, the end wall 19 of which, only, need be a ground surface. A fixed abutment 11 in conjunction with a vane 2, oscillatable within the space and carried by a shaft 20, divides the closed space into two chambers A and B, which are mutually variable in size. The chamber A may be considered the high pressure chamber and the chamber B the low pressure chamber. The size or angular extent of the abutment 11 may vary considerably, its principal function being to divide the space within the casing 1 in conjunction with the movable vane 2. It has been found unimportant that the vane may leak somewhat about its edges, or at the abutment 11. Any such leakage does not harmfully affect the operation of the device, and hence exact fitting of parts may be dispensed with.

An oil pressure supply passage 3 to which connects the conduit 33 from the pump P, admits to the high pressure chamber A at all times, and the vane 2 is suitably stopped in its inoperative position, shown in Figure 1, so that it does not pass the port or passage 3. The stop means may be any which is convenient. To represent such a means diagrammatically, there is shown a set screw 31 engaging the edge of a plate 6, which, seating on the end wall 19, moves with the vane 2. Such engagement limits movement of the vane 2 to the right or toward inoperative position. Its movement in this direction is under the influence of yieldable means such as a weighted arm 21 (see Figure 9).

Admitting to the space within the chamber B is a relief port 4, from which a conduit 41 leads to a supply tank. A suitable stop is employed to prevent the vane 2 from moving to the left past the port 4, so that the latter port never communicates directly with the high pressure chamber A. Such a stop means is diagrammatically indicated in Figures 1 to 4, inclusive, by the set screw 7 having the tapered end 70 projecting into the path of the vane 2 and engageable therewith, for fine adjustment of the final operative position.

A further port admitting to the space within the casing 1 is the port 5. This is the oil discharge or delivery port, leading by a conduit 50 to the burner nozzle N. The vane 2 may sweep from one side to the other of this port, but regardless of the position of the vane 2 the plate 6 always masks this delivery port 50, except as the plate is provided with a port 65 which comes into registry with the port 5 as the vane approaches or reaches its operative position, shown in Figure 4. When the ports 65 and 5 are in registry, partly or wholly, the oil admitted through the passage 3 finds an outlet through the registering ports 65 and 5 to the burner nozzle. Engagement of the vane 2 with the tapered tip 70 determines the amount of opening of the combined ports 65 and 5, and thereby determines the maximum amount of oil permitted to be delivered, and this amount is variable by appropriate movement of the screw 7, or any other adjustable stop means, such as will readily suggest itself to the designer of this device.

Preferably there is a further port 40 which is in the nature of a relief port, but which is primarily for the purpose of regulating the volume discharged through the delivery port 5, 65, regardless of the viscosity of the oil. This port admits to the high pressure chamber A, in all positions except in the full inoperative position of the parts shown in Figure 1. From this a line 42 leads to the supply tank, or is connected to the line 41. To distinguish this relief port 40 from the relief port 4, when necessary, the port 40 may be termed a viscosity control port.

It is known to be generally true that rotary pumps such as are in common use in the rotary fuel oil burners, revolving at a constant speed, will deliver an equal amount of liquid measured in gallons whether the liquid be thin or thick, viscous or nonviscous, operating under identical conditions of suction and discharge. Where there are two ports for the discharge of the liquid, of different size, each offering suitable resistance to the discharge, the amount delivered through each such port will be in the ratio of the sizes of the ports, regardless of the viscosity of the liquid. This principle is the basis of the usual viscosity valves employed in such systems, and is incorporated in the present device in lieu of any separate viscosity valve. Such regulation, in this device, can be carried down to the point of delivering a few gallons an hour of heavy fuel oil, thereby making possible the use of fuel oil in heating small residences, which heretofore has not ordinarily been considered feasible.

To understand the operation of the device, we may assume, as would be the case, that at the end of a period of operation, and after the supply of oil to the burner, through this control device, had ceased, the weight-controlled arm 21 had brought parts to the position of Figure 1, which may be termed the inoperative or "off" position. In this position oil fills the chambers A and B, the ports 4 and 40 being interconnected, directly through lines 41 and 42, or because both connect to the same supply tank. In effect oil which is forced out of the chamber A, after closing down of the operation of the burner, merely passes to the chamber B. Leakage from one chamber to another may occur also because the parts are not fitted closely.

