Dec. 18, 1956 S. I. MacDUFF 2,774,377

VALVE

Filed April 7, 1951 2 Sheets-Sheet 1

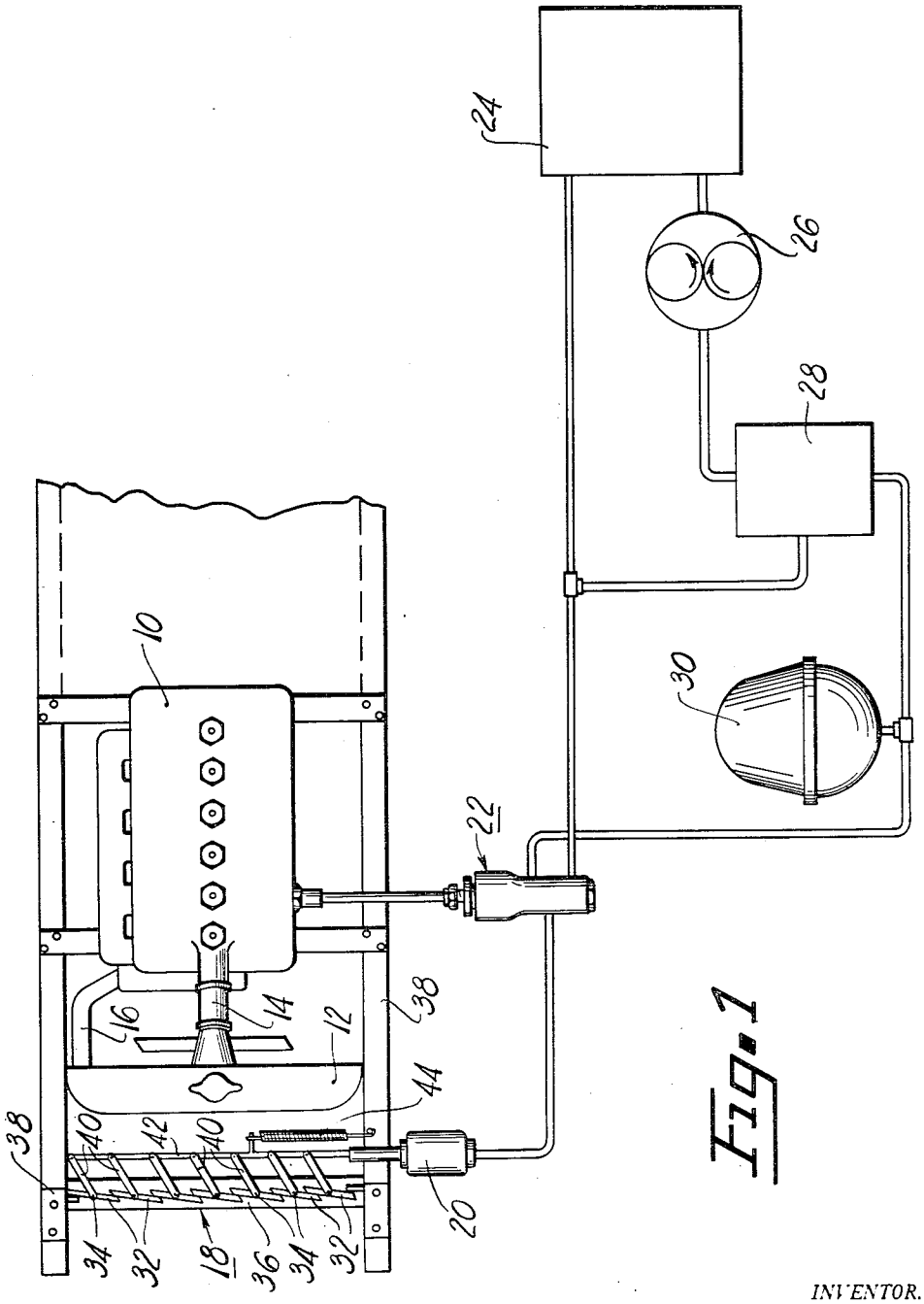


Fig. 1

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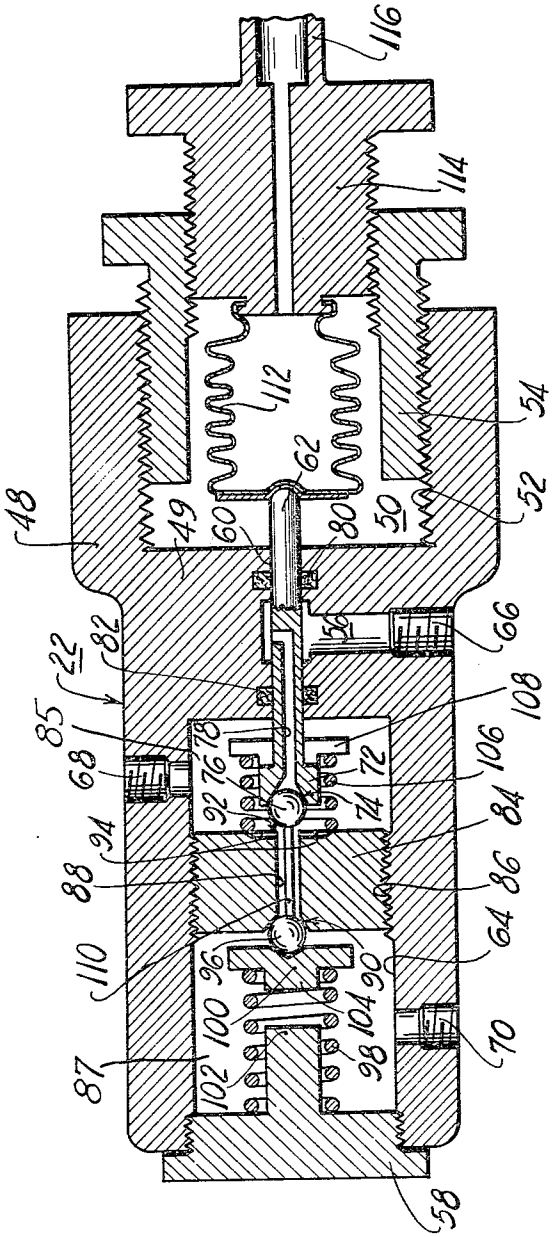


Fig. 2

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VALVE

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2 Claims. (Cl. 137—620)

This invention relates to valves of a type responsive to a condition to be controlled.

It is an important object of the invention to provide a valve which is responsive to engine temperature for controlling a fluid motor which actuates a shutter positioned in front of a radiator.

An important object of the invention resides in the provision of a valve mechanism having novel structure.

The above and other objects and features of the invention will be apparent from the following description of the apparatus taken in connection with the drawings which form a part of this invention and in which:

Figure 1 is a diagrammatic representation of the invention shown incorporated into the hydraulic system of a vehicle; and

Figure 2 is a longitudinal sectional view of the device of the invention.

The valve of the present invention is particularly adaptable to vehicle hydraulic systems where it is desired to employ a fluid operated shutter for automatically controlling the engine temperature.

Referring now to Figure 1 of the drawings the reference numeral **10** designates a vehicle engine with which a radiator **12** is associated. Hose connections **14** and **16** provide for circulation of coolant, such as water, from the engine through the radiator, where the temperature of the coolant is reduced, and thence back to the engine. A common method of cooling engine water is by circulating it through a radiator over which air is passed. The cooling effect of the air on the water in the radiator depends partly on the mass of air passing over the radiator, which mass flow is regulated by a shutter **18**, located in front of the vehicle and ahead of the engine, in this particular installation.

The shutter **18** is controlled by a single acting fluid motor **20**, the fluid to which must pass through valve **22**, of the invention. The hydraulic system into which the fluid motor and valve are incorporated comprises a reservoir **24**, pump **26**, pressure regulator valve **28**, accumulator **30**, and associated pipe lines interconnecting the aforesaid elements. It is a function of the pressure regulator **28**, which is of conventional design, to maintain the accumulator pressure at a preselected value; when this preselected accumulator pressure is attained the regulator valve by-passes the fluid back to the reservoir **24**.

The shutter **18** includes a plurality of vertically disposed overlapping flaps **32** pivoted substantially at their mid-point on pins **34**, carried on a transverse support **36**, mounted on a chassis **38**. Each flap **32** is equipped with a lever **40**, having one end securely fixed thereto. The opposite end of the lever is pivotally connected to a bar **42** mounted for transverse movement. The bar **42** is connected at one end to the fluid motor **20**, which when energized moves the shutters to closed position, as shown. When the motor is deenergized, that is, connected to the reservoir to exhaust the fluid, a spring **44**, having its opposite ends connected to the bar **42** and the chassis **38** respectively, biases the shutter to open position, not shown.

