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D. G. THOMAS ET AL

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MUFFLER WATER-QUENCH SPARK ARRESTOR

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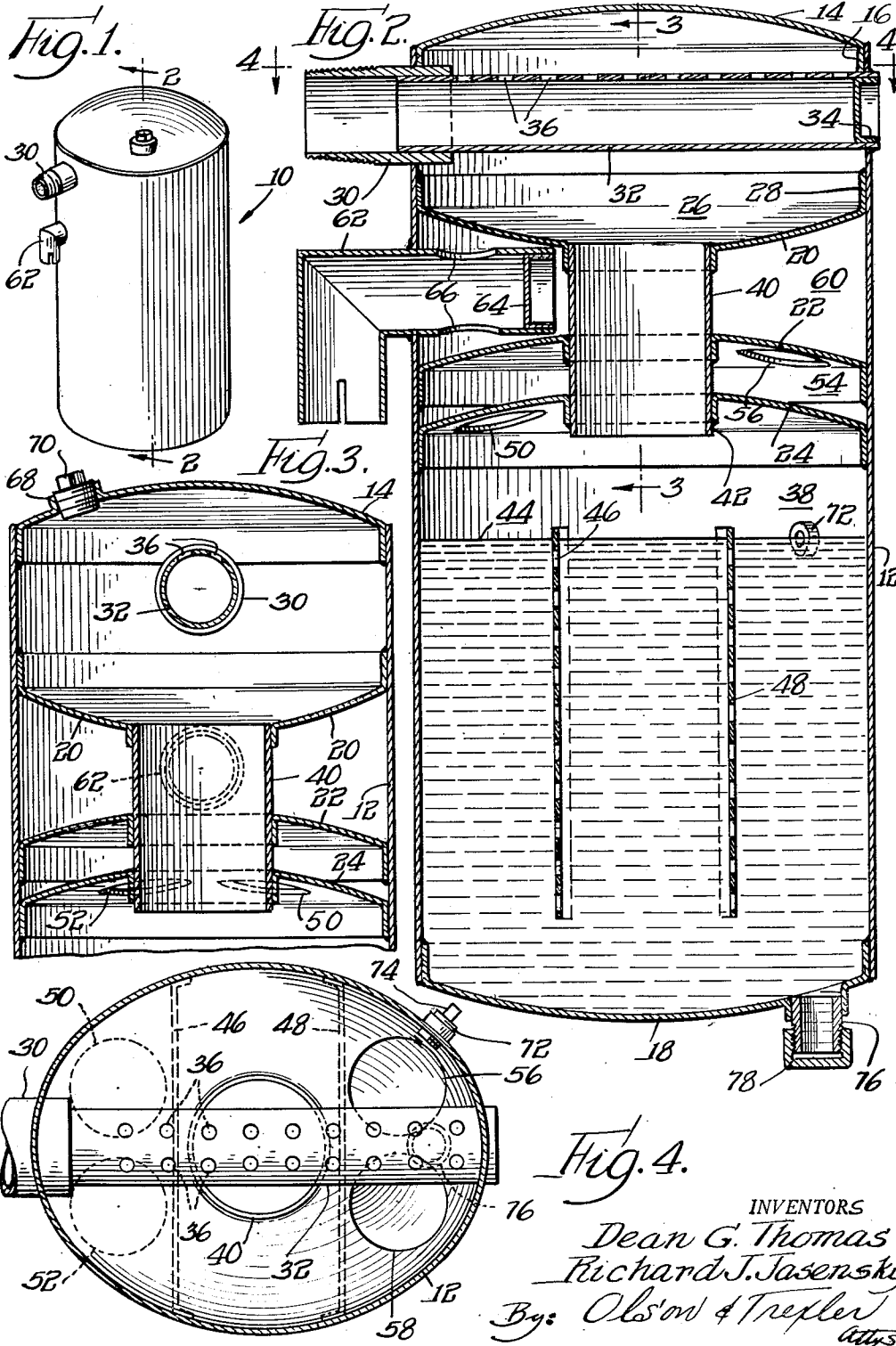


Fig. 4.

