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AUTOMATIC SHUTTER CONTROL FOR OIL COOLERS

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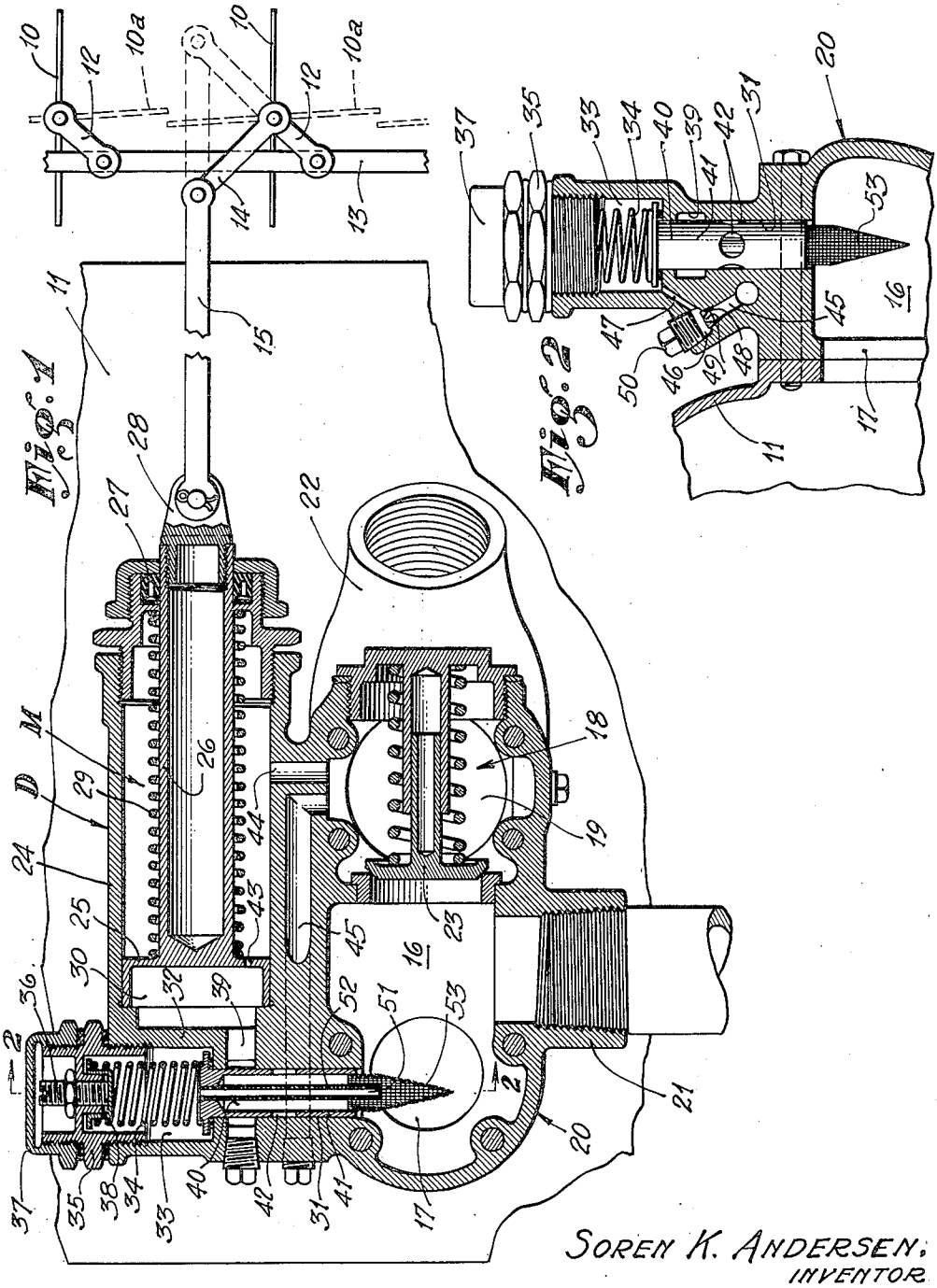


Fig. 1

Fig. 2

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AUTOMATIC SHUTTER CONTROL FOR OIL COOLERS

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10 Claims. (Cl. 236—35)

My invention relates to devices for cooling oil, in relation particularly to a device especially useful in the cooling of crank case oil from internal combustion engines, such as employed in airplanes.

Oil cooling devices of this general character ordinarily include a heat exchanger comprising passages through which the oil is conducted and adjoining passages through which a cooling medium, such as air, is passed. It is an object of the present invention to provide means responsive to relatively small changes in temperatures in the oil to control the flow of air through the heat exchanger so that the oil will be maintained very close to the condition in which maximum service may be obtained therefrom.

