Aug. 27, 1963 T. N. KELLY 3,101,811

MARINE TYPE MUFFLER

Original Filed Oct. 19, 1960

FIG.1.

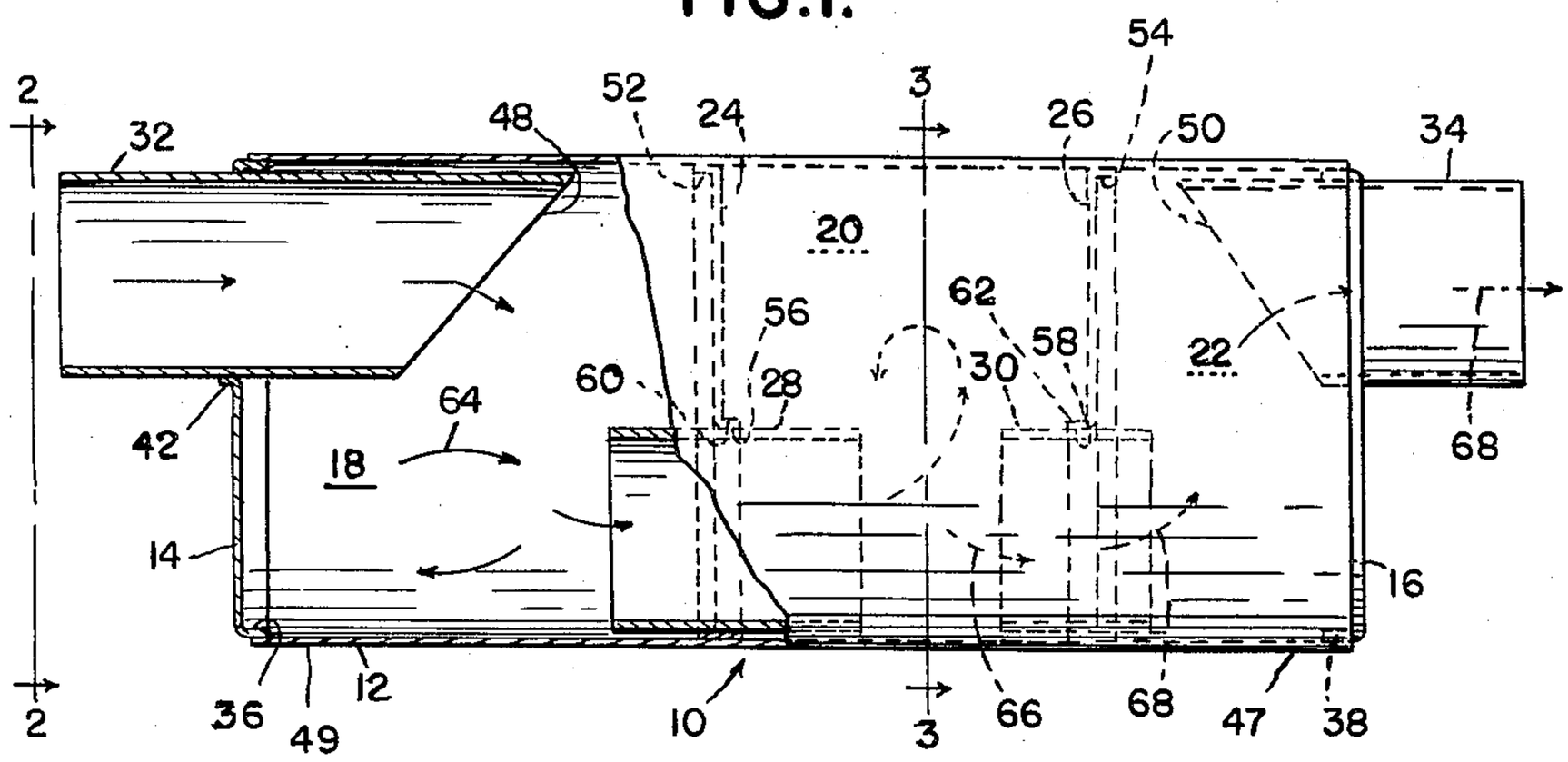


FIG.2.

