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HYDRAULIC TIME-DELAY DEVICE FOR HIGH-PRESSURE LIQUID-FUEL-SUPPLY PUMPS

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Fig. 1.

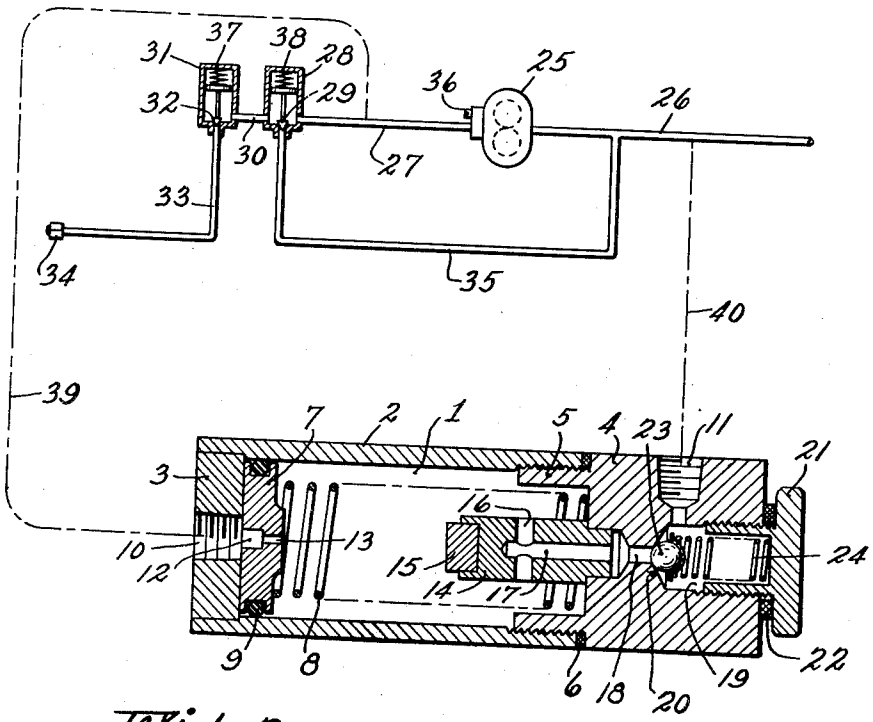
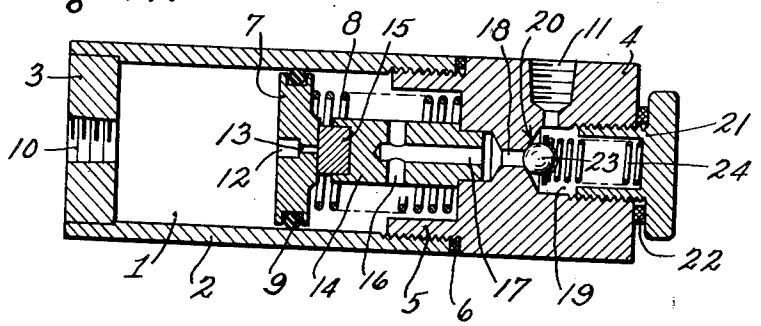


Fig. 2.



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HYDRAULIC TIME-DELAY DEVICE FOR HIGH-PRESSURE LIQUID-FUEL-SUPPLY PUMPS

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3 Claims. (Cl. 103—42)

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This invention relates to an improved hydraulic time-delay device, which is adapted for connection to opposite sides of a pump, such for example, as one used for supplying liquid fuel under high pressure to the atomizing nozzle of an oil burner.

The invention has for its object the provision of a time-delay device of comparatively simple and inexpensive construction that can be sold to dealers or distributors of oil burners and attached, without requiring special skill, to oil burners, regardless of make or construction, so long as they utilize a high-pressure fuel-supply pump, and that will materially improve the operation of the burner and enable higher efficiency of combustion to be obtained.