A further object of the invention is to provide a device operating in response to changes in the related factors of temperature and viscosity, to control the flow of air through the air passages of the heat exchanger.

In conjunction with oil coolers, means, of the general character of shutters, may be employed for controlling the flow of air through the air passages of the cooler. My present invention provides a motor for actuating this control means, which motor has an associated control which is operated in response to pressure variations resulting from change in temperature and also change in viscosity of the oil, thereby producing a very sensitive control of the motor, which control is carried by the motor to the means for controlling the flow of air.

Further objects and advantages of the invention will be brought out in the following part of the specification.

Referring to the drawing, which is for illustrative purposes only:

Fig. 1 is a schematic view, showing an embodiment of my invention in section, as used in conjunction with an oil cooling device.

Fig. 2 is a cross section taken as indicated by the line 2—2 of Fig. 1.

For the purpose of indicating the environment in which the invention has utility, I have in Fig. 1 shown shutters 10 disposed in front of a heat exchanger 11, so as to be swung between open position as shown in full lines, and closed position as shown in dotted lines 10a. Each of these shutters has an operating lever 12, and these levers 12 are connected by linkage 13 so that the shutters 10 may be swung in unison. A crank 14 is associated with one of the levers 12, for connection through suitable linkage 15 with an actuating means which will be hereinafter described.

My shutter controlling device D is shown connected to a side of the heat exchanger 11 so that the inlet space 16 will communicate through an opening 17 with the oil inlet of the heat exchanger, and so that the by-pass space 18 thereof will communicate through an opening 19 with the outlet of the heat exchanger 11.

The control device D comprises a hollow body 20 forming the inlet space 16, and having a threaded fitting 21 to which the oil piping from the oil pump of an internal combustion engine may be connected. Connected to the interior of the heat exchanger 11 there is an internally threaded outlet fitting 22, to which the return or outlet piping of the oil circulating system may be connected. Between the oil inlet space 16 and the by-pass space 18 there is a spring pressed relief valve 23, adapted to open when the pressure differential between the inlet and the outlet of the heat exchanger 11 builds up to a prescribed value due to the congealing of oil in the oil spaces of the heat exchanger as the result of low temperature therein.

For movement of the crank 14, to accomplish adjustment of the shutters 10, I provide a fluid motor M comprising cylinder and piston parts 24 and 25, arranged so that fluid pressure will move one of these parts, whereby movement may be transmitted to the link 15 and thence to the crank 14. In the form of the invention disclosed, the cylinder 24 is shown stationary, and the piston 25 is movable therein. This piston 25 has a projecting stem 26 which extends through packing 27 at the end of the cylinder 25 and has means 28 on the exposed end thereof whereby it may be connected to the link 15. A spring 29, placed around the stem 26, acts in compression to urge the piston 25 leftward to the left end of the cylinder 24. Between the piston 25 and the left end of the cylinder 24 there is a fluid space 30 adapted to receive fluid under pressure to force the piston 25 in rightward direction whereby to transmit clockwise rotation through the crank 14 to the system of shutters 10 to swing them toward or into closed position.

The device D includes a passage 31 which is extended from the inlet space 16 across the rear end wall 32 of the cylinder 24, the outer end of this passage being enlarged to form a chamber 33 in which a compression spring 34 is placed. The outer end of the chamber 33 is closed by a threaded plug 35 carrying an adjusting screw 36

covered by a cap 37. A spring retainer 38 is connected to the inner end of the adjusting screw 36 so that adjustment of the spring 34 may be accomplished through rotation of the screw 36 to move the retainer 38 in the chamber 33. For control of the motor M, the wall 32 has a valve port 39 disposed so as to lead from a side of the passage 31 and to communicate with the fluid space 30 of the cylinder piston device comprising the motor M in this embodiment of the invention. To cooperate with the stationary port 39 to close and open the same in keeping with variations in the temperature and the viscosity of the oil which is forced into the inlet space 16, I provide a piston 40 which is slidable in the passage 31 and has a cylindric wall 41 with a valve opening 42 therein, arranged to connect the inlet space 16 with the port 39 when the piston 40 is moved upward or outward from the position in which it is shown in the passage 31 against the resisting force of the spring 34. The piston 25 has an oil escape opening 43 for the space 30 whereby the oil from the space 30 may slowly flow into the rightward portion of the cylinder 24. A passage 44 connects the outer portion of the internal space of the cylinder 24 with the by-pass space 18, so that the outer face of the piston 25 will be exposed to the pressure existing in the outlet of the heat exchanger 11. The chamber 33 is connected with the outlet of the heat exchanger 11 by means of a duct 45 which extends from a small orifice chamber 46, Fig. 2, which is connected through an opening 47 with the lower part of the chamber 33. This duct 45 is shown in Fig. 1 as being connected through the passage 45 with the by-pass space 18 which in turn connects with the outlet of the heat exchanger 11. For restricting the flow of oil from the chamber 33 through the duct 45 to a low value and in such a manner that this flow of oil will vary in proportion to the change in pressure differential existing between the chamber 33 and the outlet of the heat exchanger 11, I provide an orifice member 48 having a relatively short orifice opening 49 formed by a sharp annular edge. This orifice member 48 is threaded into the mouth of the duct 45 where it leads from the chamber 46, wherein the upper end thereof is exposed, when the cover plug 50 is removed from the position in which it is shown, so as to be readily cleaned as occasion may require.

