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SILENCER

Harold D. Smith, Los Angeles, Calif.

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5 Claims. (Cl. 181-69)

My invention relates to silencers and has particular reference to a silencer or muffler for use with the exhaust system of an internal combustion engine to minimize the noises resulting from the operation thereof.

Silencers of the type applied to the exhaust systems of internal combustion engines are commonly known as mufflers and may be classed in either of two classes. The first class includes a type that may be termed the labyrinth type, ordinarily consisting of an external shell within which is supported a set of concentric internal shells with baffles so located and arranged as to require the exhaust gases to travel in a tortuous path and traverse the length of the shell three or more times. A second class of mufflers in current use may be termed the multi-passage type and includes those in which a shell encloses a series of baffles having a plurality of holes there-through or tubes interconnecting the baffles so that the exhaust gases are caused to travel through the muffler in a plurality of parallel paths. Both of these types of mufflers are in current use on automobiles and trucks.

Stationary Diesel type engines, or other types of high compression, high speed, multi-cylinder engines have come into recent common use as prime movers for pumping oil wells, and because of the increasing proximity between pumping oil wells and residential or business districts in our larger cities, an acute need has arisen for a muffler which will effectively silence these engines. The types of mufflers previously referred to are generally unsatisfactory for this service primarily because they give rise to such high exhaust back pressures as to seriously impair the efficiency of the engines to which they are attached. Furthermore, these types of mufflers are in general too fragile in their construction, being shortly disintegrated by the vibrations resulting from the heavy explosions occurring in this type of stationary engine.

If the foregoing types of mufflers were to be made in larger and sturdier sizes, so as to reduce the back pressure on the exhaust system and to avoid the danger of disintegration from vibration stresses, the muffler would be so large that a large proportion of it would operate at a temperature lower than the boiling point of water with the result that water vapor, forming one of the constituents of the exhaust gases, would be condensed in the muffler and oxidation or rusting of the muffler parts resulting from the presence of this water would occur and soon destroy the muffler.

It is therefore an object of my invention to provide a compact, sturdy muffler or silencer for passing large volumes of exhaust gases without creating an excessive back pressure on an internal combustion engine with which it may be used.

It is also an object of my invention to provide a muffler of the character set forth in the preceding paragraph which, while operable at a low back pressure, is of such small physical size as to operate at a temperature higher than the boiling point of water and thus prevent moisture condensation within the muffler.

It is a further object of my invention to provide a muffler of the character set forth in the preceding paragraphs which is simple in construction and which employs well known materials and methods of manufacture so that it may be inexpensively manufactured.

It is also an object of my invention to provide a muffler of the character set forth in the preceding paragraphs which is sturdily constructed in an essentially one-piece manner so as to reduce the danger of the muffler disintegrating under continued pressure impacts transmitted thereto by exhaust gases passed through the muffler.

Other objects and advantages of my invention will be apparent from a study of the following specification, read in connection with the accompanying drawing, wherein:

Fig. 1 is a perspective view of the preferred embodiment of the muffler of my invention illustrated with a part of the shell broken away to show the relative location and shape of the baffles enclosed by the shell; and

Fig. 2 is a longitudinal section illustrating the internal construction of the muffler shown in Fig. 1 and showing particularly the method of bracing employed between the baffles and the muffler shell to provide a substantially one-piece type of construction.

It has been found that in order to effectively silence the exhaust noises of an internal combustion engine, a muffler must be applied to the exhaust system thereof which is built in accordance with certain well established principles. The silencing action of a muffler depends primarily upon providing a means for changing the direction of flow of the exhaust gases through the muffler so as to cause internal sound reflections within the muffler shell and the gradual absorption of the sound energy from these reflected waves so that such sound energy is not transmitted to the outside air.

Furthermore, surge chambers, or the equivalent

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lent, must be provided to smooth out the pressure impulses in the exhaust gases which enter the muffler so that they may be discharged therefrom as a substantially continuous, non-pulsating flow. If the exhaust gases are discharged in a pulsating fashion, the discharge end of the muffler operates as a secondary sound generator and will generate sounds at that point corresponding to the sounds of the explosions within the engine.

