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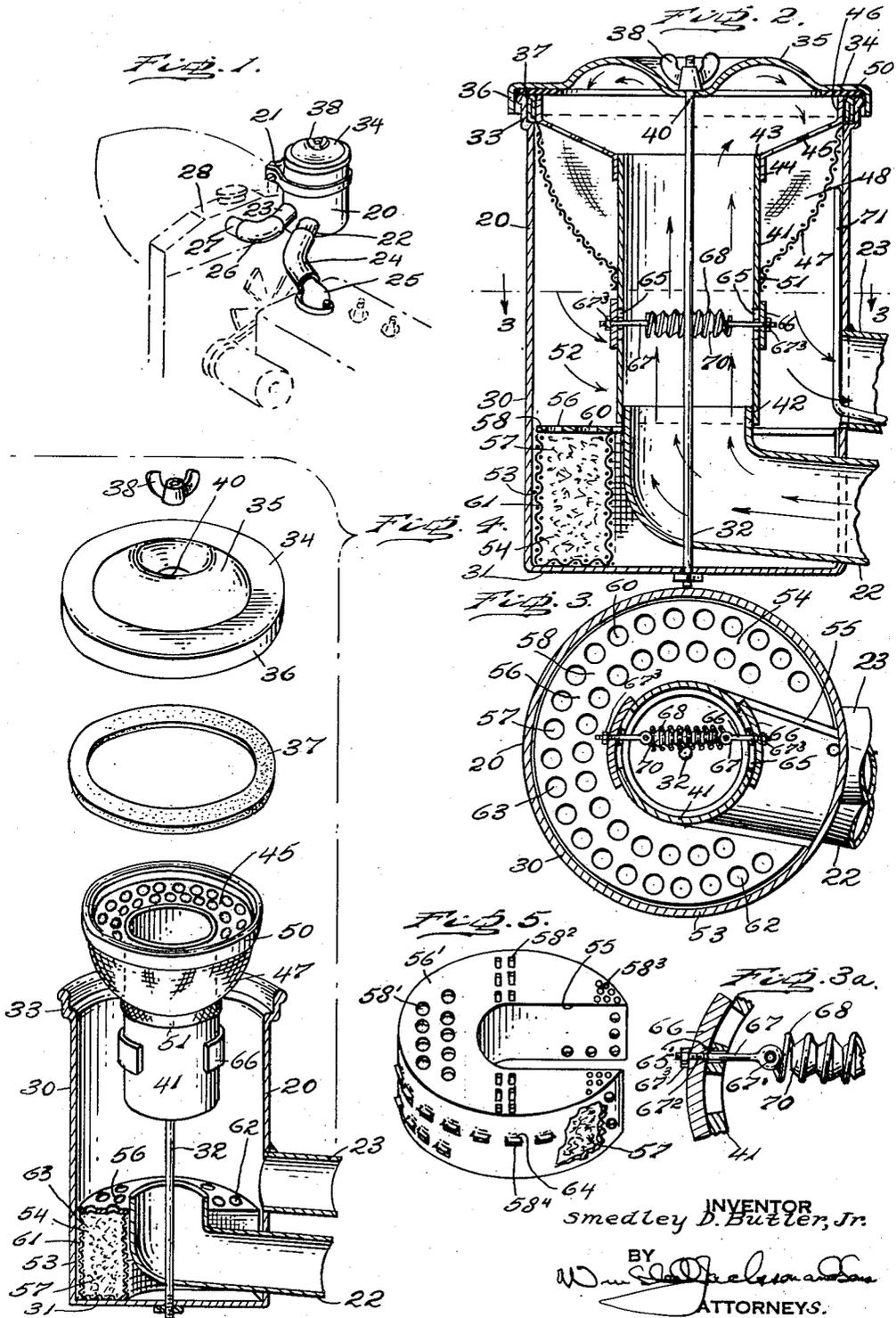
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THERMOSTATIC VALVE FOR ENGINE COOLANTS