More particularly, the invention is adapted to be applied to an oil burner of the pressure-atomizing type, adapted for house-heating service. Such burners customarily have positively-acting fuel pumps, which have a pumping rate far in excess of that at which the fuel is consumed, the major part of the pumped fuel being bypassed. These pumps, if started simultaneously with the air-supply fan, build up the required high-atomizing pressure, say 100 p. s. i., very rapidly, almost instantaneously, and long before the fan, which is non-positive in action, can get the air moving past the fuel nozzle at the rate necessary to secure good combustion. Consequently, the fuel-air mixture will be over rich during the starting interval of operation of the burner, resulting in initially smoky operation, unless the burner is adjusted to admit excess air, and in such case the efficiency of combustion, during normal running intervals of operation, will be decreased. The device of this invention is adapted to delay the building up of the rated fuel pressure for a predetermined time, which is long enough, say for example, several seconds, to enable the fan to reach full speed and get the air for combustion moving past the fuel nozzle at the proper rate for good and efficient combustion.

The invention will be disclosed with reference to an illustrative example of it in the accompanying drawings, in which:

Fig. 1 is a full-size sectional-elevational view of a time-delay device embodying the invention, the parts being shown in the positions which they occupy when the fuel-supply pump is stopped, this view also showing, diagrammatically and on a small scale, a fuel-supply system for an oil burner of the class described; and

Fig. 2 is a similar view of the time-delay only,

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the parts thereof being shown in the positions, which they occupy at the end of the time-delay interval on starting the pump.

Referring to these drawings; the time-delay device includes a cylinder 1, formed within a tubular barrel 2, which has heads 3 and 4, suitably fixed, one in each of the ends of the barrel. As shown, head 3 has a drive fit in one end of barrel 2 and head 4 has a threaded portion 5, which is screwed into the interiorly threaded end of the barrel. A gasket 6 seals the joint between the head 4 and the barrel. Slidable in cylinder 1 is a piston 7. A spring 8, acting between one face of the piston and the head 4 tends to move the piston into engagement with head 3. As shown, piston 7 has a circumferential groove, containing an O-ring 9, which may be of synthetic rubber and which prevents leakage past the piston. Inlet and outlet ports 10 and 11, respectively, are provided for cylinder 1 and, as shown, these ports are respectively formed in the heads 3 and 4. The inlet port 10 extends coaxially through head 3 in alignment with a passage 12, 13 which extends coaxially through piston 7. The passage portion 13 is of relatively small diameter, in this case .04 inch. Its cross sectional area is relatively small in comparison with that of the inlet 10. Suitably fixed in head 4 and extending coaxially into cylinder 1 is a stud 14, having a socket in its inner end, in which socket is fixed a valve disk 15 of any suitable material and adapted to be engaged by piston 7, when the latter is moved against the force of spring 8 into the position shown in Fig. 2, whereby to close the passage 12, 13 through the piston. The clearance space in the right hand end of cylinder 1 is connected to outlet port 11 by the following passages. A passage 16, which extends diametrically through stud 14 at a location intermediate its ends, is connected at a central point to an axial passage 17 in the stud and passage 17 opens into an aligned axial passage 18 in head 4. The radial outlet 11 communicates at its inner end with an axial passage 19 in head 4. This passage 19 aligns with the passage 18 but is larger in diameter, thereby providing a shoulder 20 at the intersection of these passages. The outer end of passage 19 is closed by a plug 21, screwed into the outer end of the passage, and a gasket 22. The shoulder 20 affords a seat for a check valve 23, which is held to its seat by a spring 24, acting against a seat on the closure plug 21.

The device described finds one advantageous use in connection with the high-pressure positively-acting, fuel-supply pumps used in oil burn-

ers, of the mechanical or pressure atomizing type, for the purpose of delaying the emission of oil from the atomizing nozzle until the motor, which drives the pump and also a non-positively-acting air-supply fan, has acquired high speed, and preferably full speed, to secure the proper rate of air flow to result in good combustion. In Fig. 1, there is shown, diagrammatically and on a small scale, the oil-supply means of such a burner. A pump 25, adapted for connection to a fuel supply by suction pipe 26, forces oil through a conduit 27 to a casing 28, containing a by-pass valve 29 and from such casing through a conduit 30 to a casing 31, containing a cut-off valve 32. The outlet of casing 31, which is controlled by valve 32, is connected by a conduit 33 to the mechanical or pressure atomizing nozzle 34 of the oil burner. The outlet of casing 28, which is controlled by valve 29, is connected by a by-pass conduit 35 to the suction side of pump 25, as to pipe 26. The pump 25 has a screw plug 36, which may be loosened in order to rid the system of air, whenever necessary, as for example, initially on installing the burner and whenever the pump, after having stopped because of exhaustion of the oil supply, is subsequently started.