INVENTORS

Dean G. Thomas
Richard J. Jasensky

By: Olson & Trepley
attys

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WATER-QUENCH SPARK ARRESTOR MUFFLER

Dean G. Thomas and Richard J. Jasensky, Stoughton, Wis., assignors to Nelson Muffler Corporation, Stoughton, Wis., a corporation of Wisconsin

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6 Claims. (Cl. 183—22)

The present invention relates to an improved internal combustion engine muffler, and more particularly to an improved water-cooled muffler.

There are many instances where the use of an internal combustion engine having a conventional muffler provides a serious fire hazard, due to sparks or incandescent particles being discharged into the surrounding atmosphere along with the exhaust gases. An example of such an instance is the use of an internal combustion engine in trucks operated in warehouses and the like, where dust or fumes in the air might be ignited by a spark from the exhaust. It has been proposed to provide a so-called water-cooled muffler for use in such instances to quench any sparks in the exhaust gases, thereby reducing fire hazard. One disadvantage of the water-cooled mufflers heretofore known in prior art is that the water evaporates in a relatively short period of time, necessitating frequent work stoppages for refilling the reservoir. In addition, the reservoir may easily become dry without this fact coming to the operator's attention, so that the engine may continue to be operated, whereby sparks may be discharged in the exhaust gases.

It is an object of the present invention to provide a novel muffler of the above described type, wherein the water or any other suitable liquid coolant is maintained at a reduced temperature so as to reduce the rate of evaporation, whereby the engine may be safely operated for increased periods of time without the necessity for replenishing the reservoir.

A more specific object of the present invention is an improved muffler of the above described type, wherein the exhaust gases are initially air-cooled and then caused to impinge against a liquid coolant, such as water, to quench any sparks, said liquid coolant being maintained at a relatively lower temperature because of the initial air-cooling of the exhaust gases, whereby the rate of evaporation of the coolant is reduced.

Still another object of the present invention is to provide a novel muffler of the above described type which includes an expansion chamber for initially cooling the hot exhaust gases and a liquid quenching chamber, which quenching chamber is spaced from and out of heat transferring contact with the expansion chamber, whereby the liquid coolant may be maintained at a relatively lower temperature.

Still another object of the present invention is to provide a water-cooled muffler which includes baffle means in the liquid chamber, which baffle means are constructed so as to permit the liquid to circulate uniformly throughout the chamber so that the entire body of the liquid is maintained at a relatively lower, substantially even temperature.

Still another object of the present invention is to provide a novel muffler of the above described type, wherein the exhaust gases are directed against the surface of a body of liquid coolant in a manner that will insure the quenching of all incandescent particles or sparks carried by the exhaust gases.

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Still another object of the present invention is to provide a novel water cooled muffler of the above described type, wherein the relatively cool outgoing exhaust gases may be used to aid in the initial cooling of the incoming relatively hot exhaust gases in order to maintain the body of liquid coolant at a relatively lower temperature.

Other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings, wherein:

Fig. 1 is a perspective view, illustrating a muffler embodying the principles of this invention;

Fig. 2 is a vertical cross sectional view taken along line 2—2 in Fig. 1;

Fig. 3 is a fragmentary cross sectional view taken along line 3—3 in Fig. 2; and

Fig. 4 is a horizontal cross sectional view taken along line 4—4 in Fig. 2.

Referring now more specifically to the drawings, wherein like parts are designated by the same numerals throughout the various figures, a muffler which embodies the principles of this invention includes an upstanding tank 10 having a body section 12 of generally elliptical cross section and a cover 14 having an inverted generally dish-shaped inner surface disposed for closing the upper end of the body section. The cover 14 is provided with a peripheral flange 16 which fits snugly within the body section 12. The cover is preferably secured to the body section by means of welds connecting the flange 16 and the sides of the body section 12. The lower or bottom end of the body section is closed by a dish-shaped bottom 18 which is substantially similar to the cover 14.