Filed July 19, 1950

2 Sheets-Sheet 1



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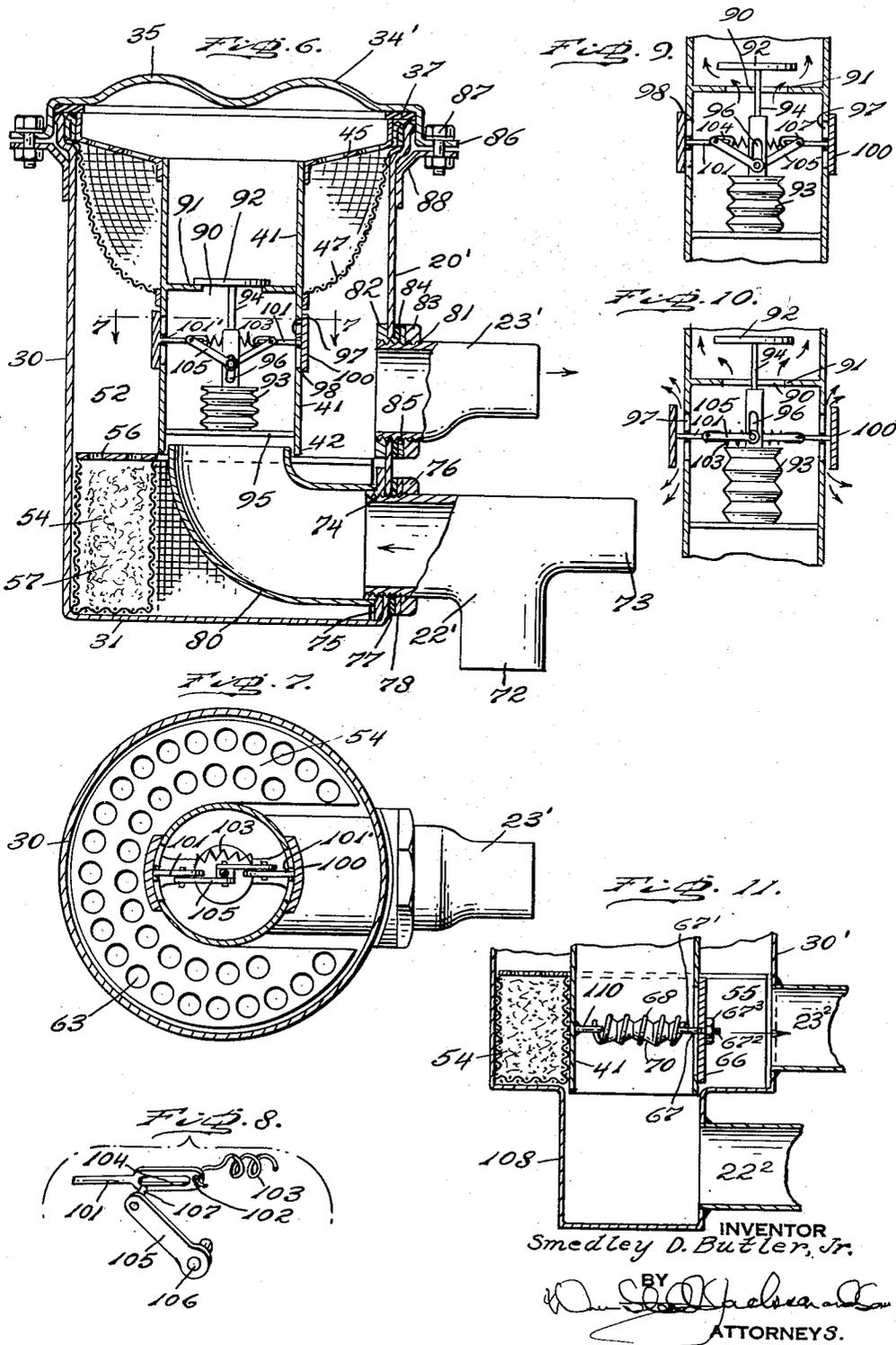
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UNITED STATES PATENT OFFICE

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THERMOSTATIC VALVE FOR ENGINE COOLANTS

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4 Claims. (Cl. 236-34)

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The present invention relates to coolant systems of automatic type, suitable for use on automobiles, aircraft, diesel locomotives or wherever liquid cooled engines are employed.

