Jan. 3, 1961 R. B. SMITH ET AL 2,966,955

MUFFLER

Filed Aug. 13, 1958

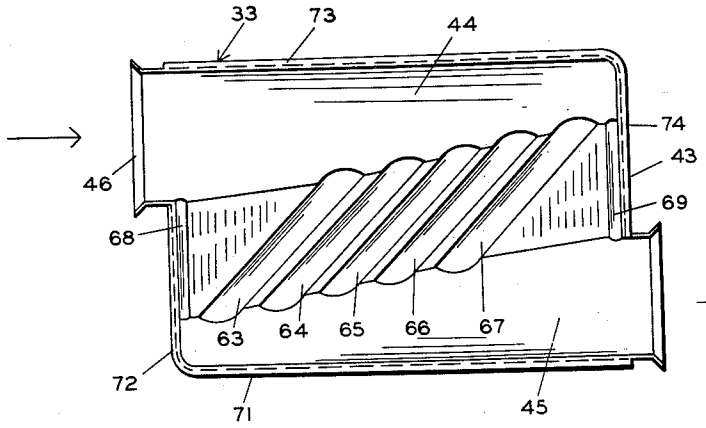


FIG. 4

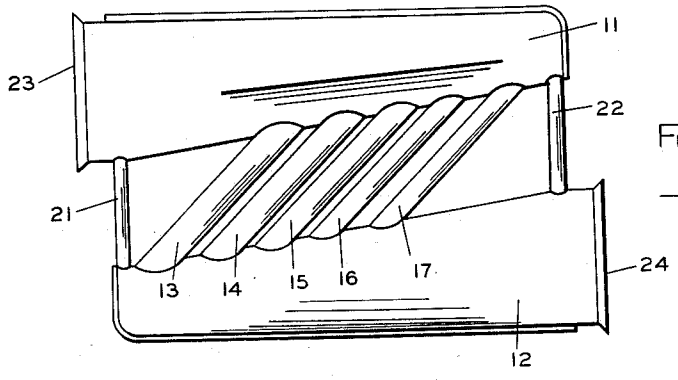


FIG. 1

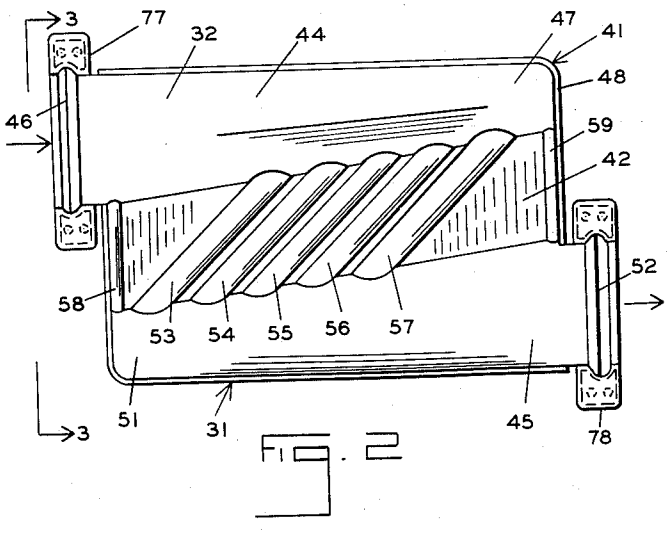


FIG. 2

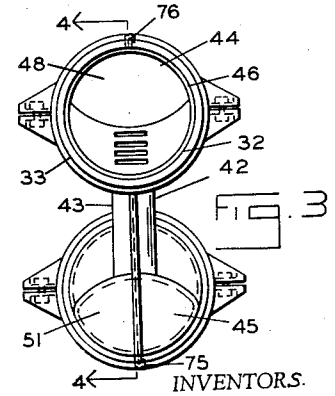


FIG. 3

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MUFFLER

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2 Claims. (Cl. 181—53)

The invention disclosed and claimed in this application relates to devices for dampening pulsation and for cooling heated gases. Such devices include for example, mufflers and exhaust silencers for combustion engines and particularly for automotive engines. Many attempts have been made to produce an exhaust muffler which will eliminate the noise of exhaust gases and which will cause but little back pressure on the motor. Most of these attempts have been based upon the gradual expansion principle according to which exhaust gases are allowed to expand gradually before they are exhausted in the atmosphere to reduce their temperature and pressure, or upon the principle of attempting to break up or sub-divide the stream of gases in order to reduce the noise of the exhaust.

