

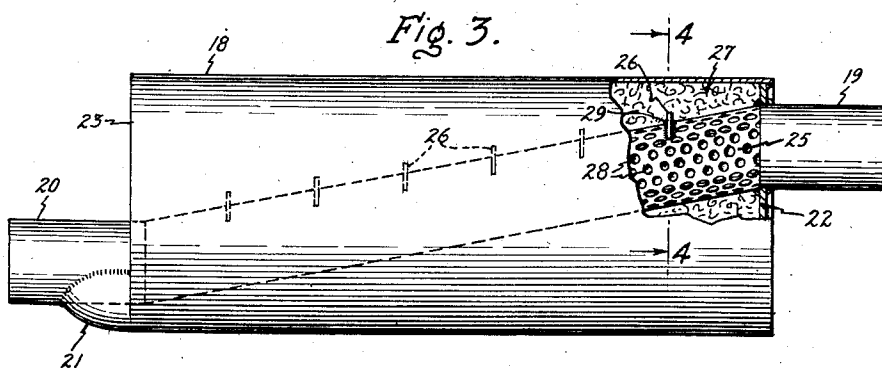
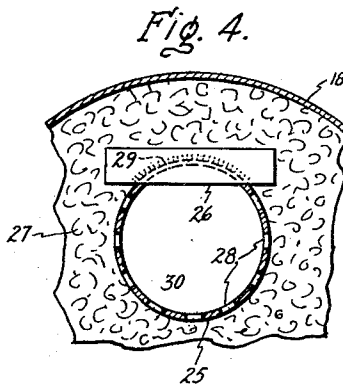
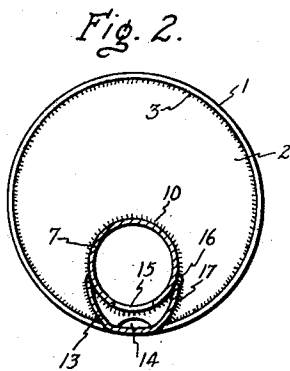
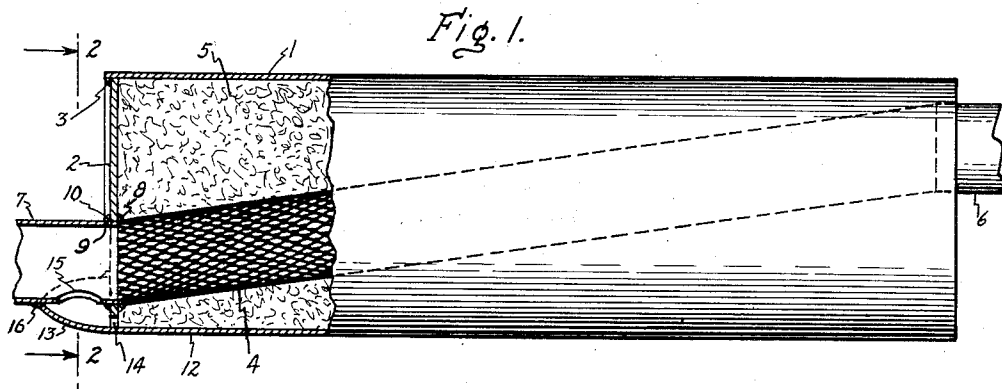
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MUFFLER

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This invention relates to internal combustion engine mufflers or silencers, and particularly to a muffler adapted for wet exhausts wherein a substantial amount of water may be entrained with the exhaust gases entering the muffler.

An object of the invention is to provide an improved muffler, characterized, by very low back pressure and efficient silencing action, which is simple and economical in construction and small in size and light in weight.

Another object of the invention is to provide an improved muffler to silence pulsating gas streams having substantial quantities of water entrained with the gases in the stream.

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in which:

Fig. 1 is a side view of a muffler in accord with this invention, a portion of the side wall being broken away to disclose the internal construction;

Fig. 2 is a sectional end view taken along line 2—2 of Fig. 1;

Fig. 3 is a side view of a muffler according to a modified embodiment of this invention, a portion of the side wall being broken away to disclose the modified internal construction; and

Fig. 4 is a sectional view of the modified muffler taken along line 4—4 of Fig. 3.