A purpose of the invention is to provide a very simple filter to break up and remove solid matter in engine cooling systems, separating the same by filtration and also by sedimentation, and desirably having full flow and full contact with the coolant medium.

A further purpose is to introduce the coolant through a riser tube from an inlet connection, to carry the coolant out over the top of the riser tube, to bring the coolant successively preferably through a perforated plate and then a fine filter depending from the housing in paraboloid form, and then to withdraw the liquid from an outlet connection below the fine filter screen.

A further purpose is to entrap solids in a sump, desirably throwing the heavier material to the outside by centrifugal force, and preferably employing a separable sedimentation unit in the sump consisting of a foraminated housing filled with fibrous material.

A further purpose is to employ smaller openings on the sedimentation unit toward the outlet side.

A further purpose is to utilize the scoop principle to retain particles in the sedimentation housing, making the upper sides of the side openings of the housing outwardly bulging beyond the lower sides.

A further purpose is to facilitate replacement of the filter screen.

A further purpose is to provide a thermostatic release valve in the riser operating by a thermostatic element against a spring, and short-circuiting the filter when in operation.

A further purpose is to employ a thermostatic main cut-off valve which also operates the thermostatic relief valve and to permit the thermostatic relief valve to operate also for pressure relief.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate a few only of the numerous embodiments in which my invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

Figure 1 is a perspective of the filter of the present invention installed in an automotive engine, the other parts of the engine being skeletonized.

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Figure 2 is a central vertical section through the preferred embodiment of the filter of the invention.

Figure 3 is a section of Figure 2 on the line 3-3.

Figure 3^a is an enlarged fragment of Figure 3.

Figure 4 is an exploded vertical sectional perspective showing the separation of the parts of the filter of Figures 2 and 3.

Figure 5 is a detached perspective showing a variation in the sump sedimentation unit.

Figure 6 is a view corresponding to Figure 2 but showing a variation.

Figure 7 is a section of Figure 6 on the line 7-7.

Figure 8 is a fragmentary exploded perspective of one of the toggle arms and one of the valve stems of Figures 6 and 7.

Figures 9 and 10 are fragmentary sections corresponding to Figure 6 showing the valves in different operating positions.

Figure 11 is a fragmentary axial section similar to Figure 2 but showing a variation.

In the drawings like numbers refer to like parts.

Great difficulty has been encountered in liquid cooling systems of engines due to the presence of foreign matter, either scale from the water, rust or corrosion products from the engine components or extraneous matter such as dirt. Even before actual clogging is produced, these solids reduce the efficiency of the engine, and when actual clogging results, they may completely interfere with engine operation by causing excessive overheating. Much expense is involved in correcting the difficulty through reverse flushing of the radiator and eventually rodding out of the radiator tubes.

The device of the present invention is designed to overcome this difficulty by holding scale and other solids in a filter chamber indefinitely if such products are hard and resistant, or holding them until they are broken up by hydraulic forces if the products are soft and friable. I further remove solids even below the size of the filter openings by centrifugal force and sedimentation.

Since the circulation is very frequent, each portion of the cooling liquid desirably passing through the filter several times per minute, it will be recognized that a very frequent removal of objectionable solids is accomplished. Unlike many filters, the filter of the present invention is employed on the full flow principle, so that all portions of the liquid have full contact with the filter. The amount of scale formation is definitely reduced by the filter since scale is encour-

aged by overheating and the filter will reduce overheating.

The device of the invention provides very conveniently replaceable units for the filter itself and for the sedimentation structure. The sedimentation structure may provide for chemical treatment if desired, for example to inhibit corrosion, as by inclusion of copper sulphate crystals.

In case of clogging of the filter, thermostatic short circuiting may optionally be provided as shown, and in one of the forms this is combined with a thermostatic control for the system and with a pressure short circuit.

