Nov. 28, 1967 W. A. MOSS ETAL 3,354,986

MUFFLER WITH FRUSTO-CONICAL BAFFLE MEMBERS SPACED ALONG CENTRAL TUBE

Filed July 21, 1965

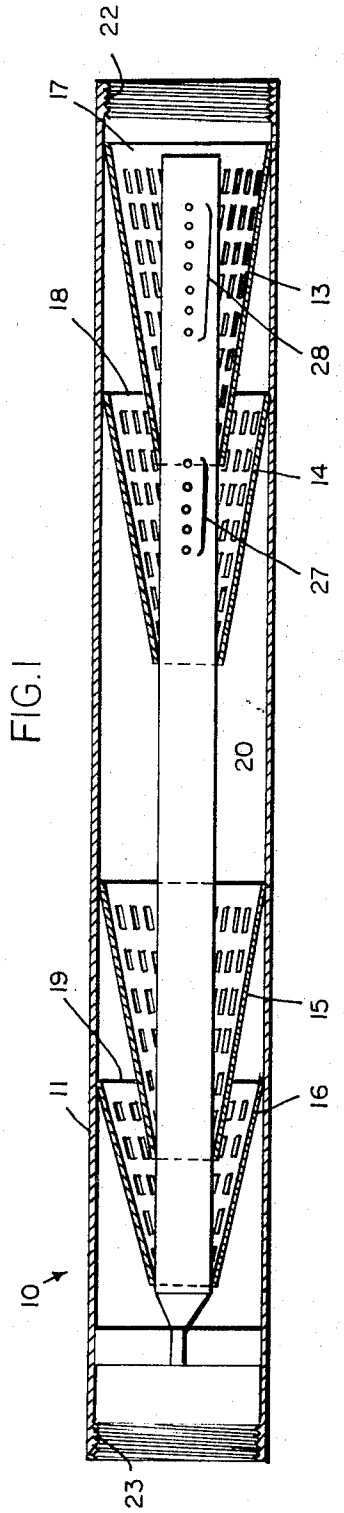

FIG. 1

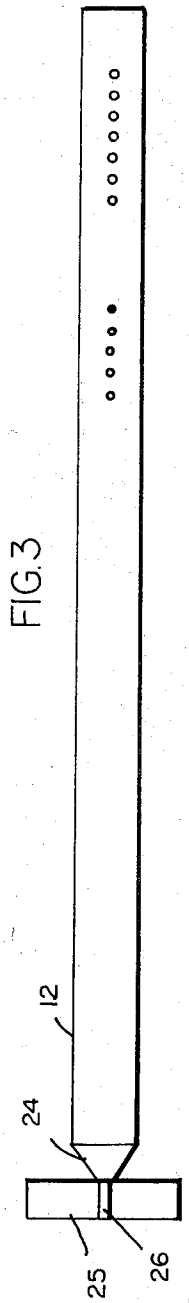

FIG. 3

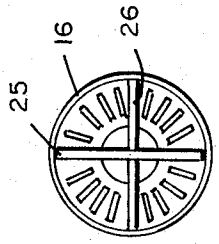

FIG. 4

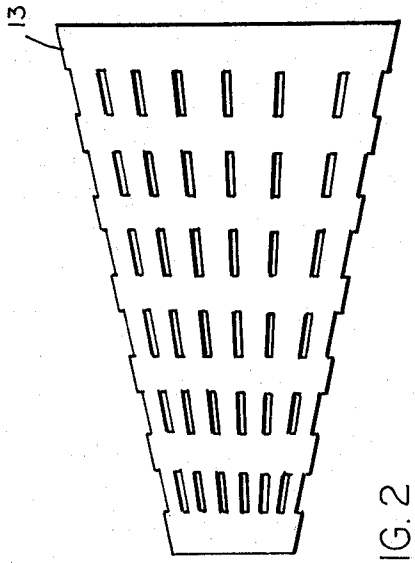

FIG. 2

INVENTORS
WILLIAM A. MOSS
ROSE E. GRIFFIN
BY
Wolf, Greenfield & Hieken
ATTORNEYS

United States Patent Office

3,354,986

Patented Nov. 28, 1967

3,354,986
MUFFLER WITH FRUSTO-CONICAL BAFFLE MEMBERS SPACED ALONG CENTRAL TUBE

William A. Moss and Rose E. Griffin, Lafayette, La., assignors, by direct and mesne assignments, of fifty percent to said Moss, twenty-five percent to James D. Parkerson, and twenty-five percent to J. Arthur Roy, all of Lafayette, La.