The muffler as seen in Fig. 1 comprises an enclosed elongated, hollow shell or tank 1 preferably of generally cylindrical or slightly oval shape, which may be formed of sheet metal and which, for wet exhaust applications, is preferably formed of stainless steel or from the alloy comprising about 66% nickel, 28 percent copper, and 5% iron, manganese, silicon and other elements which is commonly referred to as Monel metal.

An end closure panel or wall such as wall 2 is provided at each end substantially to close the shell, and a suitable peripheral weld 3 joins the end walls to the side walls of the shell. Extending from one end to the other internally of the shell is an elongated, tubular, preferably cylindrical open-mesh-walled member 4 which serves to establish an open passageway for the free flow of gases through the muffler. The interior space of the shell, outside of the passage defined and maintained clear by the mesh-walled member 5, is filled or packed with a filling mass of material 5. The mass is loosely matted and consists essentially of elongated, thin, curved or curled particles, elements or pieces of non-corrosive and non-absorbent materials heterogeneously disposed and admitting of free though tortuous passage of gases and liquids into and through the interstices, passages and pockets formed between the particles or elements making up the mass. Suitable filling materials include a mass

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of coarse glass fibers, a mass of Monel metal shavings, or a mass of synthetic rubber coated animal hair. It will be noted that each of these suggested materials is relatively impervious to water and is resistant to corrosion by acids, water, salt water and petroleum chemicals. Each of the materials, furthermore, is elongated and the individual particles or pieces which go to make up the mass are curved or curled, whereby a great many pockets and passages remain open throughout the mass. The materials should also be resistant to matting and should remain resilient. All of these properties are possessed particularly by Monel metal shavings and by coarse glass fibers, whereas synthetic rubber coated hair, being somewhat less expensive, may have somewhat less life than the inorganic materials but may be substantially as satisfactory in other respects. Shavings of copper or brass are also useful, whereas steel wool mats too closely, is absorbent and is much too corrosive, i. e. subject to corrosion.

An inlet pipe 6 is arranged to communicate directly with the passageway at one end and an outlet pipe 7 is similarly arranged at the other end of the passageway. As shown in Fig. 1, the mesh member 4 is welded at 8 to the end wall 2 peripherally around an opening 9 in the end wall, and pipe 7 is welded at 10 externally of the end wall. As seen, the passageway formed by member 4 and the interior of pipe 7 open directly into one another through opening 9. The pipe may enter opening 9 as shown, or it may terminate at the outer surface of wall 2, while the mesh member may terminate at either surface of wall 2 or may extend a short distance into pipe 7 as may be most convenient in fabrication and as desired for the strength of the welded joints. Preferably the internal diameters of the inlet and outlet pipes of the passageway defined by the mesh member and of the openings through the end walls through which the exhaust gases enter and leave the muffler are equal or substantially equal, varying, for example, merely by the thickness of the pipe walls as necessary to fit the several parts together.

It will be noted that the mesh member extends from a lower portion of end wall 2 in an inclined or diagonal direction to an upper portion of the end wall at the inlet end of the shell. Thus the inlet end of the passageway is immediately adjacent the upper side 11 of the shell, while the outlet end is immediately adjacent the lower side or bottom 12 of the shell 1.

The mesh wall of member 4 is not intended and does not confine the gases or liquids in the passageway maintained therein but permits substantially free access or passage of the gases and liquids into and out of the filling material mass 5. It has been found that the passage of gases into and out of the passages and pockets existing as interstices in the filling mass effectively reduces the amount of noise produced by the finally exhausted gas stream, while the liquids, comprising principally water in the case of a wet exhaust as is common in the case of marine installations wherein the engine cooling water is introduced into the exhaust pipe, collect upon the filling material 5. The water, or other liquids, so collecting drains rapidly to the bottom of the shell. Apparently the pulsing gas stream tends to shake the elements of the filling mass sufficiently to prevent any substantial accumulation of water in the mass and to considerably hasten the draining of the water to the bottom of the tank.