Now, to recommence operation, whether after a long or a short shut-down, the pump is restarted. Following in order the diagrammatic showings of Figures 1 to 4, inclusive, it is seen that oil discharged from the pump P, coming from the tank T, is admitted through the passage 3 to the chamber A. Since it has no immediate outlet from the chamber A (the port 40, if employed, being substantially closed by the vane 2 and plate 6), the entering oil builds up pressure in chamber A, sufficient to overcome all resisting forces, and this pressure, acting on the vane, tends to move it to the left, forcing oil from the chamber B through the port 4. The relief port 4 is sufficiently freely open that immediately movement of the vane 2 and plate 6 to the left begins, overcoming sticking or inertia, but almost at once the plate 6 closes down the effective area of the relief port 4, and begins to open the viscosity control port 40, the edge of the plate being suitably cut away to afford a slight opening through each of these ports. The speed of movement, at this stage, is regulable by the degree of masking of the port 4, particularly with relation to the effective size of the port 40, and the speed of movement is dependent principally upon the time required to bring the burner itself up to speed, before the oil can be admitted to the nozzle. The speed of this movement as pointed out above, may be controlled by regulating the relative areas of the respective ports uncovered by the plate 6 in any given position. That surface of the plate 6 which wipes over the finished end wall 19 is likewise a finished surface, and being pressed by the internal pressure against the end wall, serves to scrape from the latter any dirt, sticky paraffine, or asphalt, and breaks the seal caused by the stickiness of the heavy oil, particularly noticeable after an overnight shutdown.

This movement to the left proceeds until parts reach the position of Figure 2, and at this point, in order to insure that the metering port 65 is blown out and cleared of sticky oil or any other accumulation which may tend to clog it, this port is permitted to come into registry with a groove or passage 46 in the end wall of the casing, communicating with the viscosity control port 40. At this time the port 40 is nearly closed by the nub 64, and substantially the entire pressure within the chamber A is imposed on any material which may have collected in the port 65, and this is blown out through the passages 46 and 40.

However, the relief thus afforded does not materially stop the movement of the vane 2 to the left, since the port 4 is still open and pressure in chamber A tends to move the vane to the left. This proceeds until parts reach the position of Figure 3, when the viscosity control port 40 is completely uncovered, and the relief port 4 is very nearly completely covered, though it need never be entirely closed. Because of the opening of the port 40, relieving part of the pressure, the movement by this time has been slowed down materially, but still the ports 65 and 5 are not in registry. As a result the movement of the vane 2 to the left slowly continues, bringing the ports 65 and 5 into registry and slowly opening them to their maximum extent desired. The time, or point in the cycle, when they begin to open, is governed by their relative size, shape, and position. It requires about thirty seconds for the parts to pass from the position of Figure 1 to the position of Figure 4, where the port 5, 65 is fully opened as far as it is desired to permit it to open, and the vane is stopped by engagement with the tapered tip 70 of the set screw 7, or equivalent stop means, which regulates the effective size of the oil delivery port within very small increments. Now the oil passes through the ports 65 and 5 to the burner nozzle, and the excess not thus used passes by the port 40 to the tank.

The oil is thus afforded two ports by which it may escape from the chamber A, during normal operation, namely, the metering port 65, 5, which is adjustable in size to a fine degree, and the relief port 40, which normally need not be adjustable in size. These two ports, by variation of their relative size, constitute a viscosity control, by means of which the amount of oil delivered may be kept constant, regardless of its viscosity, which may change under varying conditions.

When the oil supply is closed down, the weight-controlled arm 21 moves the vane 2 to the right from the position of Figure 4 until it eventually reaches the position of Figure 1, both the interconnected chambers A and B being kept full of oil at all times. With the pump shut down, the weighted arm constitutes the only force acting to move the vane, and that force is sufficient to overcome the fluid resistance of the oil, and slight friction, which are the only forces resisting such movement.

A preferred type of limit stop for the position of the vane 2 is shown in Figure 7, where a cam 71 is mounted upon an oscillatable shaft 72, the cam being positioned to engage the vane 2, and upon oscillation of the cam by the shaft 72 the final position of the vane 2 may be varied at will, and this oscillation may be accomplished by a boiler pressure control, as is common in the control of such oil burners. A chain 73, leading from such a control (not shown) is illustrated in Figures 6 and 8. Upward pull upon this chain tends to increase the effective area of the opening 65, 5 as the boiler pressure falls, and as the pressure rises the weight 74, acting on the arm 75, tends to decrease the area of the oil discharge port. Limit stops 77 fix the ultimate limits of such control.