The cut-off valve 32 is held closed by a spring 37 until the pressure of pumped oil reaches a predetermined minimum value, say for example 100 p. s. i. The by-pass valve 29 is held closed by a spring 30 until the pressure of the pumped oil reaches a predetermined maximum value, say for example, 105 p. s. i. The inlet 10 of the time-delay device is adapted to be connected to the pressure side of the oil pump between its outlet and the by-pass and cut-off valves and, as indicated by the dot-dash line 39, to conduit 27. The outlet 11 is adapted for connection to the suction side of the oil pump, and, as indicated by the dot-dash line 40 to pipe 26.

In an oil-supply system of the type described, the pump 25 must be vented initially and each time after the fuel supply has become exhausted, in order to rid the system of air. The only outlets for the pump are closed by valves, such as 29 and 32 which open at relatively high pressures, greater than any that the pump can produce when pumping air alone. For example, in the present case, the greatest pressure which pump 25 can produce, when pumping air is 20 p. s. i. Hence, the valve 32 will not open and allow air to escape from nozzle 34. Therefore, the plug 36 on the pump is provided and this plug, when loosened, will afford an outlet for the pumped air to escape. As soon as oil appears, the plug 36 is screwed in tightly and the system will then operate in the normal manner.

The time-delay device of this invention operates by providing a slow leak for oil to flow through the piston 7 from one end to the other of the cylinder. This leak must be closed in order to enable the air to be eliminated from the system. To do this automatically, the check valve 23 is provided and its spring 24 has sufficient force, in this case 25 p. s. i., for example, to hold the valve closed against any pressure that the pump can create, when pumping air alone. Thus, the fuel-feed system may be vented, whenever necessary, in the usual manner unaffected by the time-delay device, which becomes operative only after a predetermined minimum pressure, has been established.

In normal operation, on starting, the parts of the time-delay device will be positioned, as shown in Fig. 1. The cylinder and all the various passages described will be filled with liquid fuel at zero pressure because, whenever the pump stops, leakage from its pressure to its suction side will cause the pressure to drop to zero. When the pump 25 is started, there will be a very rapid increase in pressure until the minimum pressure necessary to open check valve 23 is produced. Prior to this time, the piston 7 will not have moved because the liquid cannot move until check valve 23 opens. After the latter opens, liquid will flow through the slow leak provided by the passage 12, 13 from the pressure to the suction side of the pump, whereby the building up of the requisite pressure is delayed. Since the area of passage 13 is very small in comparison with that of the inlet pipe (connected to port 10) there will be a drop in pressure on the outlet side of the piston and a pressure differential will be created to move the piston slowly to the right against the resistance of spring 8. When the piston abuts valve 15, the outlet of passage 12, 13 will be closed, and the pressure will then build up very rapidly to the values necessary to open valves 29 and 32. In the instant case, the time needed for the piston to complete its travel and engage valve 15, is about six seconds. This time will vary according to the cross sectional area of passage 13, the length of travel of the piston and the resistance offered by spring 8. As herein shown, the oil pressure will rise sharply to 25 p. s. i., then it will slowly increase (in about six seconds) to about 40 p. s. i., after which the pressure will sharply rise to 100 p. s. i.

When the pump is stopped, the cut-off valve 32 closes to stop the flow to the burner nozzle and the outlet and inlet pressures gradually become equalized, due to leakage in the pump, and the piston 7 is moved back by spring 8 to its Fig. 1 position. The return travel of the piston is relatively slow because the spring 8 has just about enough stress to move the piston back to initial position, when the pressure of the fuel reaches zero. The time-delay device helps, during the stopping interval of operation of the burner. The pump 25 is usually oversize and pumps fuel at a rate much higher than it is consumed. The greater part of the pumped oil is by-passed. After the switch of the driving motor is opened, the pump will make a few revolutions before it stops. Usually, when the cut-off valve 32 closes, the fuel pressure will momentarily rise, causing the cut-off valve to open and emit a squirt of oil to relieve the pressure. The cut-off valve will then close and pressure may again build up enough to open the valve. This action will tend to cause the cut-off valve to flutter, opening and closing several times and emitting oil each time it opens. With the use of the time-delay device, as herein described, when the pressure drops enough to allow the cut-off valve to close, the valve 15 of the time-delay device will open. A subsequent pressure rise may close valve 15 and it may flutter, opening and closing several times. The fluttering thus occurs at the valve 15, where it does no harm, and the cut-off valve is prevented from fluttering and emitting the undesired after-squirts of oil at the atomizing nozzle.