The tank formed by the body section 12 and the ends 14 and 18 is divided into a plurality of chambers by means of partitions 20, 22, and 24. The partition 20 is disposed with a concave surface facing upwardly and is spaced from the cover 14 a sufficient distance to provide an expansion chamber 26. The partition 20 is provided with a peripheral flange 28, which is preferably secured to the walls of the body section by means of suitable welds.

In order to introduce hot exhaust gases from the engine into the expansion chamber 26, a pipe end section 30 extends through a suitable opening in the wall of the body section 12 and into the chamber. A tube 32 having one end extending into and preferably welded to pipe section 30 extends horizontally across the expansion chamber 26. Preferably, the opposite end of the tube 32 is disposed within an aperture in the wall of the body section 12 opposite from the pipe section. The end of the tube 32 is closed by means of a plug 34, which is inserted within the tube and welded thereto. The tube 32 is provided with a plurality of apertures 36 in the upper surface thereof. As shown best in Fig. 4, these apertures are preferably arranged in a pair of parallel rows 36. It should be noted that the exhaust gases passing into the tube 32 and out through the apertures 36 will be directed against the inner dish-shaped or concave surface of the cover 14. This concave surface will deflect the streams of gases emerging from the apertures to mix the gases thoroughly and break up shock waves caused by the explosions in the engine. In addition, the gases entering the chamber 26 will be expanded and cooled due to such expansion and also because of heat radiation from the cover 14 and the walls of the body section 12.

A second expansion chamber 38 is provided in the tank by the partition 24. This chamber is adapted to contain a body of a liquid coolant, such as water, for quenching sparks or incandescent particles carried by the exhaust gases. It should be noted that the partition 24, which defines the upper limits of the chamber 38 is spaced substantially from the chamber 26 to reduce pos-

sible heat transfer from the chamber 26 to the lower chamber 38. The gases are conducted from the expansion chamber 26 to the lower quenching chamber 38 by means of a conduit 40 which communicates between centrally located aligned openings in the partitions 20 and 24. It should be noted that the conduit 40 extends well below the partition 24, as at 42, to insure that the gases are directed against the surface of the liquid coolant in the chamber 38. Since the conduit 40 directs the gases along a vertical axis of the tank, it is clear that the gases will be directed substantially normally against the surface of the liquid coolant. This insures that the heavier incandescent particles will impinge the cooling liquid since the momentum of the particles moving vertically downwardly in combination with the forces of gravity will be sufficient to overcome the lifting power of any currents of the gases escaping from the chamber, as more fully described below.

The chamber may be filled with any suitable cooling liquid, such as water, up to the preferred level indicated by the line 44. In order to reduce any surging action of the liquid either because of forces of the exhaust gases directed thereagainst or because of movement of the vehicle on which the muffler is mounted, a pair of baffle plates 46 and 48 are provided. As shown in Figs. 2 and 4, the baffle plates 46 and 48 extend transversely across the chamber 38 and are provided with flanges along their vertical edges, which flanges may be secured to the body section 12 as by welding. It should be noted that the baffle plates 46 and 48 are disposed on opposite sides of the mid portion of the body of cooling fluid so that the fluid is in effect divided into three sections. In order to maintain the entire body of liquid at substantially an even temperature and thereby prevent overheating and rapid evaporation of the mid portion of the liquid body, the baffles are provided with a plurality of perforations which are spread over substantially their entire areas so that the liquid may circulate freely at substantially all levels or depths thereof. Because of this free circulation, the liquid, which is directly impinged by the exhaust gases, constantly is mixed with the remaining portions of the liquid body so that the temperature of the entire body is maintained relatively even. In addition, this circulation enables all portions of the liquid body to benefit from the cooling effect of heat radiation from the walls of the body section 12.