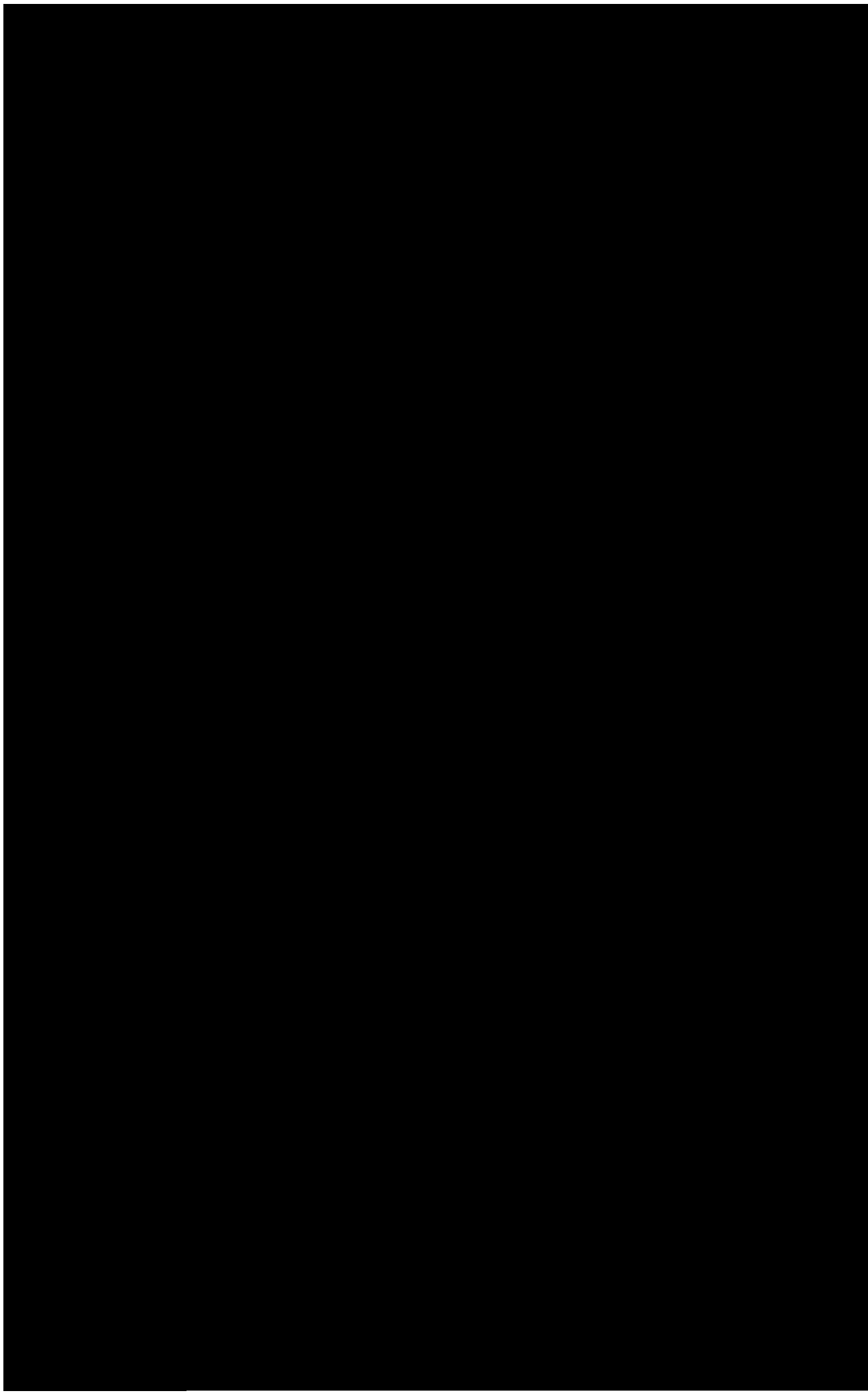
The air for combustion is commonly controlled along with the oil supply, and if it is desired to accomplish this the arm 21 may be connected through links 22 to an arm 23 connected through a shaft 80 to the damper 8 controlling the supply of air, and this in turn may be connected through a chain 82 to a damper 81 controlling the secondary air. A counterweight 24 on the arm 23, or if the connection to the air is not used, upon the arm 21, serves to return parts, after cut off of the oil supply, to the position of Figure 1. The burner nozzle has associated with it a fan to deliver air with the oil, and due to the fact that the nozzle and fan have been permitted to attain maximum speed, and to establish a forced draft, prior to delivery of any oil, that is, while parts move from the position of Figure 1 to the position of Figure 4, the burner does not light before the draft has become established, and the usual starting puff is minimized.