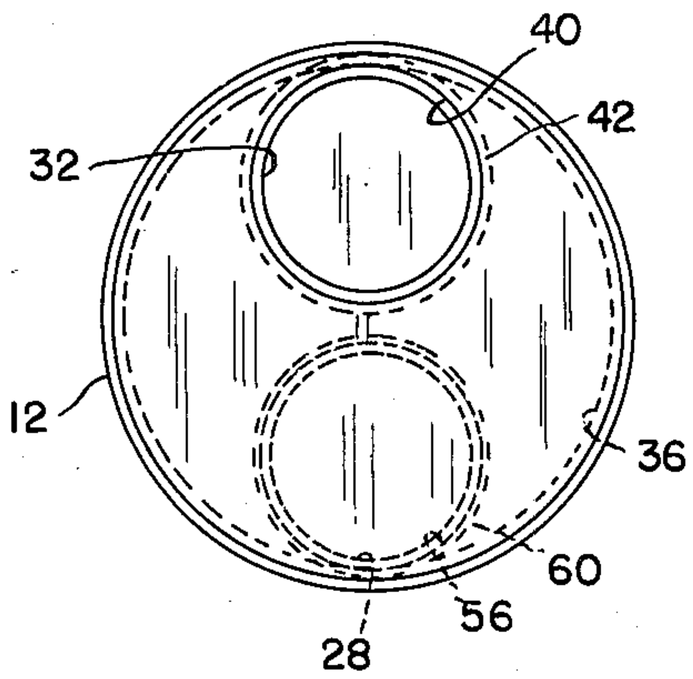
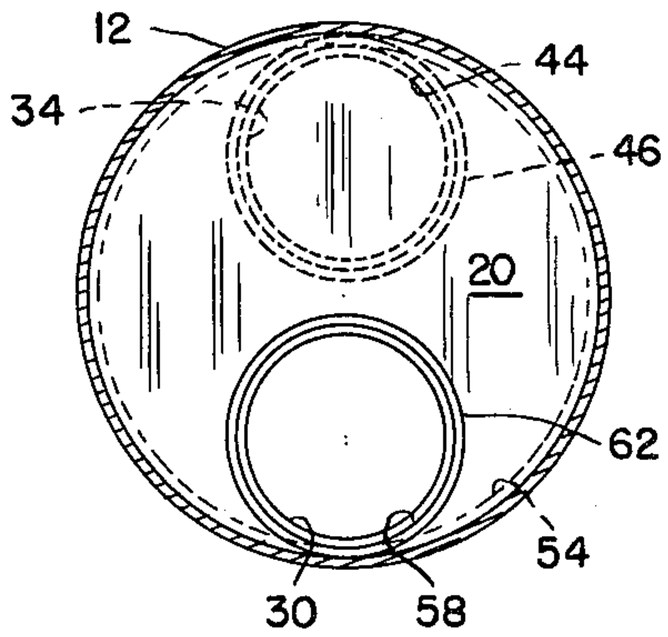


FIG.3.



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MARINE TYPE MUFFLER

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Original application Oct. 19, 1960, Ser. No. 63,638, now Patent No. 3,080,939, dated Mar. 12, 1963. Divided and this application Dec. 11, 1961, Ser. No. 158,265

4 Claims. (Cl. 181—52)

The present invention relates to noise suppressors and refers more specifically to a marine type muffler constructed to receive hot exhaust gases and fluid simultaneously and to cool the exhaust gaess, suppress exhaust sound, and discharge the cooled gases and fluid without creating an undesirable and objectionable back pressure.

The present application is a division of my copending application, Serial No. 63,638, filed October 19, 1960, and entitled "Marine Type Muffler."

An object of the invention is to provide an improved muffler which mixes hot exhaust gases and cooling fluid and is constructed to provide particular flexibility in the mounting thereof and to maintain minimum back pressures.