The muffler must also be constructed in a sturdy and rigid manner so that the pulsating exhaust pressure within the body will not cause mechanical vibrations of the muffler body and cause it to act as a secondary sound generator.

In building a muffler which embodies these principles of construction, the problem is encountered of allowing the passage of the exhaust gases without undue friction. If a great deal of resistance to the passage of exhaust gases is caused by the tortuous path through which the exhaust gases are forced, a relatively high back pressure will be applied to the exhaust system of the engine and seriously impair the operating efficiency of the engine. Accordingly the tortuous path through which the exhaust gases are caused to travel must have a large cross-section at all points and must be of a streamline character so as to reduce to a minimum the turbulence of the gases and the friction resulting therefrom.

Referring to the drawing, I have illustrated in Figs. 1 and 2 the preferred embodiment of my invention which incorporates the principles of construction and design as set forth above. The muffler of my invention may include a tubular shell or muffler body 1 which is provided at one of its ends with a conical transition section 2 connecting to a muffler inlet 3 and a similar transition section 4 secured to the opposite end of the muffler body 1 and provided with a discharge orifice 5. The inlet connection 3 may be provided with screw threads 6, or other suitable means for attaching to the discharge of the exhaust system of an internal combustion engine.

Within the interior of the muffler body 1, I provide a series of semi-circular baffles 7, one set of which (7a, 7b and 7c) are secured to one side of the inside of the muffler body 1 as by welding 8 and spaced apart relative to each other. Another corresponding set of baffles (7d, 7e and 7f) are provided and secured to the opposite side of the inside of the muffler body 1 and secured thereto as by welding 9 in positions disposed alternately along the length of the muffler body 1 with respect to the other set (7a, 7b, and 7c) of baffles.

In order that these baffles may be securely inter-tied with each other and with the muffler body 1, I provide a series of longitudinally extending brace members 10 which are disposed on the approximate center line of the muffler body 1 and extend between adjacent baffle plates and are secured to each of these plates as by welding 11. For example, one of the braces 10 may extend between the plates 7a and 7d while another of the brace members may extend between the plates 7d and 7b, additional bracing members being provided in a similar fashion to inter-tie each of the baffle plates with all of the others.

In addition to the brace members 10, I provide a pair of additional brace members 12 and 13 which are respectively secured to the baffle plates 7a and 7f and extend between the center line edge of each of these plates and the muffler body 1 and are secured thereto as by riveting,

welding, or other suitable means. It will be noted that with this type of construction the baffle plates and the muffler body 1 are so inter-tied and braced relative to each other as to constitute substantially a single element.

In operation, exhaust gases enter the muffler by means of the inlet connection 3 and travel in a tortuous path therethrough somewhat in the fashion as indicated by arrows 14 in Fig. 2 and discharged through the discharge opening 5. It will be noted that each of the baffle plates 7a through 7f provides a reflecting surface for reflecting the sound waves carried by the exhaust gases and operates to gradually absorb the energy of these sound waves and prevent the transmission of such sound waves through the discharge opening 5. This type of construction provides a very low back pressure upon the exhaust system to which it is applied since the exhaust gases, travelling as indicated by the arrows 14, travel in a substantially streamlined path. This type of path is provided by the relative spacing and relationship of the baffles 7 to each other such that during operation substantially stationary exhaust gases are trapped in the corner spaces as defined in Fig. 2 by dotted lines 15.

As is well known to those skilled in the art, these substantially stationary gases provide a "pneumatic or hydraulic elbow" of such type that the moving gases travel without turbulence through a streamlined path, the substantially stationary gases trapped in the corner represented by the dotted lines 15 acting in the same fashion as if a solid structural member were provided along this boundary line. Furthermore, the "dead" spaces operate as surge chambers to smooth out the pulsating pressure of the incoming exhaust gases so that said gases are discharged from the discharge opening 5 in a substantially continuous and smooth, non-pulsating flow.

If desired, the baffles 7 may be inclined rearwardly toward the discharge opening 5 in order to further "streamline" the passage for the exhaust gases and reduce the back pressure built up in the muffler when it is in use. A reduction, however, in the silencing efficiency of the muffler may result from this change.