Filed July 21, 1965, Ser. No. 473,631
9 Claims. (Cl. 181—57)

The present invention relates to mufflers for internal combustion engines and more particularly to a novel and improved muffler structure which is highly effective in reducing unwanted noise generated by exhaust gasses from an internal combustion engine while creating only a small amount of back pressure thereby enabling efficient, economical operation of an internal combustion engine.

Various muffler designs are well known in the internal combustion engine art. These mufflers are normally constructed to minimize back pressure and noise due to expanding gasses. Many of these mufflers employ divided flow passageways for exhaust gasses but all have met with certain problems. In some cases back pressure produced by such mufflers is unnecessarily high and/or noise reduction is not maximized.

It is an important object of the present invention to provide a new and improved muffler construction which enables quiet, economical operation of an internal combustion engine. Another important object of this invention is to provide a muffler in accordance with the preceding object which can easily be taken apart for cleaning when desired and reassembled with ease.

Still another object of this invention is to provide a muffler in accordance with the preceding objects which is highly compact with minimized cross sectional area facilitating its compact mounting on an automobile or other apparatus with which it is used.

According to the invention, the muffler comprises an elongated tubular, imperforate casing defining an outlet opening and an inlet opening aligned therewith. A tube extends substantially axially of the casing and has a closed end spaced within and apart from the outlet opening. A plurality of frusto-conical members surround the tube and extend between the tube and the casing to define at least two overlapping gas expansion chambers. At least two of the plurality of frusto-conical members are spaced apart intermediate the outlet and inlet openings to define a flow chamber of larger volume than either of the expansion chambers and arranged in axial alignment with the expansion chambers. Apertures are provided in the frusto-conical members and in the centrally located tube to provide a gas flow passageway from a portion of the tube adjacent the inlet opening through the expansion chambers and the flow chamber to the outlet opening.

In the preferred embodiment, two overlapped frusto-conical members are provided at one end of the casing and two frusto-conical members are provided at the other end with a space extending between the pairs of frusto-conical members. This space acts as a flow chamber to decrease muffler back pressure and thereby permit economical operation of the internal combustion engine with which the muffler is used.

These and other objects, features and advantages of the invention will become apparent from the following specification and attached drawings in which:

FIG. 1 is a cross sectional view taken on a vertical plane through the center of a preferred embodiment of the muffler of this invention;

FIG. 2 is a side view of an element thereof;

FIG. 3 is a side view of another element thereof; and

FIG. 4 is a rear view of a frusto-conical element as

shown in FIG. 2 with the element of FIG. 3 positioned therein.

With reference now to the drawings a preferred embodiment of the muffler of this invention is illustrated at **10** and comprises an imperforate casing **11** containing an inner axially aligned tube **12** having surrounding frusto-conical members **13**, **14**, **15** and **16** extending from the tube **12** to the inner surface of the casing **11**. The frusto-conical members are arranged to extend axially of the casing as best shown in FIG. 1 dividing the casing into expansion chambers **17** and **18** spaced from a forward expansion chamber **19** with a flow chamber **20** intermediate thereof.

The imperforate casing **11** is preferably a cylindrical pipe composed of a high temperature resistant material such as solid copper pipe type K. Means such as threads **22** and **23** are carried at inlet and outlet ends of the casing respectively. Since the casing **11** is circular in cross section, and all flow through the elongated muffler is substantially from end to end thereof, a minimum cross sectional area for the outer configuration of the muffler may be maintained. Suitable adapters (not shown) are provided for the ends of the muffler to attach an exhaust pipe from the manifold on a threaded flange with the exhaust pipe abutting the rear end of the central tube **12** and with a tail pipe attached to the outlet end **23** through a suitable reducing flange.

In the specific example of this invention, casing pipe **11** preferably has an inside diameter of 2⅜ inches with an outside diameter of 2⅝ inches being a solid copper seamless pipe having a length of approximately 21 inches.

The inner tube **12** is preferably a solid copper pipe which extends axially of and within the outer casing having a closed forward end pinched together at **24** as best seen in FIG. 3. The pinched together end **24** is provided with crossed plates **25** and **26** which act to center the pipe within outer tube **11** as will be described. Plates **25** and **26** are welded or otherwise fixed to the pinched end **24**. The copper pipe **12** of the preferred embodiment has an outside diameter of ⅞ inch and a series of perforations extending from ½ inch of its end adjacent the intake end of the casing in a first and second group towards the closed end. Perforations **27** lie within the frusto-conical member **14** and preferably comprise four rows of five circular openings with the rows spaced approximately 90° about the circumference of the pipe. The group of perforations **28** preferably comprises four rows of seven openings aligned with the rows of group **27** with all of the openings preferably having a diameter of ⅛ inch. The particular material of the tube **12** as well as its dimensions may vary considerably depending upon the particular size engine with which the muffler is used as may the dimensions of other elements of the mufflers while their relative dimensions to each other are preferably substantially as described. The spacing, number, size and location of the holes **27** and **28** within baffles **13** and **14** is important for optimum operation of the invention.