The inlet space 16 is connected with the chamber 33 through a relatively long and slender passage. This passage is indicated by the numeral 51, and is shown as consisting of the opening through a tube 52 extended longitudinally through the piston 40. So as to minimize clogging of the orifice 49, I provide a screen 53 having openings therein smaller in diameter than the diameter of the orifice 49. This screen 53 is preferably connected to the inner end of the piston 40 so that by removal of the piston 40 through the chamber 33, the screen 53 may be cleaned. The passage 51 formed by the tube 52, being of smaller diameter and relatively long, controls the flow of oil from the inlet space 16 into the chamber 33 in such a manner that the rate of flow of such oil will vary with changes in viscosity of the oil and also changes in pressure differential. The orifice 49, being very short, will restrict the discharge of oil from the chamber 33 through the duct 45 at a rate of flow which will vary in accordance with changes in pressure differential between the chamber 33 and the outlet of the heat exchanger 11, but this flow of oil through the orifice 49 will be subjected to very little variation from changes in viscosity in the oil.

The inner or lower end of the piston 40 will be exposed to the inlet pressure of oil from the inlet space 16, and this pressure will tend to move the piston 40 upward against the force of the spring 34 and against the pressure existing in the chamber 33. The pressure existing in the chamber 33, and the volume of oil trapped therein at any time, which will determine the piston position, is controlled by the rate of flow of oil into and out of the chamber 33 through the elongated orifice or passage 51 and the short orifice 49. When the piston 40 is moved upward to such distance that the valve opening 42 thereof communicates with the valve port 39, oil under pressure will flow from the inlet space 16 to the space 30 to force the piston 25 rightward whereby a closing movement of the shutters 10 will be accomplished. By the combination of effects and functions obtained through the arrangement of parts disclosed, a control for the shutters 10 is obtained which is very sensitive and responds to relatively small changes in oil temperature, This sensitiveness or responsiveness being accomplished in part by use of the changes in viscosity of the oil to obtain pressure changes to supplement the normal pressure changes which occur between the inlet and outlet of the heat exchanger during the operation thereof. It will be noted that in the normal operation of this device, when the heat exchanger 11 becomes cooled to such extent that oil starts to congeal therein, there will be a building up of pressure in the inlet space 16, so that the pressure against the piston 40 will be sizeably increased. At the same time the increase in viscosity of the oil which passes through the tube 52 will result in a reduction of the flow of oil into the chamber 33, without material reduction of the flow of oil out from the chamber 33 through the orifice 49. Also, a pressure increase in the inlet space due to congealment of oil in the heat exchanger will be accompanied by a pressure decrease in the chamber 33 so that an extensive movement of the piston 40 is obtained.

I claim as my invention:

1. In an oil cooling device of the character described, having a heat exchanger and means to control the flow of a cooling medium through the heat exchanger, and an oil inlet member and an oil outlet member connected to said heat exchanger, the combination of: a fluid motor having a moving part connected to said flow control means; walls forming a valve port leading to said fluid motor; valve means for controlling a flow of fluid under pressure through said valve port, said valve means comprising a hollow body having a passage, the front end of which is connected to said inlet of said heat exchanger and the rear end of which is closed so as to form a chamber, a piston in said passage having a relatively long and slender passage extending lengthwise therethrough so that the rate of flow through said passage will vary materially as the viscosity of the oil changes, a spring urging said piston toward said front end of said passage, means forming an outlet orifice leading out from said chamber, said orifice being relatively short so that the flow of oil therethrough will vary a relatively small amount as the viscosity of the oil changes, and means moved by said piston so as to open and close said valve port.