The valve 23 is desirable in that it will automatically close and open whenever needed but it is not necessarily essential for all purposes. The leak, provided by the time-delay device, could be otherwise stopped, as by manual operation of a separate valve. However, the valve 23 does its work, without requiring any attention or effort

on the part of the operator, and its inclusion with the time-delay means offers a desirable solution of the problem.

The invention thus provides a hydraulic time-delay device, which may be used with pumps, and particularly with the high-pressure fuel-supply pumps for oil burners of the pressure-atomizing type, to postpone the emission of fuel until the proper rate of air flow has been established. This device can readily be attached to the fuel line around the fuel pump of any make of oil burner of the type described without requiring any special skill. It enables anyone, at a very low cost, to convert his burner so that smoking during the starting and stopping intervals of operation is prevented and so that the burner can be adjusted to secure high efficiency of combustion.

What is claimed is:

1. A hydraulic time-delay device for a high-pressure fuel-supply pump, comprising, a tubular barrel affording within it a cylinder having inlet and outlet passages communicating with opposite ends thereof and being otherwise closed, said outlet and inlet passages being respectively adapted for connection to the suction side and the pressure side of the pump, a piston slidable in the cylinder and over a stroke located wholly between the points at which said passages communicate with the cylinder, a spring tending to move the piston to and hold it at one end of its stroke near the connection of the inlet passage to the cylinder, said piston having a passage therethrough at least a portion of which has a cross sectional area relatively small in comparison to the cross sectional area of the inlet passage, a projection from the barrel at the outlet passage end of the cylinder extending inwardly into the cylinder toward the other end thereof but terminating in axially-spaced relation with such end, and a valve carried by said projection and located to close the passage in the piston when the latter is moved by liquid pressure into abutment with the valve.

2. A hydraulic time-delay device for a pump supplying fuel under a predetermined high pressure, comprising, a tubular barrel affording within it a cylinder having inlet and outlet passages communicating with opposite ends thereof, said outlet and inlet passages being respectively adapted for connection to the suction side and to the pressure side of the pump, a piston slidable in the cylinder over a stroke located wholly between the points at which said passages communicate with the cylinder, a spring tending to

move the piston to and hold it at one end of its stroke near the connection of the inlet passage to the cylinder, said piston having a passage therethrough at least a portion of which has a cross sectional area relatively small in comparison to the cross sectional area of the inlet passage, a projection from the barrel at the outlet passage end of the cylinder extending inwardly of the cylinder toward the other end but terminating in axially-spaced relation with such end, and a valve carried by said projection and located to close the passage in the piston when the latter is moved by liquid pressure into abutment with the valve, a check valve in said outlet passage opening in the direction of out flow from the cylinder, and a spring for holding said check valve closed under a pressure of not less than one-quarter of said predetermined pressure.

3. A hydraulic time-delay device for high-pressure fuel-supply pumps, comprising, a tubular barrel affording within it a cylinder, heads fixed one in each end of the barrel and having passages therethrough one adapted for connection to the pressure side of the pump and the other to the suction side of the pump, a piston slidable within the barrel over a stroke located wholly between the locations at which said pressure and suction passages communicate with the cylinder, a spring acting between the piston and the head containing the suction passage tending to move the piston against the other head, said piston having a passage extending coaxially therethrough and communicating with said pressure passage and having a portion relatively small in cross sectional area compared to that of said pressure passage, a stud fixed to the head containing the suction passage and projecting inwardly into the cylinder coaxially thereof and extending toward but terminating short of the other head, and a valve fixed to the inner end of said stud and adapted to be engaged by said piston when the latter is moved by liquid pressure against the force of said spring and to close said passage in the piston.

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