The mufflers disclosed in this application as embodiments of our invention are generally mufflers of the subdivision type but employ both of the above principles in cooling and dampening and are designed expressly for use on present day multi-cylinder engines of the internal combustion type using diesel oil, gasoline, or propane as a fuel. Many of the prior art mufflers of the subdivision type were built upon the principle of providing baffles within the muffler which oppose passage of gases immediately on entering the muffler. About 1946 the largest truck engine in common use had a 416 cubic inch displacement with a top speed of 2100 r.p.m. and a compression ratio of 6 to 1. The common exhaust pipe size at that time was less than three inches diameter (usually about 2½ inches), but in 1958 we have truck engines having 535 cubic inch displacements operating at 3000 r.p.m. with a compression ratio of 8 to 1 and developing around 250 h.p. In 1945 the gasoline used was formed with a tetraethyl lead additive which encouraged slow burning. Today we add boron compounds to the fuel which encourages rapid burning and resists pre-ignition by compression heat. This new gas is extra hot. The new engines are fast with high compression ratios, and discharge gases extremely rapidly so that pressure puffs are created and will remain separated until they are cooled and compressed or are otherwise smoothed out. The exhaust pipe sizes range from 3½ to 4 inches which expedites the flow of gas from the engine, but puts more burden upon the mufflers. Present day mufflers of prior art designs are inadequate to handle this extreme heat because they employ baffles and they take the first impact at one spot on the first baffle and ordinary metals employed in the baffles will not withstand all of the heat imposed upon them, especially where these baffles are confined within the interior of the muffler and are not subject to cooling air flowing over them. After the first baffle is burned out the second it attacked, etc. Internal parts in present day mufflers burn up completely in a very short time. So the problem today is not only reduction of noise but more importantly the reduction of heat.

One of the objects of our invention is the provision of a new and improved pulsation dampener or heat reducer

of the type of mufflers or silencers for multi-cylinder engines of the combustion type today used on heavy duty trucks.

A further object of our invention is the provision of a muffler of the type above described which is extremely resistant to the high heat produced under present day conditions.

This is accomplished largely by gradually reducing pressure and consequently velocity by drawing off portions of the hot gases through a plurality of tubes interconnecting the inlet and outlet chambers of the muffler. These tubes are so situated and graduated that they progressively reduce the pressure and velocity. This also results in the reduction of heat inasmuch as the outsides of the inlet and outlet chambers and of the interconnecting tubes are always exposed to cooling air. The shape of the outside of the muffler encourages rapid cooling.

A further object of our invention is the provision of such a muffler that may be manufactured at a relatively low cost.

A further object of our invention is the provision of a muffler which directs the gases through a plurality of predetermined S-shaped paths and step by step positively smooths out the pressure puffs produced by the internal combustion engine.

A further object of our invention is to provide a muffler with inlet and outlet chambers or conduits which are tapered or graduated so that the area is substantially proportionate to the area of the tubes or interconnecting conduits available at that point in the chambers.

A further object of our invention is the provision of a muffler in which every part exposed to heat is also exposed to cooling air thus reducing temperatures rapidly.

A further object of our invention is to provide a muffler of small size, light weight, and economical to manufacture which is effective to remove and cool the exhaust gases and to silence the exhaust noises within a reasonable time.

A further object of our invention is to provide a muffler which is universal in the sense that it is usable with engines of various sizes and having various sized exhaust pipes.

A further object of our invention is to provide a muffler which avoids the use of any baffling of any kind within the interior of the muffler especially baffling which absorbs the first impact of the hot gases.

A further object is to provide a muffler which slows the velocity of the hot gases and cools them.

A further object of our invention is to provide a muffler in which the inlet is located in a part of the muffler higher than the outlet to avoid trapping of condensation and thus to avoid excessive rust-out of the muffler.

Further objects and features of our invention will be apparent from the following specification and claims when considered in connection with the accompanying drawings.

In the drawings we have shown two embodiments of our invention.

In the drawings:

Fig. 1 is a view in side elevation of one embodiment of our invention;

Fig. 2 is a view in side elevation of a different embodiment of our invention;

Fig. 3 is a view in end elevation taken from substantially along the line 3—3 of Fig. 2 showing the embodiment of our invention disclosed in Fig. 2; and

Fig. 4 is a view in side elevation of a sheet metal stamping used in forming the muffler of the embodiment of our invention shown in Figs. 2 and 3.

No available present day mufflers can stand the high

heat of present day motors used on large trucks for any extended time. Running at full power a 500 cubic inch engine runs with the exhaust manifold and the exhaust pipe cherry red (i.e. approximately 1200° F.). One truck in use today has an exhaust which measures 1700° F. at the exhaust pipe. It is thus necessary that both the pressure and the temperature be reduced without the use of baffles or other obstructions as such baffles and other obstructions burn out usually in two or three weeks time on a steady truck haul. Mufflers constructed according to our invention have been tested on the dynamometer and have stood such tests with 500 cubic inch engines and have resisted burning up tendency in the same manner as the exhaust pipes do. Our mufflers are basically return tube mufflers forcing the gases into an S flow in which the flow of gases is first separated and then united. Cross passages are provided at each end of the muffler which prevent gathering of condensation.