Another object is to provide an improved muffler as set forth above which includes a plurality of acoustic filter sections for accomplishing noise suppression and is constructed to utilize hydraulic ram principles to discharge the cooled gases and fluid from an opening adjacent the top thereof.

More specifically, it is an object to provide an improved muffler construction comprising a tubular housing provided at opposite ends thereof with closures and including an inlet tube extending through the closure at one end of the housing and being disposed adjacent and extending lengthwise of one side wall of said housing, and an exhaust tube extending through the closure at the other end of said housing and being disposed adjacent and extending lengthwise of said one side wall of said housing in alignment with said inlet tube.

Another object is to provide a muffler construction as set forth above wherein the housing is divided into a plurality of resonant chambers of different size for noise suppression by transverse partitions having ducts extending therethrough and being disposed against and extending lengthwise of a side wall of said housing in an arrangement which is diametrically opposed to the inlet and exhaust tubes.

Another object is to provide a muffler construction as set forth above wherein the inner end of the inlet tube and the exhaust tube are tapered axially inwardly of the respective tubes and radially inwardly of the housing to provide uniform expansion and exhaust respectively of the gas in the muffler.

Another object is to provide a muffler construction as set forth above wherein the ducts have diameters approaching or exceeding their length so that the ducts will not resonate as open pipes but will function as acoustic coupling ducts.

Another object is to provide a muffler as set forth above which is simple in construction, economical to manufacture and efficient in use.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawing, illustrating a preferred embodiment of the invention, wherein:

FIGURE 1 is an elevational view of a muffler, partly in section, constructed according to the invention.

FIGURE 2 is an end view looking in the direction of arrows 2—2 of FIGURE 1.

FIGURE 3 is a sectional view taken on line 3—3 of FIGURE 1.

With particular reference to the drawings a specific embodiment of the present invention will now be disclosed.

As best shown in FIG. 1, the muffler 10 of the present invention comprises a tubular housing 12, provided with closures 14 and 16 at opposite ends and which is divided into resonant chambers 18, 20 and 22 by partitions 24 and 26 located between the closures 14 and 16 at longitudinally spaced points of the housing 12. The partitions 24 and 26 have coupling ducts 28 and 30 respectively extending therethrough. An inlet tube 32 extends through closure 14 and is disposed against and extends lengthwise of one side wall of the housing 12. Exhaust tube 34 extends through closure 16 and is disposed against and extends lengthwise of said one side wall of the housing such that the tubes 32 and 34 are aligned and longitudinally spaced from one another.

The muffler 10 constructed as shown is particularly adapted to receive a mixture of water and hot exhaust gases from an internal combustion engine through inlet tube 32. The muffler 10 is operable to further mix the water and gases to cool the exhaust gases. Muffler 10 is also constructed to suppress the exhaust noise and discharge the gases and water through the exhaust tube 34 without creating objectionable back pressures. In addition, since the exhaust tube 34 is located in the upper portion of the muffler as installed and water is exhausted therefrom by means of hydraulic ram principles rather than by gravity as previously greater flexibility of mounting of the muffler 10 is provided.

More specifically, the housing 12 comprises an elongated cylinder which may be constructed of relatively light weight corrosion resistant material such as titanium-stabilized stainless steel. Closures 14 and 16 which are similar in construction are secured over the opposite ends of the housing 12 by means of the annular flanges 36 and 38 respectively by convenient means such as welding to provide a seal between the closures 14 and 16 and the housing 12.

As indicated best in FIGURE 1 the closure 14 has an opening 40 therethrough adjacent the periphery thereof through which the inlet tube 32 extends. The inlet tube 32 may be secured to the flange 42 around the opening 40 by convenient means for sealing the inlet tube 32 to the closure 14 such as welding. The inlet tube 32 is positioned adjacent the periphery of the closure 14 so that the exhaust gases and water may be introduced into an upper portion of the muffler 10 as installed.

The closure 16 is also provided with an opening 44 therethrough adjacent the periphery thereof. Flange 46 is provided around the opening 44 to which the exhaust tube 34 may be sealed by convenient means such as welding. The exhaust tube 34 as shown in FIGURE 1 also extends through an upper portion of the closure 16 with respect to the muffler 10 as installed and is aligned with and longitudinally spaced from the inlet tube 32.