The frusto-conical members **13**, **14**, **15** and **16** act as baffles to provide expansion chambers and a flow chamber within the muffler. Each of the baffles preferably has a large or base end outside diameter approximately ¼ inch greater that the inner diameter of the casing **11** and a small end inner diameter approximately ¼ inch less than the outside diameter of pipe **12**. The baffle members may be made of any heat resistant material such as 16 ounce copper and can be formed with a welded or soldered seam. Each baffle preferably has a length of approximately 4 inches in the preferred embodiment with the extreme end baffle nearest the intake end having a length approximately 10% longer. Each of the baffle members with the exception of the two central members are over-

lapped or inserted into one another for a distance of approximately 1 inch.

The baffles contain a series of perforations which are preferably elongated slots extending in thirteen rows equally spaced about the circumference thereof with approximately 5 slots of .07 square inch area in each baffle row. In some embodiments, the smaller diameter opening of the baffle members are soldered or welded to the tube **12**. The forward baffle member **16** is provided with a closed end cap formed by end **24** and the plates **25** and **26** may be welded or tightly fit within the inside of outer tube **11** as best shown in FIGS. 1 and 4 to centrally locate both the baffle and the pipe within the tubular casing. Preferably the perforations extend within the baffles approximately ⅝ inch from the casing **11** and approximately ⅜ inch from the tube **12**. While these dimensions are not absolute as previously described, they give best results in the preferred embodiment of the invention.

The baffle members **13**, **14**, **15** and **16** are preferably force fit over pipe **12**. In all cases the metallic baffle members are welded or braised to pipe **12**. The assembled baffle members and pipe are then positioned in the casing **11** where they are held in place by a force fit since the diameters of the baffle members and plates **25** and **26** are slightly greater than the casing **11**. Thus the baffle members are preferably formed of a relatively thin resilient metal such as copper or a copper alloy. Due to the force fit assembly the muffler can be easily taken apart for cleaning when desired and later reassembled.

The spacing between baffle **14** and **15** is critical and provides for an enlarged flow passageway which is believed to create a partial vacuum during operation of the device to enhance flow of gasses from the expansion chambers **17** and **18** through the muffler. It is important that this chamber be formed with a spacing between facing ends of adjacent baffles greater than one half the axial length of the shortest baffle employed. The flow passageway includes the space between the outer surface of the concentric tube **12** and the inner surface of the outer wall of casing **11**. In the preferred embodiment the axial distance that the flow chamber **20** extends between ends of its adjacent baffle members is 3¼ inch. Preferably the ratio between the axial uninterrupted length of the flow chamber **20** between its adjacent baffles, to the distance represented by the length of an adjacent baffle plus the length of the flow chamber is approximately 3¼ to 7¼.

In operation of the muffler of this invention, gasses from the manifold of an internal combustion engine are passed into the inner tube **12** in the direction of the arrows shown. Some of these gasses will go immediately into the expansion chambers while the greater percentage of the gasses will flow towards the forward end to create a zone of churning gasses within the pipe in the forward baffle member **16**. This churning action causes more of the gasses from the engine to flow through openings **27** and **28** directly into the expansion chambers **17** and **18**. The baffles inhibit the sudden discharge of expanding gasses by means of redirecting, reflecting and controlling the passage of gasses through the muffler. From the expansion chambers **17** and **18** a slight vacuum created in flow chamber **20** will draw the gasses therethrough and allow them to pass onwardly into expansion chamber **19** and out of the muffler through exhaust end **23** to the tailpipe when used. Thus gasses pass through holes **27** and **28**, baffles **13**, **14**, chamber **20**, baffle **15** and out through baffle **16**. This flow pattern is significant in providing for reduced back pressure within the muffler while allowing rapid expansion and expulsion of gasses. In addition, the multiple chambers provided act to acoustically trap vibrations caused by pulsing of the motor and also act as vibration absorbers to smooth the pulsing out into a smooth pulse pattern thereby deadening the noises created by explosion of the gasses within the motor.