Considering the structure of Figure 1, the filter casing 20 is supported in any suitable manner as by bracket 21 attached to any convenient portion of the engine. Inlet connection 22 enters at the lower portion, and outlet connection 23 is positioned above. Inlet connection 22 is joined as by hose 24 to the outlet connection 25 of the cylinder block of the engine and outlet connection 23 is united as by hose 26 to inlet connection 27 of radiator 28.

It will be understood that any of a wide variety of inlet and outlet connections and fastenings may be employed, with or without reduction of size to fit the required hoses. The modifications normally required by a V or other double bank engine are illustrated in Figures 6 and 7.

As best seen in Figures 2, 3 and 4, the filter casing 20 has side walls 30 and a suitably integral bottom wall 31 to which is secured a suitably central assembly bolt 32 extending up through the casing. At the top, the casing is outwardly enlarged at 33 and receives a top or closure cap 34 having an annular upward ridge 35 useful in streamlining the flow as later explained. A flange 36 is provided at the outer edge and the top or closure is sealed by gasket 37. A thumb nut 38 on the threaded upper end of the assembly bolt 32 holds the top in place, there being an opening 40 in the top to pass the bolt.

The casing as shown is annular to gain the advantage of such swirling or centrifugal action as is possible, which will throw the solid particles toward the outside.

A suitably tubular riser 41 makes telescoping connection at 42 at the bottom with the upwardly directed end of the L-shaped inlet connection 22. The riser is desirably centrally located in the housing and terminates at 43 below the top and in line with the center of the annular ridge 35 which provides streamlining of reverse flow.

The riser 41 is secured to a downwardly directed flange 44 on a downwardly conical perforated plate 45 which carries at its outer edge an upward flange 46 suitably engaging inside the casing. There is thus a downwardly and inwardly annular sloping contour of the plate 45.

Surrounding the riser and suitably extending annularly from the riser to the casing, is a screen 47 desirably of paraboloid form, which constitutes the main filter. The screen 47 may suitably be of metallic wire mesh smaller than the smallest tube in the radiator. It has been found convenient to employ mesh of about one-sixteenth inch with a wire size of about 0.010", but it will be understood that other mesh and wire sizes or layers of screens may be used. The generally paraboloid form provides an entrapment space 48 inside the screen 47 and around the riser, below an upper rim 50 on the screen and above a bottom portion 51 which hugs the riser but is not fastened thereto where it is to be removed from the riser to replace the screen.

As well shown in Figure 2, the upper rim 50 of the screen is well above the top of the riser while the bottom portion 51 hugging the riser is well below the top of the riser.

The rim 50 seats in the annular recess 33 at the top of the casing and the flange 46 on the perforated plate 45 fits immediately inside, both of them being pressed down by gasket 37. The riser is therefore supported by the engagement with the casing at the outer edge.

From the screen 47 the liquid flows into a discharge chamber 52 between the casing and the riser, and below the filter screen 47. At this point the liquid is deflected over to the side to discharge connection 23. Due to the annular construction and the deflection to the side there is freedom for swirling to take place in the discharge chamber which tends to throw the particles in the liquid downward and to the outside due to centrifugal action.

Immediately below the bottom of the discharge chamber 52 is a sump 53 which sediments and holds many of the particles. In the sump flow is extremely slow compared to the rapid flow in the discharge chamber above. The sump is preferably not open but it is filled by a particle absorbing sedimentation unit 54 as seen in Figures 2, 3 and 4, which will include chemicals in one embodiment of the invention.

The sedimentation unit is desirably an incomplete annulus or partial moon shape, broken at 55 to provide for the inlet (or outlet) connection. When the top 34 is removed and the filter screens and riser are taken out the sedimenting unit 54 can be lifted out bodily and replaced.

The sedimenting unit 54 desirably comprises a casing 56 suitably of sheet metal and a desirably fibrous filling 57.

The casing may as shown consist of a sheet metal top 58 provided with holes 60, and screen wire 61 on the sides and bottom.