The partition 24 is provided with a pair of openings 50 and 52 through which the exhaust gases escape from the quenching chamber 38. The gases passing through the openings 50 and 52 enter a passageway or chamber 54 defined by the partition 22 and the partition 24. The partition 22 is provided with a pair of openings 56 and 58 to allow the gases to escape from the chamber 54. It should be noted that the openings 56 and 58 are at the opposite side of the chamber 54 from the openings 50 and 52 so that the gases must pass across the chamber and around the conduit 40. The gases passing through the openings 56 and 58 enter still another chamber 60, which is defined by the partitions 20 and 22. A discharge conduit 62 is provided for conveying the gases from the chamber 60 to the exterior of the muffler. The conduit 62 extends through an opening in the body section 12 and has its inner end closed by a plug 64. A plurality of apertures 66 are arranged around the periphery of the conduit 62 for permitting the exhaust gases to enter the conduit. It should be noted that the apertures 66 are located adjacent an opposite side of the chamber 60 from the openings 56 and 58 so that the exhaust gases must pass across the chamber and around the conduit 40 before they are discharged from the muffler. It should be further noted that the exhaust gases leaving the quenching and cooling chamber 38 are relatively cool as compared to the hot gases entering the expansion chamber 26 and that these relatively cool gases passing

through chambers 54 and 60 effectively insulate the quenching chamber against heat radiation from the expansion chamber 26. In addition, these relatively cool gases pass in a heat transferring relationship over the surfaces of the partition 20 and the conduit 40, thereby cooling these surfaces and aiding in the initial cooling of the exhaust gases.

In order to fill initially the quenching chamber, a filling opening 68 is provided in the cover 14, as shown best in Fig. 3. A threaded plug 70 normally seals this opening. When it is desired to fill the tank, the plug is removed, and the liquid is poured through the opening. As seen best in Fig. 3, the opening is disposed at one side of the tank so that liquid passing therethrough will fall onto the concave surface of the partition 20, thence through the conduit 40, and into the chamber 38. In order to prevent overfilling of the quenching chamber, a vent conduit 72 is provided in the side of the body section 12 at the desired liquid level. This conduit is normally closed by a threaded plug 74 (see Fig. 4), which plug is removed during the filling operation so that any excess liquid will be vented to the outside of the muffler.

The bottom 18 of the tank is provided with a drain pipe 76, which is preferably welded within an opening in the bottom. This pipe is normally maintained in a closed condition by a cap 78 threaded thereon. Whenever it is desired to drain the liquid from the chamber 38 for cleaning the chamber or for any other desired purpose, it is merely necessary to unscrew the cap 78. It should be noted that the baffles 46 and 48 terminate short of the bottom 18 so that the baffles do not interfere in any way with the draining of the fluid from the chamber.

While the functioning of the above described device is believed to be clear, a short description of the operation is as follows. Exhaust gases are conveyed from the manifold of an internal combustion engine by any suitable means to the pipe end 30 and conduit 32. The gases are then discharged through the openings 36 into the chamber 26, wherein the gases are mixed, expanded, and cooled. The initially cooled gases are then directed through the conduit 40 into the chamber 38 and substantially normally against the surface of the cooling liquid therein. The gases are further expanded and cooled in this chamber and, as described above, any incandescent particles carried by the gases will be quenched by the cooling liquid. The relatively cool gases then pass through the tortuous passageway between the expansion chamber 26 and the quenching chamber 38, which passageway is provided by the intermediate chambers 54 and 60. As the gases pass along this tortuous passageway, they are conducted in heat transferring relationship with the partition 20 and conduit 40 to aid in the initial cooling of the incoming gases. The relatively cool gases are then discharged from the chamber 60 through the outlet conduit 62, which may be connected to an exhaust pipe for conveying the gases to any suitable point.

From the above description, it is seen that the present invention provides a novel water-cooled muffler, wherein the water or other liquid coolant may be maintained at a relatively low temperature by reason of the novel arrangement of parts for initially cooling incoming exhaust gases and maintaining the quenching chamber out of heat transferring relationship with the initial expansion chamber. In addition, it is seen that novel means is provided for preventing surging out or splashing of the liquid quenching bath while at the same time permitting free circulation of the bath so that the entire bath may be maintained at a substantially even relatively low temperature. Furthermore, it is seen that by the novel arrangement of parts, whereby the initially cooled gases are directed substantially normally against the surface of the cooling bath, all of the sparks or incandescent particles carried by the gases will impinge the liquid.