The control valve **22** comprises a body **48**, including a wall portion **49** forming an end or control chamber **50**, the walls of which are threaded interiorly at **52**, to receive an adjusting bushing **54**, whose function will be hereinafter described. The valve body is further provided with a longitudinal bore **56** extending from the chamber **50** to the left end of the body, where the bore is closed by a plug **58**. The diameter of the bore **56**, at **60**, is of such a size as to slidably receive a valve stem or plunger **62**; the diameter of the bore at **64** is of such a size as to permit the assembly of the valve parts in the bore from the left end when the plug **58** is removed. The body is provided with accumulator, cylinder, and reservoir ports **66**, **68** and **70** terminating at axially spaced intervals within the bore **56**. The valve stem **62**, which is slidably received in that portion of the bore **56** having the diameter **60**, has one end projecting into the chamber **50**, with the other end terminating in that portion of bore **56** having the diameter **64**. The said other end of the valve stem is equipped with a valve head **72** having a female conical valve seat **74** formed therein, and on which a ball **76** seats, for controlling communication through a passage **78**, located in the valve stem, and connecting the cylinder and accumulator ports. Seals **80** and **82** prevent leakage between the accumulator port and the chamber **50** on the one hand and between the accumulator port and the cylinder port on the other hand. To permit extraction of the valve stem **62** from the left end of the bore, a removable partition **84** is provided, which threadedly engages the bore at **86**. The partition is located in the bore between the cylinder and reservoir ports dividing said bore into work and exhaust chambers, **85** and **87**, respectively, and establishes communication therebetween through a passageway **88**, one terminus of which is formed with a female conical seat **90**, and the opposite terminus of which is constructed to provide an abutment or stop **92** for limiting the axial travel in one direction of the ball and stem. That side of the removable partition **84** containing the stop **92** is cut out radially from the passageway to provide slots **94** which allow the flow of fluid between the cylinder and reservoir ports when the ball **76** rides on the stop **92**, and ball **96** is unseated from the conical seat **90**. The ball **96** is normally held on the seat **90** by a spring **98** interposed between the plug **58** and a ball retaining element **100**. The plug **58** and ball retaining element **100** are formed with centrally extending portions **102** and **104** respectively, for holding these parts in alignment for coaxial movement with the valve parts.