The weight 24 serves two valuable ends. First, in starting operations it imposes the necessity of developing adequate oil pressure at the pump, and in the chamber A, before the vane 2 can be moved, and, consequently before the oil can be delivered to the burner nozzle. This means that the pump, and the burner itself, must develop sufficient speed, and the fan must develop sufficient draft, all before admission of oil to the nozzle, that when the admission of oil does occur there can be no starting "puff". The time of admission is further delayed and controlled by the relative shape and disposition of the vane 6 and the several ports, and the amount of oil initially admitted is small, due to the arrangements described whereby the ports 5 and 65 are initially but minutely opened, and are slowly brought into full open position, thereby gradually building up the fire from low to high fire.

Second, upon shutting down operations, since the oil, from the operation, is relatively free-flowing, it impedes movement of the vane 2 the least. When for any reason (leakage in the oil line, for instance, or mere shut-down), pressure drops in chamber A, the weight 24 snaps the vane 2 back towards its Figure 1 position, quickly cutting off delivery of further oil to the nozzle. Thus are combined initially delayed-action oil delivery means, and an automatic and quick-acting shut-off means.

Such an arrangement, embodying a finer degree of control of viscosity and of maximum delivery, absence of starting puff, automatically self-cleaning and self-starting, and a simplified and less expensive control device, susceptible of complete automatic control, capable of low-cost manufacture, and requiring no appreciable care or servicing, will make possible successful operation of heavy oil automatic oil burners in small residence installations, such as have not heretofore been considered successful commercially, although used on a small scale in the Pacific Northwest, in installations where the higher cost of the complicated controls heretofore considered necessary has been believed to be justified by the lower cost of the heavy fuel oil.

The port 5, 65, as shown in the diagrammatic views, Figures 1 to 4, is small as compared to the port 40. It follows that the major portion of the fuel delivered will return through the viscosity control or secondary relief port 40 to the tank. This arrangement might be suitable for small burners, but would entail adjustment of the size or change of bushings fitted into such ports, to accommodate systems requiring a materially different rate of delivery to the burner nozzle N. To avoid this, and to make the device flexible in this respect, and adaptable to varying requirements of different installations, without change of parts, the arrangement of Figure 7 may be employed. Here the ports 5' and 65' are alike in size, and the same in size as the port 40. The



fective sizes of the two relief ports, maintaining the first-mentioned relief port of greater effective area than the last-mentioned relief port, until the oil delivery port is uncovered, as parts approach the final operative position, and means adjustable to stop the movement of said member, to control the effective area of the oil delivery port, with parts in the final operative position.

7. The combination of claim 5, the masking member having a port complemental to and adapted to register with and cooperatively to control the effective area of the oil delivery port, a passage in the chamber wall, in communication with the second relief port, and disposed for registry with the port in said masking member, prior to the latter's registry with the oil delivery port, thereby to clear any accumulation from the port in the masking member, through the second relief port, as parts move toward operative position.

8. The combination of claim 5, the masking member having a port complemental to and adapted to register with and cooperatively to control the effective area of the oil delivery port, a passage in the chamber wall, in communication with the second relief port, and disposed for registry with the port in said masking member, prior to the latter's registry with the oil delivery port, thereby to clear any accumulation from the port in the masking member, through the second relief port, as parts move toward operative position, and the masking member being formed to mask the second relief port from the high pressure chamber while said passage is in communication with the port to be cleared.

9. An oil burner control comprising a casing defining a closed space, and a vane movable therein and dividing the space into two chambers of mutually variable size, an oil pressure supply port communicating at all times with one, high pressure, chamber, two relief ports communicating, in operative position of the parts, with the high pressure chamber and with the other, low pressure, chamber, respectively, an oil delivery port communicating, when parts are in the operative position, with the high pressure chamber, a masking member movable with said vane, and cooperating with the relief ports to control their effective size, a port in said masking member registrable with and cooperating with the oil delivery port to control its effective size, such port in the masking member being so located as to leave the oil delivery port fully open when the second relief port is fully open, and the masking member being shaped, relative to the second relief port, to begin to close the latter as the port in the masking member moves past the oil delivery port, and stop means to control the final operative position of the masking member.