As will be readily recognized the placing of the exhaust tube 34 in the upper portion of the closure 16 hinders gravity drainage of the cooling water therefrom. It has however been found with mufflers constructed as shown in the drawing that adequate drainage is provided in operation. It is believed that drainage is accomplished due to the pulsation of the gases from the internal combustion engine (not shown) attached to the muffler. The pulsating gases apparently act on the water in chamber 22 in the manner of the driving force of the well known hydraulic ram to force the water from the exhaust tube 34. Improved silencing characteristics are found to be present in muffler 10 with the exhaust tube 34 located in the upper portion of closure 16 over mufflers having

gravity water discharge with the exhaust tube located in the bottom portion of the closure.

Furthermore since the exhaust tube **34** is not required to be located at the bottom of the closure **16** in accordance with the invention as was previously the case to provide adequate drainage for the muffler the exact positioning of the muffler during installation is not required. Thus the end **47** of the muffler need not be lower than the end **49** thereof. A drain, not shown, is generally provided in the lower portion of the housing **12**. Also the muffler **10** may be rotated axially slightly if required in installation. In other words the flexibility in positioning of the muffler **10** constructed as shown in FIGURE 1 is greatly improved over other marine type mufflers.

The inner end **48** of the inlet tube **32** is tapered axially inwardly of the tube **32** radially inwardly of the housing **12** as shown. The tapered end of the inlet tube **32** provides uniform expansion of exhaust gas and water discharged into the chamber **18** therefrom to cause the gas and water to circulate within chamber **18** to most advantageously cool the gases and prevent generation of internal noises within the muffler.

The exhaust tube **34** is similarly provided with an inner end **50** which is tapered axially inwardly of the tube **34** radially inwardly of the housing **12**. The tapered end **50** of the exhaust tube **34** permits smooth flow of the cooled exhaust gas and water from chamber **22**.

Partitions **24** and **26** are circular as shown best in FIGURE 3 and include annular flanges **52** and **54** around the outer periphery thereof which are secured to the housing **12** as shown in FIGURE 1 by convenient means such as welding to provide resonant chambers **18**, **20** and **22** as previously indicated. It will be noted that the partitions **24** and **26** are spaced longitudinally of housing **12** so that the chambers **18**, **20** and **22** have different dimensions and therefore resonate at different frequencies to produce sound attenuation at the most objectionable frequencies.

Partitions **24** and **26** are further provided with openings **56** and **58** in the lower portion thereof with respect to the installed muffler and diametrically opposed to tubes **32** and **34** as shown in the figures. Flanges **60** and **62** are provided about openings **56** and **58** in partitions **24** and **26** respectively to which the acoustic coupling ducts **28** and **30** are secured by convenient means.

Ducts **28** and **30** have diameters approaching or greater than their lengths as will be evident from inspection of FIGURE 1 whereby the ducts **28** and **30** will not resonate as open pipes but will function as acoustic coupling ducts to couple the sound from chamber **18** into chamber **20** and from chamber **20** into chamber **22**.

The ducts **28** and **30** also serve to provide a path through the muffler **10** from the inlet tube **32** to the chamber **22** for the exhaust gases and water discharged into the muffler **10** which is substantially unimpeded so that a low back pressure is created by muffler **10** and water in chamber **22** is discharged from exhaust tube **34** in the manner in which water is discharged from a hydraulic ram by means of the pulsating exhaust gases.

In operating it will be understood that the muffler **10** is connected with the inlet tube **32** and the exhaust tube **34** positioned in the top portion as shown. The muffler **10** may either be installed level or inclined slightly toward either end **47** or **49** in accordance with the positioning of the drain, not shown.

A combined mixture of hot exhaust gases and water is discharged into chamber **18** through inlet tube **32**. The hot gases and water are caused to expand uniformly on exit from the inlet tube **32** due to the tapered inner end thereof and are caused to intermingle in chamber **18** as indicated by the flow arrows **64** therein whereby the gas is caused to cool and the sound at the frequency to which the chamber **18** is tuned is suppressed.