Referring now to the drawings for a detailed description of the embodiments of our invention shown, it may be seen that we have shown in Fig. 1 a muffler comprising an inlet tube, chamber, or conduit 11, an outlet tube, chamber, or conduit 12, and sloping interconnecting conduits or tubes 13, 14, 15, 16 and 17. These interconnecting conduits or tubes 13–17 inclusive slope downward toward the inlet end of the muffler. They are welded to the inlet conduit 11 and the outlet conduit 12 so that their end openings register with openings formed in the inlet and outlet conduits. It is to be noted that the tubes toward the right (e.g. tube 17) are smaller in diameter than the tubes adjacent the left (e.g. 13). Cooling air passes over these tubes so that in spite of the high heat of the gases therein they withstand the heat and are very effective in cooling and contracting the hot gases. In addition to the sloping conduits 13 to 17 inclusive, we provide perpendicular tubes or conduits 21 and 22, the former being provided at the front or inlet end of the muffler and the latter provided near the outlet end thereof. These perpendicular conduits serve partly for the transmission and cooling of hot gases from the inlet conduit to the outlet conduit, but also serve to insure that condensation products shall drain from the upper inlet conduit to the lower outlet conduit. The inlet conduit 11 has a relatively large inlet opening 23 and the outlet conduit 12 has a relatively large outlet opening 24 which however is smaller than the inlet opening 23.

In Fig. 2 we have shown another embodiment of our invention in which instead of having separated inlet and outlet tubes joined by interconnecting tubes welded thereto, we form our improved muffler to two complementary shells clamped or secured together in any convenient manner. As shown, the embodiment in Fig. 2 has two shells with flanges which are crimped to each other by such flanges and also secured to each other by clamps around the necks of the inlet and outlet ends of the conduits. However, any convenient manner of securing the two shells together would be satisfactory. This embodiment comprises a muffler 31 having a pair of shells such as the shell 32 shown in Fig. 2 and Fig. 3, and such as the shell 33 shown in Figs. 3 and 4.

The two shells cooperate to form an upper inlet conduit 44 and a lower outlet conduit 45. It may be seen that the inlet conduit 44 tapers from a relatively large inlet opening 46 to a smaller opposite portion 47 which is closed as at 48. The outlet conduit 45 tapers from a relatively small closed end 51 to a relatively large outlet opening 52. Connecting the inlet conduit with the outlet conduit are a plurality of interconnecting conduits formed by grooves in each of the castings. The outline of these interconnecting conduits is shown in Fig. 2 at 53, 54, 55, 56 and 57. The conduits 53–57 inclusive, are all sloping downward to the left and respectively connect and lead from the smaller portion of the inlet conduit 44 toward the smaller portion of the outlet conduit 45. In addition to the sloping conduits 53–57 inclusive, we also provide adjacent the ends of the inlet and outlet conduits smaller perpendicular conduits 58 and 59 which also serve to aid in the function of passing the heated gases from the inlet conduit 44 to the outlet conduit 45 and thus supplement the conduits 53–57 inclusive, in this respect, but also are primarily constructed for the purpose of insuring that condensation shall be conveyed from the inlet conduit 44 to the outlet conduit 45 and thence driven out with the passage of exhaust gases. The provision of tubes 13 to 17 and 53–57 gives a longer path for the gases in a given dimension and thus aids in cooling. The S-shaped path also slows down the passage of the gases.

In Fig. 4 we have shown the construction of one of the shells (i.e. 33) which together with the complementary shell forms the muffler 31. It may be seen that this shell 33 is provided with grooves 63 to 67 inclusive, which cooperate with similar grooves in the complementary shell section 32 to form the conduits 53 to 57 inclusive, respectively. It is also provided with grooves 68 and 69 which cooperate with corresponding grooves in the complementary shell 32 to form the conduits 58 and 59 respectively.

As shown in Figs. 2 and 4 we provide flanges 71, 72, 73 and 74 on the stamping 33. These flanges cooperate with similar flanges on the complementary stamping 32 and are crimped in the manner shown at 75 and 76 to secure the two stampings to each other and thus form the integral muffler. Clamps 77 and 78 secured around the necks of the inlet 46 and the outlet 52 also aid in securing the two stampings to each other.