10. An oil burner control comprising a casing defining a closed space, and a vane movable therein and dividing the space into two chambers of variable size, an oil pressure supply port communicating at all times with one, high pressure, chamber, a plane wall of such space having a relief port communicating with the other, low pressure, chamber, and a second relief port adapted for communication with the high pressure chamber, following commencement of the vane's movement away from its inoperative position, the same wall having an oil delivery port communicating with the space, a plate movable with the vane along the plane wall, and extending on opposite sides of the vane, and covering the oil discharge port, in the inoperative position of the vane, and during advance of the vane from its inoperative position partially closing the two relief ports, and regulating their relative effective area to move the vane slowly towards its operative position, a port in the plate adapted to register with the oil delivery port in the operative position of the vane, a passage in the plane wall communicating with a relief port, and disposed to register with the port in the plate, before the latter comes into registry with the oil delivery port and before the relief port for communication with the high pressure chamber comes into unrestricted communication therewith, thereby to blow out said port in the plate.

11. An oil burner control comprising a casing defining a closed cylindrical space having a fixed abutment therein and an oscillatable radial vane cooperating with the abutment to divide the space into a high pressure chamber and a low pressure chamber, a plate movable with the vane and projecting into each such chamber, to seat on the end wall thereof, a port in said plate in the high pressure chamber, an oil discharge port in the end wall of the casing registrable with the port in the plate when parts are in operative position, but otherwise closed by the plate, an adjustable stop to determine the final effective area of the passage formed by the registry of such ports, a relief port in the end wall communicating with the low pressure chamber, and freely open when parts are in inoperative position, the plate having an edge which cooperates with the latter relief port to increasingly close the port as parts move towards the operative position, and an oil pressure supply port communicating at all times with the high pressure chamber.

12. An oil burner control comprising a casing defining a closed cylindrical space having a fixed abutment therein and an oscillatable radial vane cooperating with the abutment to divide the space into a high pressure chamber and a low pressure chamber, a plate movable with the vane and projecting into each such chamber, to seat on the end wall thereof, a port in said plate in the high pressure chamber, an oil discharge port in the end wall of the casing registrable with the port in the plate when parts are in operative position, but otherwise closed by the plate, an adjustable stop to determine the final effective area of the passage formed by the registry of such ports, a relief port in the end wall communicating with the low pressure chamber, and freely open when parts are in inoperative position, the plate having an edge which cooperates with the latter relief port to increasingly close the port as parts move towards the operative position, an oil pressure supply port communicating at all times with the high pressure chamber, and a second relief port substantially closed by the plate when parts are in inoperative position, and the plate having an edge cooperating with the latter port to increasingly open the same into the high pressure chamber, during movement of parts towards operative position, and finally freely opening the port to the high pressure chamber just prior to and during opening of the oil discharge port.

13. In a liquid control device, a casing defining a closed space, a vane dividing the space into two chambers, and movable to compensably vary the relative size of said chambers, a delivery port admitting to the closed space, a viscosity control port likewise admitting to such space, an oil pressure supply port capable of delivering a given quantity of liquid to such space under a given pressure in a given time, for discharge through the delivery port and the viscosity control port,

a ported member movable with said vane, and cooperating with the delivery port to control the effective size thereof, and means adjustable to limit the movement of said ported member, and thereby to determine the effective size of the delivery port, relatively to the viscosity control port.

14. In a liquid control device, a casing defining a closed space, a vane dividing the space into two chambers, and movable to compensably vary the relative size of said chambers, a delivery port admitting to the closed space, a viscosity control port likewise admitting to such space, an oil pressure supply port capable of delivering a given quantity of liquid to such space under a given pressure in a given time, for discharge through the delivery port and the viscosity control port, a ported member movable with said vane, and cooperating with the delivery port to control the effective size thereof, means adjustable to limit the movement of said ported member, and thereby to determine the effective size of the delivery port, and means automatically operable in accordance with conditions responsive to the amount of liquid discharged through said delivery port, to operate said adjustable member.