The filling may conveniently be of fiber glass, glass wool, mineral wool, metallic wool, or cotton waste and the filling will desirably be of fine material 62 near the outlet and of coarser material 63 remote from the outlet so that a filtering action will be exerted on liquid passing to the outlet through the sump. The distinction can conveniently be made by using coarse and fine fiber materials of the same character remote from the outlet and near the outlet respectively, or by using different materials, for example fine glass wool near the outlet and coarse wool or waste remote from the outlet.

Figure 5 shows a variation in the sedimentation receptacle in which the casing 56' is of sheet metal throughout, provided with relatively coarse holes 58' remote from the outlet, holes of intermediate size 58² nearer the outlet and holes of very fine size 58³ close to the outlet.

On the sides holes 58⁴ are provided at the portion remote from the outlet which are outwardly bulged at the top at 64 to assist in retaining particles in the interior of the sedimentation unit by scoop effect. There is no bulging of the lower portion of the openings.

The form of Figures 1 to 4 shows an optional thermostatic relief valve for use in case the filter becomes clogged. Ports 65 extend through diametrically opposite positions on the riser connecting the interior of the riser with the outlet space 52 and thus short circuiting the filter screen 47. Valves 66 cooperate with the outside of the ports. As shown in Figures 3, 3^a and 4, the

valves are of arcuate contour to conform with the curvature of the outside of the riser.

Inwardly extending stems 67 secured to the valves are guided in openings 65' in the riser and carry eyes 67' which engage the ends of a tension spring 68 interconnecting the valve stems. To avoid interference with bolt 32 and to permit it to be located centrally, the valve stems are offset as shown in Figure 3.

A suitably metallic bellows thermostatic element 70 occupies the space inside the coil of spring 68 between the eyes 67' of the valve stems. The bellows may be of the usual expanding metallic or non-metallic thermostatic bellows material, such as bronze or beryllium copper, rubber or synthetic rubber, filled with a volatile liquid which will cause the bellows to expand against stems 67 when a predetermined temperature is reached. Without limitation as to the character of the liquid, ether may be mentioned as one example, and it will be understood that many other thermostatic bellows liquids operating at various temperature ranges are well known in the art. The stems 67 may if desired be adjusted with respect to the valves by changing the position of threaded adjustments 67² after releasing a locking nut 67³.

In operation, the filter is connected up as shown in Figure 1, desirably at a position above the highest point of the radiator so that it can be opened for inspection at any time without draining the radiator. To prevent air binding of the system, an air release tube 71 is shown passing through the outlet in Figure 2 and suitably connecting as by a branch to the air release tube in the radiator. The top of the tube 71 will be above the normal water level in outlet chamber 52.

The cooling liquid from the engine block (such as water) will pass into the filter through inlet connection 22 and through the riser. If the temperature conditions are normal, valves 66 will be closed, but if the temperature conditions rise to an abnormal value, as for example due to clogging of the filter, the thermostatic element acting against the tension spring will cause the valves 66 to open. It will be understood that all the water of the cooling system will pass through the riser under normal conditions and be discharged through perforated plate 45 and then through filtering screen 47. Solid material of size large enough to be troublesome will be deposited on screen 47, and if it be hard, will remain there indefinitely. If, however, the scale be soft, the rapid flow will cause the scale to break up into fine material which will pass down with the cooling water into recirculation or be held by the sump.

The bulk of the liquid passing through the filter will enter outlet chamber 52 and flow out the outlet connection 23. Solid particles will in part be thrown to the outside by centrifugal action in the outlet chamber and through recirculation will find their way into the sump. In the sump the flow is comparatively slow and stagnant compared to the rapid flow (for example 70 gallons per minute or more) which will occur in the main filter. Particles in the sump will progressively enter the openings in the sump sedimentation unit and be held off by sedimentation and filtering action in the fiber at the interior of the sump receptacle. Channeling or direct flow to the outlet from the sump will preferably be discouraged by the small holes

toward the outlet in Figure 5 and by the scoop effect at the side openings.