2. In an oil cooling device of the charact

described, having a heat exchanger and means to control the flow of a cooling medium through the heat exchanger, and an oil inlet member and an oil outlet member connected to said heat exchanger, the combination of: a fluid motor having a moving part connected to said flow control means; walls forming a valve port leading to said fluid motor; valve means for controlling a flow of fluid under pressure through said valve port, said valve means comprising a hollow body having a passage, the front end of which is connected to said inlet of said heat exchanger and the rear end of which is closed so as to form a chamber, a piston in said passage having a relatively long and slender passage extending lengthwise therethrough so that the rate of flow through said passage will vary materially as the viscosity of the oil changes, a spring urging said piston toward said front end of said passage, means forming a duct leading from said chamber to said outlet member, there being an orifice in said duct of such character that the flow of oil therethrough will vary a relatively small amount as the viscosity of the oil changes, and means moved by said piston so as to open and close said valve port.

3. In an oil cooling device of the character described, having a heat exchanger and means to control the flow of a cooling medium through the heat exchanger, and an oil inlet member and an oil outlet member connected to said heat exchanger, the combination of: a fluid motor having a moving part connected to said flow control means; a body having a passage connected to said inlet member of said heat exchanger, a chamber at the rear end of said passage and a port leading from a side of said passage to the fluid inlet of said motor, there being a discharge duct leading from said chamber, with means to permit a restricted flow from said chamber; a piston in said passage having a long and relatively slender inlet duct extending lengthwise thereof to permit a flow of oil from said inlet member to said chamber, which said flow of oil varies with the viscosity of the oil, said piston having a valve opening to connect said inlet member with said port when said piston is moved toward said chamber; and a spring acting to urge said piston away from said chamber.

4. In an oil cooling device of the character described, having a heat exchanger and means to control the flow of a cooling medium through the heat exchanger, and an oil inlet member and an oil outlet member connected to said heat exchanger, the combination of: a fluid motor having a moving part connected to said flow control means; a body having a passage connected to said inlet member of said heat exchanger, a chamber at the rear end of said passage and a port leading from a side of said passage to the fluid inlet of said motor, there being a discharge duct leading from said chamber to said oil outlet member, with means to permit a restricted flow from said chamber, which flow varies with the differential of pressure existing at any time between said chamber and said oil outlet member; a piston in said passage having a long and relatively slender inlet duct extending lengthwise thereof to permit a flow of oil from said inlet member to said chamber, which said flow of oil varies with the viscosity of the oil, said piston having a valve opening to connect said inlet member with said port when said piston is moved toward said chamber; and a spring acting to urge said piston away from said chamber.

5. In an oil cooling device of the character described, having a heat exchanger and means to control the flow of a cooling medium through the heat exchanger, and an oil inlet member and an oil outlet member connected to said heat exchanger, the combination of: cooperating cylinder and piston parts forming an internal space to receive a fluid under pressure whereby one of said parts will be moved relative to the other of said parts; means for effecting operation of said control means, connected to said movable part so as to be actuated thereby; a body having a passage connected to said inlet member of said heat exchanger, a chamber at the rear end of said passage and a port leading from a side of said passage to said internal space of said cooperating cylinder and piston parts, there being a discharge duct leading from said chamber, with means to permit a restricted flow from said chamber; a piston in said passage having a long and relatively slender inlet duct extending lengthwise thereof to permit a flow of oil from said inlet member to said chamber, which said flow of oil varies with the viscosity of the oil, said piston having a valve opening to connect said inlet member with said port when said piston is moved toward said chamber, and a spring acting to urge said piston away from said chamber.

6. In an oil cooling device of the character described, having a heat exchanger and means to control the flow of a cooling medium through the heat exchanger, and an oil inlet member and an oil outlet member connected to said heat exchanger, the combination of: cooperating cylinder and piston parts forming an internal space to receive a fluid under pressure whereby one of said parts will be moved relative to the other of said parts; means for effecting operation of said control means, connected to said movable part so as to be actuated thereby; a body having a passage connected to said inlet member of said seat exchanger, a chamber at the rear end of said passage and a port leading from a side of said passage to said internal space of said cooperating cylinder and piston parts, there being a discharge duct leading from said chamber to said oil outlet member, with means to permit a restricted flow from said chamber, which flow varies with the difference of pressure existing at any time between said chamber and said oil outlet member; a piston in said passage having a long and relatively slender inlet duct extending lengthwise thereof to permit a flow of oil from said inlet member to said chamber, which said flow of oil varies with the viscosity of the oil, said piston having a valve opening to connect said inlet member with said port when said piston is moved toward said chamber; and a spring acting to urge said piston away from said chamber.