15. An oil burner control comprising a casing defining a closed space, and a movable member therein dividing the space into a high pressure and a low pressure chamber of mutually variable size, an oil pressure supply port admitting to the high pressure chamber, a relief line communicating by two connected relief ports with the high pressure chamber and with the low pressure chamber, an oil delivery port for communication with the high pressure chamber, of a size substantially equal to that of the relief port in the high pressure chamber, and means movable with the movable member, shaped to mask the oil delivery port and the last-mentioned relief port, and arranged, relative to said ports, to begin to open the oil delivery port as the relief port begins to be masked, and to open the oil delivery port fully when the said relief port is fully masked.

16. An oil burner control comprising a casing defining a closed space, and a movable member therein dividing the space into a high pressure and a low pressure chamber of mutually variable size, an oil pressure supply port admitting to the high pressure chamber, a relief line communicating by two connected relief ports with the high pressure chamber and with the low pressure chamber, an oil delivery port for communication with the high pressure chamber, of a size substantially equal to that of the relief port in the high pressure chamber, means movable with the movable member, shaped to mask the oil delivery port and the last-mentioned relief port, and arranged, relative to said ports, to begin to open the oil delivery port as the relief port begins to be masked, and to open the oil delivery port fully when the said relief port is fully masked, and means adjustable to limit masking of the relief port and unmasking of the oil delivery port, to control the volume of oil delivered.

17. An oil burner control comprising a casing defining a closed space, an oil pressure supply line admitting to said space, an oil delivery port leading from said space, and a viscosity control port likewise leading from said space, a member in said space, movable under the influence of pressure introduced through the oil pressure supply line to vary the effective area of the viscosity control port and of the oil delivery port, said member being so formed and arranged, relative to said two ports, to open one as the other closes, and stop means adjustable to determine the final effective relative areas of the two ports, in the final operative position of the member.

18. An oil burner control comprising a casing defining a closed space, an oil pressure supply line admitting to said space, an oil delivery port leading from said space, a relief port likewise leading from said space, a member in said space, movable under the influence of pressure introduced through the oil pressure supply line to vary the effective area of the relief port and of the oil delivery port, said member being so formed and arranged, relative to said two ports, to prevent intercommunication between the two ports in all positions of the member, and to leave the relief port open, with parts in the inoperative position, to increasingly mask the relief port as the parts move towards operative position, and to nearly close the relief port as the oil delivery port opens, and means to stop movement of parts in the latter, operative, position, said means being adjustable to determine the effective area of the oil delivery port.

19. An oil burner control comprising a casing defining a closed space, an oil pressure supply line admitting to such space, an oil delivery port leading from such space, and a relief port likewise leading from such space, a member in such space, movable under the influence of pressure introduced through the oil pressure supply line and having an edge movable across the oil delivery port to vary the effective area of the latter, said member masking the latter port, in inoperative position of the parts, such edge being arranged and disposed, relative to the relief port, to register with the latter, prior to unmasking the oil delivery port, during movement towards operative position of the parts, thereby to clear such edge of any accumulation, through the relief port.

20. An oil burner control comprising a casing defining a closed space having an inlet port, a delivery port, and a relief port, all communicating with such space, means formed and arranged to obstruct passage of oil, in all positions of said means, through the space from the inlet port to the relief port, and movable from an inoperative position, wherein it closes the delivery port, in accordance with the pressure of the oil admitted through said inlet port to open the delivery port, said means being further formed and arranged to choke the relief port, as the means approaches its operative position, wherein the delivery port is open.

21. The combination of claim 20, wherein the means to control the relief and delivery ports is a single element within the space, seated upon and movable over the casing walls wherein said ports are formed, and having edges formed and arranged, relatively to each other and to the positions and shapes of said ports, to open the delivery port only after discharge of oil from the relief port has begun, and to decelerate closing of the relief port, and therefore opening of the delivery port, during opening of the latter.

22. An oil burner control comprising a casing defining a closed space having an inlet port, a delivery port, and a viscosity control port communicating with such space, means formed and arranged to obstruct passage of oil, when the means is in inoperative position, through the space from the inlet port to the delivery port, and movable from such inoperative position in accordance with the pressure of the oil admitted through said inlet port to open the delivery port, said means being further formed and arranged

to obstruct passage of oil, when the means is in inoperative position, from the inlet port to the viscosity control port, and to maintain said viscosity control port open while the delivery port is open, whereby to enable discharge of oil through the delivery port and through the viscosity control port in quantities which are proportionate to the relative sizes of such two ports.