While the preferred embodiment of the present invention has been illustrated and described herein, it is obvious

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that many changes may be made in the structural details of the novel muffler without departing from the spirit and scope of the appended claims.

We claim:

1. An internal combustion engine exhaust muffler, comprising a closed tank, means within said tank providing upper and lower spaced apart chambers, said lower chamber being adapted to contain a cooling liquid, means entering an upper portion of the tank for conducting exhaust gases into said upper chamber and for directing the gases generally away from a bottom side of said upper chamber, conduit means for conducting gases from said upper chamber and for directing said gases against a cooling liquid in said lower chamber, said conduit means communicating with a central portion of said bottom side of said upper chamber so that said gases may be expanded and cooled in said upper chamber before entering said conduit means, and means providing a tortuous passageway extending transversely of the tank between said chambers and exiting from the tank adjacent said upper chamber for conducting said exhaust gases from said lower chamber to the exterior of said tank.

2. An internal combustion engine exhaust muffler, comprising a closed tank, a plurality of transverse partitions within said tank for dividing the tank into a plurality of chambers, means for conducting hot exhaust gases into a first chamber adjacent an upper end of the tank for expanding and cooling the gases, means for conducting the gases from said first chamber to a second chamber adjacent a bottom end of the tank, said second chamber being adapted to contain a liquid coolant for extinguishing any incandescent particles in said gases, means permitting said gases to escape from said second chamber into a third chamber disposed between said first and second chambers and surrounding said second mentioned conducting means, and means exiting from the tank adjacent said upper chamber for conducting said gases from said third chamber to the exterior of said tank.

3. An internal combustion engine exhaust muffler, comprising a closed tank, means providing a first chamber in an upper end portion of the tank for expanding and cooling exhaust gases, means providing a second chamber in a bottom end portion of the tank and adapted to contain a liquid coolant, conduit means extending transversely into said upper tank end portion and said upper chamber and having perforations along an upper portion thereof for directing exhaust gases upwardly into said upper chamber along a plurality of paths, means for conducting said gases from a central bottom portion of said upper chamber into said second chamber and for directing said gases substantially normally against the surface of a liquid coolant therein to insure impingement of any incandescent particles carried by said gases against said liquid coolant and means for conducting said gases out of said second chamber.

4. An internal combustion engine exhaust muffler, comprising an upstanding closed tank, means providing an expansion chamber in an upper end portion of the tank

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adapted to receive hot exhaust gases for expanding and cooling said gases, means providing a second chamber in a bottom end portion of the tank adapted to contain a liquid coolant, pipe means extending through a side of said upper tank end portion and having a perforated section extending transversely within said upper expansion chamber for directing exhaust gases into said upper expansion chamber along a plurality of paths, restricted means for conducting gases from said expansion chamber through an intermediate portion of the tank and into said second chamber and for directing said gases against the surface of a liquid coolant in said second chamber, baffle means disposed within said second chamber for restraining any surging motions of said liquid coolant, said baffle means having a plurality of relatively small closely spaced passageways therethrough, which passageways are disposed at numerous depths of the liquid coolant so that said coolant may readily circulate for contact with exterior walls of said second chamber to cool said liquid coolant, means providing chamber means in said intermediate tank portion, means providing a restricted opening between said bottom chamber and said intermediate chamber means, and an exhaust outlet pipe communicating with said intermediate chamber means at a position spaced from said bottom chamber and adjacent said upper chamber so that exhaust gases passing from the bottom chamber through the intermediate chamber means serve to insulate the bottom chamber from the upper chamber and to cool the upper chamber.

5. An internal combustion engine exhaust muffler, as defined in claim 4, wherein said baffle means comprises a perforated sheet-like member.

6. An internal combustion engine exhaust muffler, as defined in claim 4, wherein said means for conducting gases from said expansion chamber and directing the gases against the surface of a liquid coolant is disposed for directing said gases against a mid-portion of the liquid coolant, and wherein said baffle means includes a pair of perforated baffle members spaced from the sides of the tank and disposed on opposite sides of said mid-portion to restrain surging motions of the liquid coolant and to insure uniform circulation of the liquid coolant.

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