Automatic means are provided to suck or siphon the water from the bottom of the shell, in accord with this invention, comprising a short external conduit 13 in the approximate shape of a cup or sea-shell. The siphon or suction drain conduit 13 opens at one end into the lower rear corner of the shell 1, at which end wall 2 meets bottom wall 12, such as through a small drain opening 14 formed in the lowermost portion of end wall

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2. The conduit opens at its other end into the tail pipe or outlet pipe 7 through a siphon or suction drain opening 15 in the pipe. The conduit is conveniently constructed as a curved, cup shaped plate which is joined by a weld 16 along its edges to the pipe 7 and, as seen in Fig. 2, welded at 17 to the end wall 2. The cup shaped plate may comprise, as shown in Figs. 1 and 2, an extended portion from the lower portion of the shell wall, or it may comprise a separate piece suitably welded to the pipe 7, to the end wall 2 and to the lower end edge of the shell wall as desired. The conduit thus forms a closed channel or passage communicating between openings 14 and 15 at opposite ends of the passage.

Fig. 2 discloses the arrangement of end wall 2 peripherally welded at 3 to the shell walls 1 and further shows not only the position of pipe 7 welded at 10 to the end wall 2 of the shell, but also the relation of water drain opening 14 in the end wall and siphon opening 15 in the pipe 7. The siphon conduit member 13 is seen to be welded at 16 to pipe 7 and at 17 to the end wall 2.

The modified construction of Fig. 3 comprises a tank or shell 18, inlet pipe 19, outlet or tail pipe 20, drain or siphon conduit 21 and end walls, such as inlet end wall 22, all corresponding to the similar parts described above in connection with Figs. 1 and 2. It will be understood that an end wall similar to that shown at 2 in Fig. 1 is provided at the outlet end 23 of shell 18 of Fig. 2, whereas an end wall similar to that shown at 22 in Fig. 2 is provided at the inlet end 24 of the shell 1 of Fig. 1. The differences in construction between the devices shown in Figs. 1 and 3, respectively, lie in the substitution in Fig. 3 of a perforated tube 25 for the expanded metal member 4 of Fig. 1, in the provision of baffles 26, and in somewhat modified shell proportions.

The mesh member 4 of Fig. 1 is shown as constructed of a sheet of what is known as expanded metal, such as is shown in U. S. Patent No. 527,242, the metal being preferably Monel metal, stainless steel, copper, or brass, or some similar non-corrosive metal. The member 25 of Fig. 3 is also, preferably, Monel metal sheet, stainless steel sheet, copper sheet or brass sheet material so perforated as to be in effect a mesh offering very little restraint to the free passage of gas and liquids from the open passageway within the member into the surrounding filling mass 27. In the case of the perforated tube 25 at least substantially one-third of the original metal should be removed in the forming of perforations 28, the perforations being typically one-quarter inch round openings, and the whole tube 25 from end to end and on all sides is perforated, either in a fixed repetitive pattern or randomly. It is preferred that the openings be spaced throughout as closely as possible, leaving only enough metal between openings to give some strength to the member. In the case of expanded metal as shown in Fig. 1, openings may comprise more than one-half of the surface area of the member 4. In either case, the mesh wall should be so formed as to have at least about one-third of its surface area open and preferably one-half or more, sufficient metal remaining to insure against appreciable blocking of the passageway by pieces of the filling mass which may work through the openings. If relatively long, thin curved slivers or thin curled shavings of monel or similar metal are employed as the filling material, wherein the individual shavings are for the most part a few inches long, or if long glass fibers or long hair strands are used, the openings in the mesh member may be between about one-quarter inch and one inch in maximum dimension, and such proportions have been found most satisfactory. Shavings, fibers or hairs less than about one inch in length require openings which may be too small to pass water from the exhaust freely into the filling mass, and the increased packing or matting tendency of short pieces or elements is also undesirable. Curled shavings of a foot in length or fibers or hairs up to several feet in

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length are, however, entirely satisfactory. Very fine glass fiber materials have been found to mat, and coarse fibers are, accordingly, preferred. While synthetic rubber coated hairs are mentioned above as suitable filling particles, other types of non-corrosive, moisture resistant coatings, including silicone materials, may be substituted for synthetic rubber.