When the filter has completed its campaign, the top is readily removed, and the perforated plate, fine screen and riser are taken out. The fine screen will be replaced when necessary and the sump sedimentation unit will normally be replaced annually. Screen cleaning or replacement is not required frequently, since in many cases under normal conditions the screen will operate successfully for about 20,000 miles in automobile use. It will be evident that replacement of the screen is very easy as it is merely slipped off the bottom of the riser, expanding to pass over the valves 66, or it can be replaced as a unit with the perforated plate or riser.

At intervals prior to the time of replacement, routine inspection of the filter can be accomplished by simply lifting off the cover and examining screen 47 through the openings in the perforated plate.

The form of Figures 6 to 10 inclusive illustrates a modification in respect to the attachment of the cover, the dual purpose thermostatic valve construction and the inlet and outlet fittings. For dual purposes, the special features of this form may be required but the form of Figures 1 to 4 with the sedimentation unit of Figure 5 is preferred.

Illustrated in Figures 6 to 10, inlet fitting 22' is a T having branches 72 and 73 which can readily be connected to the separate blocks of a double bank or V engine. The fitting is adjustable as to angular relationship, since it has a threaded inner end 74 which engages an inner nut 75 and is secured in place by an outer nut 76 acting against a gasket 77 and washer 78. Inside casing 20' an L 80 extends upwardly and makes telescoping connection with riser 41.

The outlet fitting 23' is of similar character, being threaded at 81 and held in place by an inner nut 82 and an outer nut 83 acting against a gasket 84 and a washer 85. Both inlet and outlet may also be connected by standard compression type fittings.

To illustrate the capability of using reducing fittings, fitting 23' is shown as a reducer, and fitting 22' is shown as provided with a reduction on one branch of the T.

In the form of Figures 6 to 10, the cover 34' has an outer flange 86 which is bolted at 87 to lugs 88 on the outside of the casing. The construction of perforated plate 45 and fine screen 47 is essentially the same in Figures 6 to 10 as in the other figures, and the same form of sump and sump sedimentation unit may be used.

The valve arrangement is different in this form, it being the intention to replace the regular engine thermostat by the thermostatic control of the present invention. In this form a main valve port 90 having a valve seat 91 is provided across the riser, the valve seat cooperating with main valve 92 on the outlet side of the valve seat when the valve is closed. Valve 92 acts as the main engine thermostat, being controlled from thermostatic bellows 93, suitably of the volatile fluid type, by direct connection with actuating rod 94 at the axis. Thermostatic bellows 93 is mounted on spider 95 extending across the center of the structure.

A lost motion longitudinal slot 96 is provided in operating rod 94 suitably behind the location of transverse valve ports 97 having valve seats 98 which cooperate in closed position with valves

100 located on the outside. Valves 100 are suitably curved to conform to the outside of the riser as best seen in Figure 7.

Each of the valves 100 has a valve stem 101 which in this case may be central as no bolt passes through the center of the structure. The stems are guided at 101' on the riser. Each of the valve stems at its inner end has a hook opening 102 which engages a tension spring 103 (Figure 8) pulling the valves toward closed position.

Each of the valve stems at its inner end has a longitudinal lost motion slot 104. Lost motion toggle arms 105 extend from a common pivot pin 106 in the forward position of lost motion slot 96 to a pivot pin 107 in the outer position of one of lost motion slots 104, in the closed position of all valves.

Thus when thermostatic bellows 93 begins to expand as shown in Figure 9, operating rod 94 moves longitudinally to open valve 92 without opening valves 100, due to lost motion slot 96 which is not yet taken up. Figure 9 shows the position when lost motion at 94 has just been taken up. When thermostatic bellows 93 further expands as shown in Figure 10, having taken up the lost motion in slot 96, toggle arms 105 push outwardly against tension spring 103 and open valves 100, thus short circuiting the filter in the case of very abnormal high temperature.

Due to the presence of lost motion slots 104, if an abnormal pressure develops, valves 100 can open due to this pressure at any time without waiting for an abnormal rise in temperature. The extent of opening pressure will be controlled by spring 103, and it has been found desirable to use a spring light enough so that the relief valves 100 will open at a pressure of less than 5 p. s. i.