The cooled gases and water together with the unsuppressed noise frequencies are passed into chamber **20** through acoustic coupling duct **28** wherein the gas and water are again mixed as indicated by the flow arrows **66** and the noise frequencies to which the chamber **20** is tuned are suppressed.

Similarly the cooled gas, water and unsuppressed noise frequencies from chamber **20** are passed into chamber **22** through acoustic coupling duct **30** where the gases and water are again caused to mix as indicated by the flow arrows **68** and the remaining undesirable noise frequencies are suppressed. The cooled exhaust gas and water then flow smoothly out of the exhaust tube **34** due to the pulsating exhaust gases as previously indicated.

The muffler structure **10** of the invention is particularly efficient in silencing the exhaust of internal combustion engines while producing a relatively low back pressure due to the alignment of coupling ducts **28** and **30** and the positioning of the inlet tube **32** and the exhaust tube **34** in the upper portion of the muffler **10** as shown in FIGURE 1 in conjunction with the tapered ends of the tubes **32** and **34**.

The arrangement of the inlet and exhaust tubes in the manner specified provides flexibility of installation of the muffler at the expense of little additional back pressure and slightly diminished drainage capabilities than when the tubes are diametrically opposed to one another.

What I claim as my invention is:

1. A marine type muffler comprising an elongated tubular housing, separate inner and outer end headers respectively closing the opposite ends of said housing, a pair of transversely extending partitions secured within said housing in longitudinally spaced relation to said end headers and to each other dividing said housing into first and second resonant chambers respectively adjacent said inner and outer end headers and a third resonant chamber between said first and second chambers, an inlet tube extending through said inner end header into said first chamber, said inlet tube being disposed adjacent to the side wall of said tubular housing in laterally offset parallel relation to the longitudinal center line of said housing, an acoustical coupling duct extending through and secured to one of said partitions, a second acoustical coupling duct in spaced axial alignment with said first mentioned duct and extending through and secured to the other of said partitions, said ducts placing said chambers in communication with one another and being disposed in laterally offset parallel relation to the longitudinal center line of said tubular housing at the diametrically opposite side of said center line from said inlet tube, the end of said inlet tube within said first chamber lying in a plane inclined radially and axially inwardly relative to said housing at an acute angle to the longitudinal center line of said housing to provide for a uniform flow and expansion of exhaust gases and water into said first chamber, and an outlet tube extending through said outer end header into said second chamber, said outlet tube being in spaced axial alignment with said inlet tube, the end of said outlet tube within said second chamber lying in a plane inclined radially inwardly and axially outwardly relative to said housing at an acute angle to the longitudinal center line of said housing to provide for a smooth flow of exhaust gases and water from said second chamber, the arrangement of said tubes and ducts serving to reduce back pressure in the muffler, the ends of said ducts and the inclined ends of said tubes being open and unobstructed to further reduce back pressure.

2. The muffler defined in claim 1, wherein said third chamber is larger in volume than said second chamber and smaller in volume than said first chamber.

3. The muffler defined in claim 1, wherein each coupling duct is of a diameter closely approaching or exceeding the length thereof to prevent the same from resonating.

4. The muffler defined in claim 1, wherein said aligned ducts are vertically beneath the longitudinal center line

of said housing and said aligned inlet and outlet tubes are vertically above said longitudinal center line.

References Cited in the file of this patent

UNITED STATES PATENTS

1,074,627	Kenney	Oct. 7, 1913
2,093,893	Maxim	Sept. 21, 1937
2,194,550	Hector et al.	Mar. 26, 1940
2,205,024	Zinsitz	June 18, 1940
2,238,816	Maxim et al.	Apr. 15, 1941
2,360,429	Leadbetter	Oct. 17, 1944
2,498,979	Bourne	Feb. 28, 1950
2,516,948	Bourne	Aug. 1, 1950
3,016,972	Dugas	Jan. 16, 1962