A spring **106**, interposed between the removable partition **84** and a flange **108** carried by the valve stem, urges the latter in a direction to unseat the same from the ball **76**, thus communicating the accumulator port with the cylinder port. An axially slotted pin **110**, slidably located within the passageway **88**, is interposed between balls **76** and **96** and cut to a prescribed length so that when the ball **76** is resting against the abutment **92**, the ball **96** is unseated from the seat **90**. Note, however, that pin **110** is connected to neither of the balls **76** and **96** so that each ball is free to seat most effectively on its associated seat without restraint as a free-floating sphere. In this way it becomes unnecessary to hold the valve members in perfect alignment with their associated valve seats to prevent leakage around the seats; and an unnecessary cost of manufacture is, therefore, eliminated.

The valve **22** is temperature responsive and is accordingly provided with a bellows **112**, located in the chamber **50**, and supported on a bushing **114**. The free end

of the bellows rides on the valve stem **62** for imparting axial motion thereto when expanded. The exterior end of the bushing **114** is provided with a thermometer bulb or probe **116** which projects into the water jacket of the engine **10**. The bulb **116** and bellows **112** are filled with a liquid so that changes in engine temperature cause a change in volume of the liquid, thus changing the length of the bellows **112**.

In order to provide for accurate adjustment of the valve stem so as to obtain the proper valve movement at a given temperature setting the adjusting bushing **54** is formed with a **12** pitch exterior thread, which engages the body **48**, and a **16** pitch interior thread into which the bushing **114** is threaded.

Although this invention has been described in connection with certain specific embodiments, the principles are susceptible of numerous other applications that will readily occur to persons skilled in the art.

Having thus described the various features of the invention, what I claim as new and desire to secure by Letters Patent is:

1. A valve for use in a system for controlling thermal conditions in an engine which uses fluid as a coolant, comprising a body having inlet, working, and exhaust ports therein, a partition member in the body separating the inlet and working ports from the exhaust port, forming work and exhaust chambers, a portion of said body including a wall which forms work and control chambers, a passage in said partition member communicating the working port and the exhaust port, a valve stem reciprocable in a bore through the portion of the body forming the work and control chambers and extending into said chambers, said valve stem having a passageway therein which communicates the inlet port with the working port, a conical valve seat on said stem on the end extending into said working chamber for controlling the communication between the aforementioned inlet and working ports, a spring operatively associated with the partition member and the valve stem urging said stem toward the control chamber, said passage in the partition including a valve seat adjacent said exhaust chamber, an abutment extending from the partition at the end of the passage leading into the work chamber, said valve seats, abutment, passage, passageway and valve stem being co-linear, a ball engageable in the conical valve seat in said stem and with the abutment on said partition to establish communication between the inlet and work ports when unseated from the valve seat, and establishing communication between said work and exhaust ports when seated in the valve seat on the stem and in contact with the abutment, a second ball engageable with the valve seat in the partition member and operative to control communication between the work and exhaust port when the first mentioned ball engages said abutment, a spring in said exhaust chamber urging said second ball to a seated position in its cooperating valve seat, said spring being of a greater strength than the first mentioned spring, a reciprocable pin in the passage of the partition and having a greater length than said passage, said pin being in contact with each of the aforementioned ball members and operative to unseat the second ball from its valve seat, permitting communication between the working and exhaust ports when sufficient force is exerted on the stem in the control chamber, overcoming the spring force in the exhaust chamber, and when the first mentioned ball is seated on the abutment, the end of the passage opposite to that containing the valve seat for the second ball including radial grooves adjacent the abutment permitting the aforementioned communication between the working and exhaust ports when the pin unseats the second ball due to force on the stem in the control chamber, and an adjustable pressure responsive means contained in said control chamber in engagement with the end of the stem extending into the control chamber, said last mentioned means operative to control communication between the inlet and work ports or the work and exhaust ports depending on preset conditions of said last mentioned means.

2. A valve as set forth in claim 1 wherein said partition member is threaded into said valve body and said adjustable pressure-responsive means comprises an expandable bellows secured to a first part having external threads, said first part being laterally adjustable in a second part having internal and external threads, said second part being laterally adjustable in said valve body.

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