7. In an oil cooling device of the character described, having a heat exchanger and means to control the flow of a cooling medium through said heat exchanger, the combination of: a hollow body having a space with an outlet connected to the oil inlet of said heat exchanger and having an inlet for receiving oil which is to be passed through the heat exchanger, a passage having its inner end connected to said space, a spring chamber connected to the outer end of said passage, a valve port leading from a side of said passage, and a channel leading from said chamber for escape of oil therefrom; a cylinder having one end thereof connected to said valve port, a plunger in operative relation to said cylinder and having

operative connection with said control means; a spring in said chamber; a piston in said passage urged by said spring toward said space, said piston having a valve opening therein adapted to connect said space with said valve port when said piston is moved toward said chamber against the action of said spring, whereby oil pressure from said space will be applied to said plunger to actuate the same, and said piston having an oil passage therethrough to connect said space with said chamber, said oil passage being formed by walls so arranged that there will be a relatively large variation of flow therethrough as the viscosity of the oil in said space changes; and means forming a relatively short orifice opening to restrict the flow of oil from said chamber through said channel, whereby the escape of oil will have relatively small variation as the viscosity of the oil changes.

8. In an oil cooling device of the character described, having a heat exchanger and means to control the flow of a cooling medium through said heat exchanger, the combination of: a hollow body having an inlet space with an outlet connected to the oil inlet of said heat exchanger and having an inlet for receiving oil which is to be passed through the heat exchanger, a passage having its inner end connected to said space, a spring chamber connected to the outer end of said passage, a valve port leading from a side of said passage, and a by-pass space connected through a by-pass valve with said inlet space and being connected to the oil outlet of said heat exchanger; a channel leading from said chamber to said by-pass space for escape of oil therefrom; a cylinder having one end thereof connected to said valve port, a plunger in operative relation to said cylinder and having operative connection with said control means; a spring in said chamber; and a piston in said passage urged by said spring toward said space, said piston having a valve opening therein adapted to connect said space with said valve port when said piston is moved toward said chamber against the action of said spring, whereby oil pressure from said space will be applied to said plunger to actuate the same, and said piston having an oil passage therethrough to connect said space with said chamber, said oil passage being formed by walls so arranged that there will be a relatively large variation of flow therethrough as the viscosity of the oil in said space changes.

9. In an oil cooling device of the character described, having a heat exchanger and means to control the flow of a cooling medium through said heat exchanger the combination of: a hollow body having an inlet space with an outlet connected to the oil inlet of said heat exchanger and having an inlet for receiving oil which is to be passed through the heat exchanger, a passage having its inner end connected to said space, a spring chamber connected to the outer end of said passage, a valve port leading from a side of said passage, and a by-pass space connected through a by-pass valve with said inlet space and being connected to the oil outlet of said heat exchanger; a channel leading from said chamber to said by-pass space for escape of oil therefrom, there being an orifice communicating with said passage; a cylinder having one end thereof connected to said valve port, a plunger in operative relation to said cylinder and having operative connection with said control means; a spring in said chamber; a piston in said passage urged by said spring toward said space, said piston having a valve opening therein adapted to connect said space with said valve port when said piston is moved toward said chamber against the action of said spring, whereby oil pressure from said space will be applied to said plunger to actuate the same, walls forming an oil passage therethrough to connect said space with said chamber, said oil passage being formed by walls so arranged that there will be a relatively large variation of flow therethrough as the viscosity of the oil in said space changes; and a screen secured to the inner end of said piston and having openings smaller in diameter than the diameter of said orifice, disposed so as to guard the mouth of said oil passage of said piston.

10. In an oil cooling device of the character described, having a heat exchanger and means to control the flow of a cooling medium through the heat exchanger, and an oil inlet member and an oil outlet member connected to said heat exchanger, the combination of: a fluid motor having a moving part connected to said flow control means; walls forming a valve port leading to said fluid motor; valve means for controlling a flow of fluid under pressure through said valve port, said valve means comprising a hollow body having a passage, the front end of which is connected to said inlet or said heat exchanger and the rear end of which is closed so as to form a chamber, a piston in said passage, a relatively long and slender passage connecting said inlet and said chamber so that there may be a flow of oil from said inlet to said chamber which varies relatively greatly as the viscosity of the oil changes, a spring urging said piston toward said front end of said passage, means forming an outlet orifice leading out from said chamber, said orifice being relatively short so that the flow of oil therethrough will vary a relatively small amount as the viscosity of the oil changes, and means moved by said piston so as to open and close said valve port.

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