While a specific embodiment of this invention has been

shown and described, it should be understood that many variations thereof are possible. For example, the specific number of baffle members can be varied so long as at least one enlarged flow chamber is provided interspaced between baffle members. In some cases where extremely large volumes of exhaust gasses must be muffled and dispersed, two or more flow chambers can be made in a muffler construction in accordance with the present invention. Similarly larger numbers of expansion chambers can be formed by the use of additional baffle members. Sizes and dimensions may vary preferably consistent with the proportions of the values given.

In view of the many variations possible, this invention is to be limited only by the spirit and scope of the appended claims.

What is claimed is:

1. A compact muffler comprising an elongated tubular, imperforate, casing defining an inlet opening and an outlet opening aligned therewith,

a tube extending substantially axially of said casing and having a closed end spaced within and apart from said outlet opening,

a plurality of frusto-conical members surrounding said tube and defining at least two overlapping expansion chambers and acting as baffle means,

at least two of said plurality of members being spaced apart intermediate said outlet and inlet openings to define a flow chamber of larger volume than either of said expansion chambers and arranged in axial alignment therewith,

and apertures defined by said members and said tube to provide a gas flow passageway from a portion of said tube adjacent said inlet opening through said expansion chambers and said flow chamber to said outlet opening.

2. A compact muffler in accordance with claim **1** wherein two pairs of frusto-conical members are provided,

said apertures defined by said tube being positioned within one of said pairs of frusto-conical members spaced substantially adjacent said inlet opening.

3. A compact muffler in accordance with claim **1** wherein said frusto-conical members are force fit within said casing whereby said muffler may be easily disassembled for cleaning.

4. A compact muffler in accordance with claim **2** wherein said apertures comprise two groupings of openings with one group in each of the frusto-conical members of said pair spaced substantially adjacent said inlet opening.

5. A compact muffler comprising an elongated circular, imperforate casing defining an inlet opening and an aligned outlet opening,

a tube extending substantially concentrically within said casing and having a first closed end substantially adjacent said outlet opening and a second opened end substantially adjacent said inlet opening,

a plurality of frusto-conical members surrounding said tube and defining at least two overlapping expansion chambers and acting as baffle means with apertures provided in said members interconnecting said chambers,

at least two of said plurality of members being spaced apart intermediate said outlet and inlet openings to define a flow chamber extending axially of said casing between said tube and said casing,

and apertures defined by said members and said tube to provide a gas flow passageway from a portion of said tube adjacent said inlet opening through said expansion chambers and said flow chamber to said outlet opening.

6. A compact muffler in accordance with claim **5** wherein four frusto-conical members are provided with two of said frusto-conical members being spaced apart from two others of said frusto-conical members to define said flow chamber whereby exhaust gasses entering said tube at said inlet opening flow through said two baffle members posi-

tioned substantially adjacent said inlet opening to said flow chamber and subsequently through said two members positioned adjacent said outlet opening whereby said members act as baffles to inhibit the sudden discharge of expanding exhaust gasses by redirecting, reflecting and controlling the passage of said gasses through said muffler.

7. A muffler in accordance with claim 6 wherein said closed end of said tube is pinched together and carries a plurality of plate means for positioning said tube centrally of said casing.

8. A muffler in accordance with claim 6 wherein said tube apertures comprise a first and second group,

said first group of apertures being surrounded by one baffle and comprising four circumferentially arranged axially extending rows with each row containing seven openings.

9. A muffler for use in conjunction with an engine which normally produces exhaust gasses,

said muffler comprising an elongated casing defining an inlet opening and an outlet opening aligned therewith,

a tube extending substantially axially of said casing and having a closed end spaced within and apart from said outlet opening and an opened end positioned within said casing spaced from said inlet opening,

a plurality of frusto-conical baffle members extending from said tube to said casing with said baffle members defining a plurality of apertures to provide an axially extending passageway through said muffler,

at least two of said plurality of members being spaced apart intermediate said outlet and inlet openings to define a flow chamber with others of said baffle members overlapping each other to provide expansion chambers,

said tube defining two groups of apertures each lying in separate baffle members near said inlet opening to provide for passage of exhaust gasses from said groups through said expansion chambers and said flow chamber to said outlet opening.

References Cited

UNITED STATES PATENTS

1,140,578	5/1915	Coulombe	181—47
1,953,123	4/1934	Oldberg et al.	181—57 X
1,991,014	2/1935	Compo	181—47
2,075,316	3/1937	Tyden	181—36
2,088,576	8/1937	Compo	181—47
2,263,407	11/1941	Kittell	181—63 X

FOREIGN PATENTS

160,334	3/1921	Great Britain.
229,509	2/1925	Great Britain.

ROBERT S. WARD, JR., *Primary Examiner.*