A mesh member, as herein referred to, comprises a hollow elongated tube-like member having a large number of wall openings, of a minimum area of openings of at least substantially one-third of the wall area of the tube, and preferably approximately one-half or more of the wall area. Such a mesh member, as hereinabove mentioned, functions primarily merely to provide an open unrestricted passageway from the inlet or exhaust pipe 6 to the outlet or tail pipe 7, in Fig. 1, or pipes 19 and 20, respectively, in Fig. 3.

With further reference to Fig. 3, a plurality of soundbreakers or partial baffles 26 are shown set into slots cut transversely in the upper portion of the mesh member 25, and being held in place by welding as at 29. As seen in Fig. 4, the soundbreakers or partial baffles 26 are rectangular and extend into the interior of the passageway 30 maintained otherwise clear by the mesh member a distance equal to approximately one quarter of the diameter of the circular passageway. Fig. 4 further discloses the shape and position of mesh member 25 within shell 18.

While soundbreakers or partial baffles as disclosed in Figs. 3 and 4 are useful in reducing the noise intensity in those instances in which space limitations prevent the installation of a muffler of sufficient length to provide adequate reduction in intensity, the baffles introduce some backpressure and are not normally desirable, even though only a small fraction of the passageway area is restricted by the baffles.

Typical dimensions for a muffler as shown in Fig. 1 in accord with this invention adapted for use in connection with a gasoline boat engine of up to about 150 horsepower would be a shell length of 30 inches, a shell diameter of 8 inches, and inlet pipe, outlet pipe and internal passageway diameters of substantially 2 inches. The shell and end walls may be of 22 gauge Monel metal or stainless steel, while the expanded metal mesh member 4 may be formed of one-quarter inch mesh material, that is, material having openings about one-quarter inch wide and about one-half inch long. The upper or inlet end of the mesh member may approach to within about one-eighth to one-half inch of the inside surface of the upper side 11 of the shell, or as close as may be permitted by the particular method of manufacture which is employed, while the lower end may be spaced about one-half inch from the inner surface of the shell bottom 12. The slot or opening 14 may be about one-quarter inch in height and three-quarters of an inch in length, and the opening 15 in the tail pipe may be about one inch in diameter.

For the engine size mentioned above, the arrangement of Fig. 3 will typically comprise a shell of about 20 to 22 inches in length. The other dimensions may be substantially those given above, and the soundbreakers or partial baffles may comprise rectangular plates of 22 gauge Monel metal or stainless steel, three-quarters of an inch high and two inches long. The baffles may be set one-half inch into the passageway.

It will be understood that a conventional external exhaust pipe from the engine joins to the inlet pipe 6 or 19, while an external outlet or tail pipe extension would normally join the pipe 7 or 20 of the muffler, such arrangements being commonly employed with mufflers for use with internal combustion engines.

In operation for a dry exhaust, the pulsating gas stream introduced through inlet pipe 6 or 19 meets no appreciable back pressure or resistance to free gas flow through the passageway within the mesh passageway-defining member 4 or 25, but pulses present in the gas stream create multiple pulsations of varying time intervals into the inter-

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stices of the filling material and the pulsations are, accordingly, effectively absorbed, cancelled or dissipated. Any pulses which emanate from the main gas stream, strike the walls of the shell and are reflected back into the main passageway reach the passageway after respectively different random time intervals because of the inclined position of the passageway, and reinforcing reflected pulsations are almost entirely eliminated. It has further been found that shell vibration is reduced to a very small value, apparently because the pulses are much reduced in intensity by passage through the filling medium before reaching the shell and because of the variation in time required for a pulse spreading, for example, from the inlet end of the passageway to reach the upper and lower sides of the shell. It will also be apparent that pulses traveling through the random and tortuous passages of the filling material are delayed in returning to the main passageway, as to such that do return, by random periods of time depending upon the length of the particular path traversed by the pulse.