We prefer that the total area of the tubes 13 to 17 inclusive (or the tubes 53–57 inclusive) shall at least equal the total area of the inlet port 23 (or the inlet port 46) of the inlet conduits or chambers. Thus we use a large number of small diameter tubes. We prefer as shown in Fig.1 that the connecting tubes nearer to the inlet end shall be larger in diameter than the connecting tubes at or near the outlet end. However, in the interests of economy and simplicity at times we use tubes of the same diameter from front to rear of the muffler, and at times for the same reasons, we also use less area in the connecting tubes than at the inlet relying on the reduction of volume of the gases as they cool to reduce back pressure. Thus in one muffler constructed according to our invention, we used 25 connecting tubes each having an internal diameter of 9/16 of an inch with a manifold having an inlet port in the inlet chamber having a four-inch internal diameter. This muffler weighed twelve and one-half pounds and was 22 inches long. It reduced the noise of the engine to the acceptable range and was within the acceptable range of back pressure. It took the place of a muffler weighing 37 pounds, which was 42 inches long and 9 inches in diameter. It operated with equal or better efficiency. We prefer that an adapter be used at the outlet of our muffler which will further contract the gases into a smooth stream.

We prefer to have enough interconnecting tubes and/or tubes having a relatively large internal diameter relative to the internal diameter of the inlet port of the inlet chamber so that the area of the interconnecting tubes at least equals the area of the inlet port. Thus, for an inlet chamber having an internal diameter of four inches, we prefer to use about 25 connecting tubes having from 3/4 to 4/5 inches internal diameter. We prefer for mufflers having about 3 inch internal diameter at the inlet port of the inlet chamber to use about 25 connecting tubes each having internal diameter of about 9/16. Of course, in the drawings we have shown only five or six connecting tubes. This is for the reason that the showing of a larger number would unnecessarily complicate the drawings. It is to be understood, however, that the area of the cross-section of the connecting tubes equals, or is greater than, the area of the cross-section of the inlet port.

It is to be understood that the above described embodiments of our invention are for the purpose of illus-

tration only and various changes may be made therein without departing from the spirit and scope of the invention.

We claim:

1. A muffler for internal combustion engines comprising a substantially horizontal inlet conduit open at one end and closed at the opposite end into which exhaust gases enter at the open end of said inlet conduit and pass into said conduit toward the closed end thereof, said conduit tapering from a relatively large open end to a relatively small closed end; and a substantially horizontal outlet conduit arranged below and parallel to the inlet conduit and also open at the outlet end and closed at the opposite end, said open end being at the opposite end of the device from the open end of the inlet conduit and tapering from a relatively large open end to a relatively small closed end; and a plurality of sloping connecting conduits interconnecting said inlet and outlet conduits, through which exhaust gases flow from said inlet conduit to said outlet conduit and then toward and out of the open end of said outlet conduit wherein a plurality of the interconnecting conduits slope downwardly and rearwardly from the closed end of the inlet conduit toward the closed end of the outlet conduit whereby the greater portion of said exhaust gases follow an S path through said muffler wherein a plurality of the interconnecting conduits extend substantially perpendicularly between said inlet conduit and said outlet conduit and wherein the sloping tubes near the inlet end of said muffler are larger in diameter than the sloping tubes nearer to the outlet end; wherein the average cross-sectional area of each one of said interconnecting conduits is individually less than the average cross-sectional area of said inlet conduit; wherein the total cross-sectional area of all of the interconnecting conduits is at least as great as the greatest cross-sectional area of said inlet conduit and at least as great as the greatest cross-sectional area of the outlet conduit; and said device being formed of two complementary stamped plates secured to each other.

2. A muffler for internal combustion engines comprising an inlet conduit open at one end and closed at the opposite end into which exhaust gases enter at the open end of said inlet conduit and pass into said conduit toward the closed end thereof; an outlet conduit arranged parallel to the inlet conduit and below the inlet conduit and open at its outlet end and closed at the opposite end through which exhaust gases pass forward and then out of the open end and of which the open end of said outlet conduit is at the opposite end of the device from the open end of the inlet conduit; a plurality of sloping connecting conduits interconnecting said inlet and outlet conduits through which exhaust gases flow from said inlet conduit to said outlet and then toward and out of the open end of said outlet conduit wherein the interconnecting conduits slope from the closed end of the inlet conduit toward the closed end of the outlet conduit at an acute angle to the inlet and outlet conduits, whereby the greater portion of said exhaust gases follow an S path through said muffler; and a drain conduit extending substantially perpendicularly between the said inlet conduit and said outlet conduit.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,966,955 January 3, 1961

Roy B. Smith et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 49, for "muffler to" read -- muffler of --.

Signed and sealed this 5th day of September 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

USCOMM-DC

UNITED STATES PATENT OFFICE

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