It will be noted that by constructing a muffler in accordance with the principles of my invention as described, a muffler may be obtained which is capable of handling with great efficiency a much larger volume of exhaust gases in relation to its physical size than has been heretofore possible and that such a muffler will operate under ordinary circumstances at a temperature above the boiling point of water and thus prevent the condensation of water vapor within the muffler body. This type of muffler construction provides a streamline path of very high efficiency for the exhaust gases, together with a series of surge chambers for smoothing out the pulsating pressure impulses delivered to the muffler.

While I have shown and described the preferred embodiment of my invention, I do not desire to be limited to any of the details of construction shown or described herein, except as defined in the appended claims.

I claim:

1. In a silencer for use with the exhaust system of an internal combustion engine, the combination of: a cylindrical muffler body; an inlet and an outlet connected to opposite ends of said body for conducting exhaust gases thereto and away therefrom; one set of semi-circular baffles

extending transversely across a part of the width of said body disposed in spaced relationship relative to each other along the length of said body and secured to one side thereof; and another set of semi-circular baffles extending transversely across a part of the width of said body and interposed between and spaced from adjacent baffles of said one set and secured to the opposite side of the interior of said cylindrical body.

2. In a silencer for use with the exhaust system of an internal combustion engine, the combination of: a cylindrical muffler body; an inlet and an outlet connected to opposite ends of said body for conducting exhaust gases thereto and away therefrom; one set of semi-circular baffles extending transversely across a part of the width of said body disposed in spaced relationship relative to each other along the length of said body and secured to one side thereof; another set of semi-circular baffles extending transversely across a part of the width of said body and interposed between and spaced from adjacent baffles of said one set and secured to the opposite side of the interior of said cylindrical body; a plurality of bracing members interconnecting the inner edges of each of said baffles with the inner edge of each adjacent baffle; and a pair of brace members extending between the inner edge of each of the end baffles and the muffler body, whereby all of said baffles and said muffler body are securely intertied with each other so as to provide a substantially one-piece construction.

3. In a silencer for use with the exhaust system of an internal combustion engine, the combination of: a tubular muffler body; an inlet and an outlet connected to opposite ends of said body for conducting exhaust gases thereto and away therefrom; one set of baffles extending transversely of the width of said body to a point substantially midway between opposite sides thereof, said baffles being disposed in spaced relationship relative to each other along the length of said body and secured to one side of the interior thereof; another set of baffles extending transversely of the width of said body in the opposite direction to said point substantially midway between said op-

posite sides of the body and interposed between and spaced from adjacent baffles of said one set and secured to the opposite side of the interior of said body; a plurality of bracing members interconnecting the inner edges of each of said baffles with the inner edge of each adjacent baffle; and a pair of brace members extending between the inner edge of each of the end baffles and the muffler body, whereby all of said baffles and said muffler body are securely intertied with each other so as to provide a substantially one-piece construction.

4. In a silencer for use with the exhaust system of an internal combustion engine, the combination of: a tubular muffler body; an inlet and an outlet connected to opposite ends of said body for conducting exhaust gases thereto and away therefrom; one set of baffles extending transversely of the width of said body to a point substantially midway between the opposite sides of the body and secured to one side of the interior thereof; another set of baffles secured to the opposite side of the interior of said body extending transversely of the width of said body to a point substantially midway between opposite sides thereof and interposed between adjacent baffles of said one set; and means spacing each of said baffles from each adjacent baffle a distance equal to at least one-half the width of said body.

5. In a silencer for use with the exhaust system of an internal combustion engine, the combination of: a tubular muffler body; an inlet and an outlet connected to opposite ends of said body for conducting exhaust gases thereto and away therefrom; one set of baffles extending transversely of the width of said body to a point substantially midway between opposite sides of the body and secured to one side of the interior thereof; and another set of baffles secured to the opposite side of the interior of said body extending transversely of the width of said body to a point substantially midway between opposite sides thereof, said other set of baffles being interposed between and spaced from adjacent baffles of said one set.

HAROLD D. SMITH.