The aforementioned sound intensity reducing effects are apparent in mufflers used in wet exhaust systems, and, as heretofore explained, nearly all of the water, or other liquid, entrained in the incoming gases, or merely flowing in with the gases, rapidly drains through the filling material and collects in the bottom of the shell. The water so collecting is sucked or siphoned out through opening 14 into siphon conduit 13 and thence through opening 15 into pipe 7, as seen in Fig. 1, or similarly into conduit 21 and into pipe 20 as seen in Fig. 3, to be externally disposed of through any suitable tail pipe extension which may be connected to pipe 7 or 20. The drainage of water from the shell in this manner has been found entirely satisfactory even though the shell is horizontally disposed, but a more complete and rapid removal is obtainable by tilting the shell upwardly by two or three degrees toward the inlet end. It is believed that the siphoning action by which water is sucked out of the muffler shell is due to a slightly greater gas pressure within the shell than exists in the tail pipe 7 or 20, produced at least in part by the somewhat greater velocity of the gases within the tail pipe than within the shell.

While only certain preferred embodiments of this invention have been shown and described by way of illustration, many modifications will occur to those skilled in the art and it is, therefore, desired that it be understood that it is intended in the appended claims to cover all such modifications as fall within the true spirit and scope of this invention.

What is claimed as new and what it is desired to secure by Letters Patent of the United States is:

1. An internal combustion marine engine wet exhaust muffler, comprising an elongated shell having a horizontally disposed lower side and end closure walls, an elongated hollow tubular open-mesh-walled cylindrical member extending internally of said shell from one to the other said end closure and inclined from a connection at one end through an opening in the upper portion of said one end closure to a connection at the other end through an opening in the lower portion of said other end closure immediately adjacent said lower side of said shell, said member terminating at its said ends within said shell at the respective end closures thereof, external pipe means communicating directly through said end closure openings with said ends of said cylindrical member and adapted and arranged to introduce exhaust gases into said

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one end thereof and to pass exhaust gases from said other end, a mass of elongated curved elements substantially filling said shell externally of said cylindrical member, said pipe means including a tail pipe communicating with said other end of said cylindrical member, and an external drain conduit communicating at one end of said conduit with the interior of said shell at and through an opening in the bottom corner of said shell immediately adjacent said other end closure and at the other end of said conduit communicating through an opening into said tail pipe externally of said shell and adjacent said other end closure.

2. An internal combustion marine engine wet exhaust muffler in accord with claim 1 wherein said mass comprises synthetic-rubber-coated animal hairs.

3. An internal combustion marine engine wet exhaust muffler comprising an enclosed elongated hollow shell having end walls and having side walls including generally horizontally disposed upper and bottom walls, an elongated tubular open-mesh member disposed diagonally within said shell, one end of said member meeting one end wall of said shell adjacent said upper wall and the other end of said member meeting the other end wall of said shell adjacent said bottom wall, said member defining an unobstructed passageway within said shell, an external inlet pipe attached to said one end wall and communicating through an opening in said one end wall with said passageway and an external outlet pipe attached to said other end wall and communicating through an opening in said other end wall with said passageway, said shell having a bottom corner portion at which the lower edge of said other end wall and said bottom wall meet, said bottom corner portion underlying and being closely adjacent to said other end of said open-mesh member, said shell having a drain opening at and through its said bottom corner portion, the lower wall of said outlet pipe having an inlet opening located adjacent said other end wall of said shell, a drain conduit disposed exteriorly of said shell and outlet pipe and joined to said outlet pipe and to said shell and providing a closed drain passageway connecting from the interior of said shell at said bottom corner portion through said drain opening and to the interior of said outlet pipe through said inlet opening, and a non-corrosive, porous, sound absorbent filling mass substantially completely filling said shell externally of said member.

4. An internal combustion marine engine wet exhaust muffler in accord with claim 3 wherein said filling mass comprises Monel metal shavings.

5. An internal combustion marine engine wet exhaust muffler in accord with claim 3 wherein said filling mass comprises coarse glass fibers.

6. An internal combustion marine engine wet exhaust muffler in accord with claim 3 wherein said filling mass comprises synthetic-rubber-coated animal hairs.

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