23. The combination of claim 22, including a stop engageable with said means and adjustable to determine the extent of its movement towards operative position, and therefore the relative size of the openings of the delivery port and viscosity control port.

24. An oil burner control comprising a casing defining a closed space having an inlet port, a delivery port, and a viscosity control port communicating with such space, means formed and arranged to obstruct passage of oil, when the means is in inoperative position, through the space from the inlet port to the delivery port, and movable from such inoperative position in accordance with the pressure of the oil admitted through said inlet port to open the delivery port, said means being further formed and arranged to obstruct passage of oil, when the means is in inoperative position, from the inlet port to the viscosity control port, and to open said viscosity control port as the delivery port is opened, whereby to enable discharge of oil through the delivery port and through the viscosity control port in quantities which are proportionate to the relative sizes of such two ports, said means being further formed and arranged to obstruct the viscosity control port more greatly as the delivery port is more widely opened, to preserve the fluid pressure level and to vary the relative discharges through such ports, and stop means adjustable to limit the extent of movement of said first means towards operative position, and therefore to determine the relative effective size of the two ports.

25. An oil burner control comprising a casing defining a closed space having an inlet port, a delivery port, and a first and second relief port communicating with such space, means formed and arranged to obstruct passage of oil, when the means is in inoperative position, through the space from the inlet port to the delivery port, and in all positions of the means to obstruct passage of oil from the inlet port to the first relief port, said means being movable from its inoperative position in accordance with the pressure of the oil admitted through the inlet port to an operative position, wherein the means has opened the delivery port, said means being further formed and arranged to choke the first relief port, as the means approaches such operative position, and to open the second relief port for discharge of oil during discharge of oil through the delivery port.

26. An oil burner control comprising a casing defining a closed space having an inlet port, a delivery port, and two spaced relief ports, means formed and arranged to obstruct passage of oil, when the means is in operative position, through the space from the inlet port to the delivery port, and further formed and arranged to obstruct passage of oil, in any position of said means, through the space from the inlet port to a first relief port, said means being movable from its inoperative position, in accordance with the pressure of oil admitted through said inlet port, to open the delivery port, and to variably regulate the openings of the two relief ports relative to each other and to the delivery port, to control the speed of opening the delivery port.

27. An oil burner control comprising a casing defining a closed space having an inlet port, a delivery port, and a relief port communicating with such space, means formed and arranged to obstruct passage of oil, in all positions of said means, through the space from the inlet port to the relief port, and further formed and arranged to obstruct passage of oil, in the inoperative position of said means, from the inlet port to the delivery port, said means being movable from its inoperative position in accordance with the effective pressure of the oil admitted through the inlet port to open the delivery port, and said means being further formed and arranged to variably regulate the relative openings of the relief port and of the delivery port, to control the speed of opening of the delivery port.

28. An oil burner control comprising a casing defining a closed space and a member movable therein, and dividing the space into two chambers of variable size, limit stop means determining the limits of travel of said member, an oil pressure supply port communicating at all times with one, high pressure, chamber, a relief port communicating at all times with the other, low pressure, chamber, an oil delivery port leading from the space, the member, in all positions, obstructing communication between the high pressure chamber and the relief port, and said member in its inoperative position obstructing communication between the high pressure chamber and the oil delivery port, but uncovering the oil delivery port as it moves towards its operative position under the influence of pressure in the high pressure chamber, and means movable with said member, as the latter moves away from its inoperative position, to choke discharge of oil from the low pressure chamber, to delay full opening of the oil delivery port.

29. An oil burner control comprising a casing defining a closed space having an inlet port, a delivery port, and a relief port, all communicating with such space, means formed and arranged to obstruct passage of oil, in all positions of said means, through the space from the inlet port to the relief port, and movable from an inoperative position, wherein it closes the delivery port, in accordance with the pressure of the oil admitted through said inlet port to open the delivery port, and means to choke discharge of oil through the relief port, to delay full opening of the delivery port.

30. An automatic hydraulic control device comprising a casing defining a closed space having a pressure supply port and a relief port communicating with such space, a member formed and arranged to obstruct passage of oil, in all its positions, through the space from the supply port to the relief port, yieldable means urging said member towards an inoperative position, adjacent the supply port, said member being movable towards the relief port, in accordance with pressure of oil admitted through said inlet port, and means formed and arranged, relative to the movement of said member, to variably choke the discharge of oil through the relief port, thereby variably controlling the rate of movement of said member.

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