In operation of the form of Figures 6 to 10, it will readily be connected up, replacing the fittings easily with other fittings if special adaptors are required on the particular installation. With any fitting used the angular relationship can readily be changed.

The operation will be essentially that of the other form described except for the difference in the valve construction. In starting up the engine, unless abnormal conditions arise, valve 92 will remain fully closed until the thermostat expands to the position approaching that of Figure 9, at which point valve 92 will open and under normal conditions the operation will then be like that of Figures 1 to 5 inclusive. Should an abnormal pressure develop, the relief valves 100 will open under pressure actuation due to lost motion slots 104. On the other hand should a very abnormal temperature arise, further expansion of the thermostat will open relief valves 100 as shown in Figure 10.

In some cases it may be preferable to bring the inlet connection in immediately below the center of the riser, and this form has been shown in Figure 11. In Figure 11 the casing 30' has a lower inlet well 108 which telescopes with the lower end of riser 41, and which receives inlet connection 22' from the side. Outlet connection 23' is accordingly moved down to near the bottom of the main body of housing 30' and adequate space for flow to outlet connection 23' is provided by the separation at 55 in the U-shaped portion of the sedimenting unit 54.

The operation of the form of Figure 11 is substantially the same as that of Figures 1 to 5 except that the amount of space for quiescent sedi-

mentation in the sump is considerably reduced in the form of Figure 11.

In the form of Figure 11 a single relief valve 66' is provided, similar to that of Figures 1 to 4 except that it is larger in size, the opposite side being anchored to a stem 110, on the riser.

It will be evident that the device can be used in a wide variety of situations, to fit any existing or special liquid cooled engine.

It will be evident that in the device of the invention the inlet and outlet are desirably placed close together and one below another or one slightly out of line with another, so as to facilitate connection to the engine and the radiator.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a coolant filter, a tube through which liquid is carried connected to the inlet on the inside and to the outlet on the outside, walls forming opposed valve openings from the tube, opposed valves acting against the outside of the valve openings in closed position, a tension spring interconnecting the valves and urging them toward closure and a thermostatic element inside the spring and acting against the spring to open the valves.

2. In a coolant system, walls forming a passage through which coolant is circulated, a first valve seat in the passage, a first valve acting against the first valve seat on the side toward which the flow is directed, a thermostatic element in contact with the liquid in the passage, connected with the first valve, and acting in the direction to unseat the first valve, walls forming a second valve seat in the side wall of the passage, a second valve seating against the second valve seat on the outside, spring means urging the second valve toward seating position and a lost motion lever connected from the thermostatic element to the second valve for opening the second valve after the first valve has been unseated.

3. In a coolant system, walls forming a passage through which coolant is circulated, a first valve seat in the passage, a first valve acting against the first valve seat on the side toward which the flow is directed, a thermostatic element in contact with the liquid in the passage, connected to the first valve, and acting in the direction to unseat the first valve, walls forming a second valve seat in the side wall of the passage, a second valve seating against the second valve seat on the outside, spring means urging the second valve toward seating position, a lost motion lever connection from the thermostatic element to the second valve for opening the second valve on further temperature rise after the first valve has unseated, the lost motion lever connection having freedom permitting opening of the second valve in response to pressure without regard to the position of the first valve.

4. In a coolant system for automotive engines, a passage, a first valve seat in the passage, opposed second and third valve seats in the side walls of the passage, a first valve cooperating with the first valve seat on the side toward which the

flow is travelling, second and third valves on the outside of the passage cooperating with the second and third valve seats in closed position, a thermostatic element responding to the temperature of the liquid, an actuating rod connecting the thermostatic element with the first valve, there being a lost motion slot on the actuating rod, toggle levers pivotally connecting from the lost motion slot at one end of each toggle lever, second and third opposed valve stems on the second and third valves extending inwardly in the passage and having lost motion slots at their inner ends connecting to the outer ends of the toggle levers, and a spring urging the second and third valve stems toward one another, there being freedom to open the second and third valves under pressure at all times, the thermostatic element on first expanding opening the first valve and on further expanding and taking up the lost motion opening the second and third valves.

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