United States Patent

Nelson

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[54] **EXHAUST MUFFLER**

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[52] **U.S. Cl.**.....**181/58,** 181/53

[51] **Int. Cl.**.....**F01n 1/08**

[58] **Field of Search**.....181/35 R, 40, 49, 53, 54, 57–59, 181/63, 65, 66, 47 R, 69

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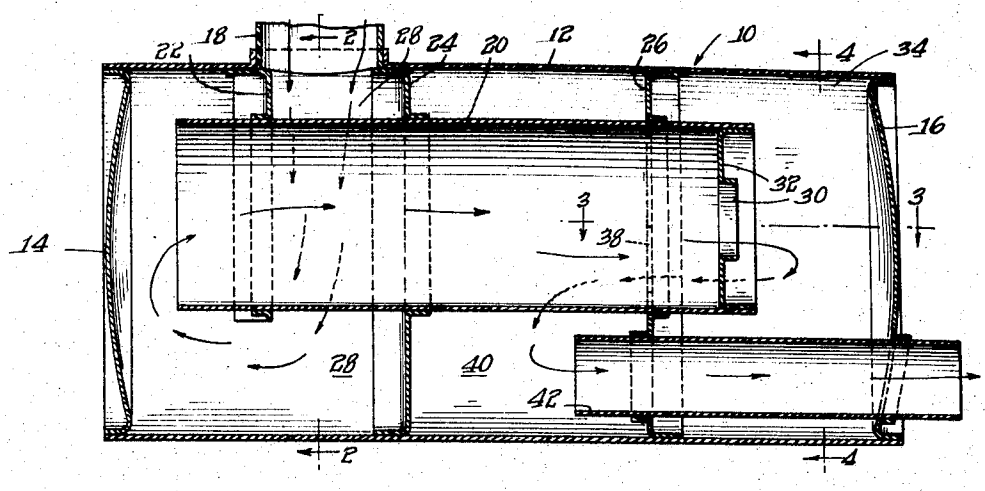
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[57] **ABSTRACT**

The present invention relates generally to improvements in mufflers, or silencers for internal combustion engines. The muffler device disclosed herein comprises an improved, compact and very unique expansion chamber for receiving exhaust gases directly from an internal combustion engine. This chamber accommodates a tube-like structure which is so disposed that gases initially received by the chamber are first directed against the periphery of the tube-like structure and then into a progressively increasing expansion area surrounding said tube structure.

10 Claims, 11 Drawing Figures



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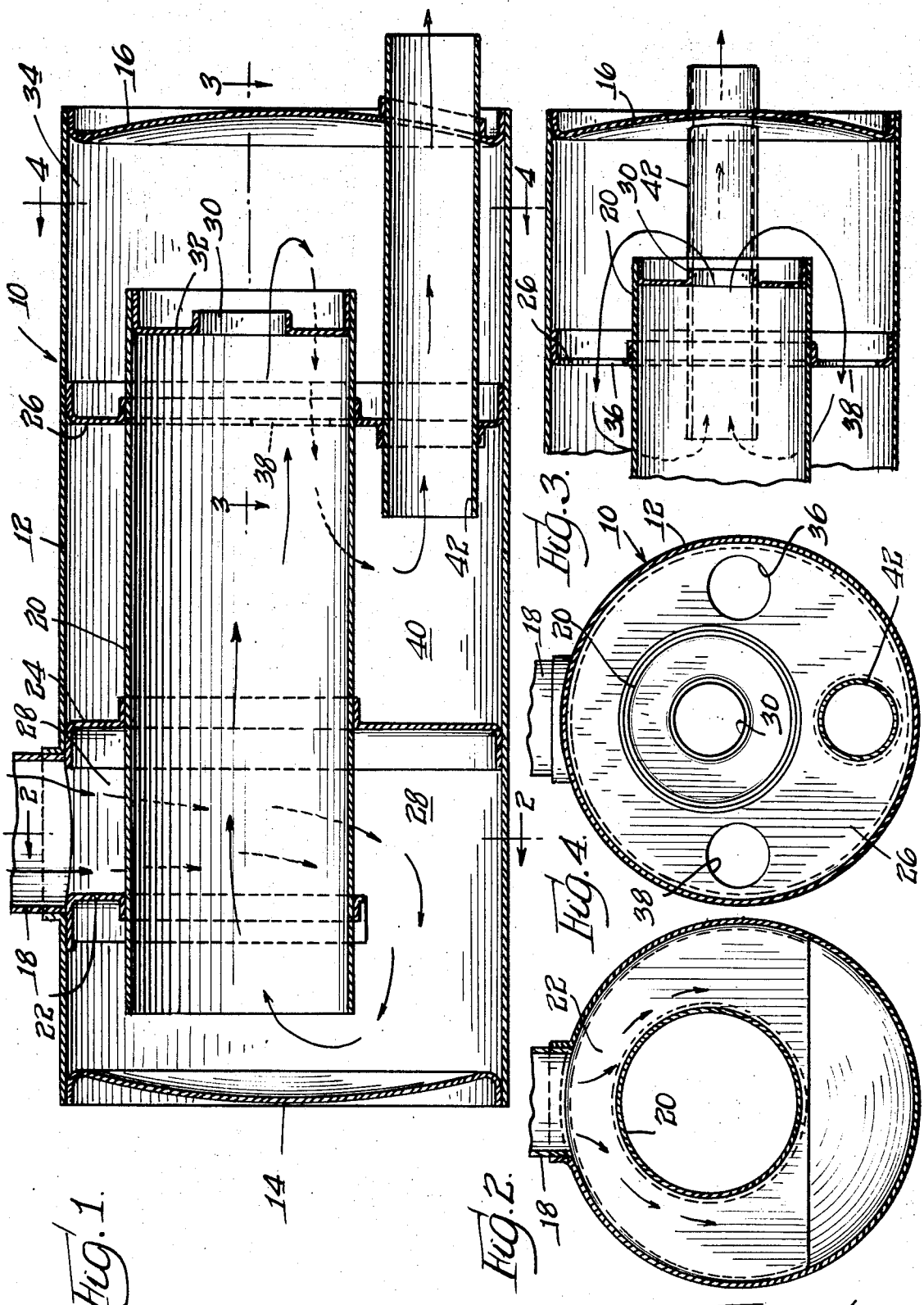


Fig. 1.

Fig. 3.

Fig. 4.

Fig. 2.

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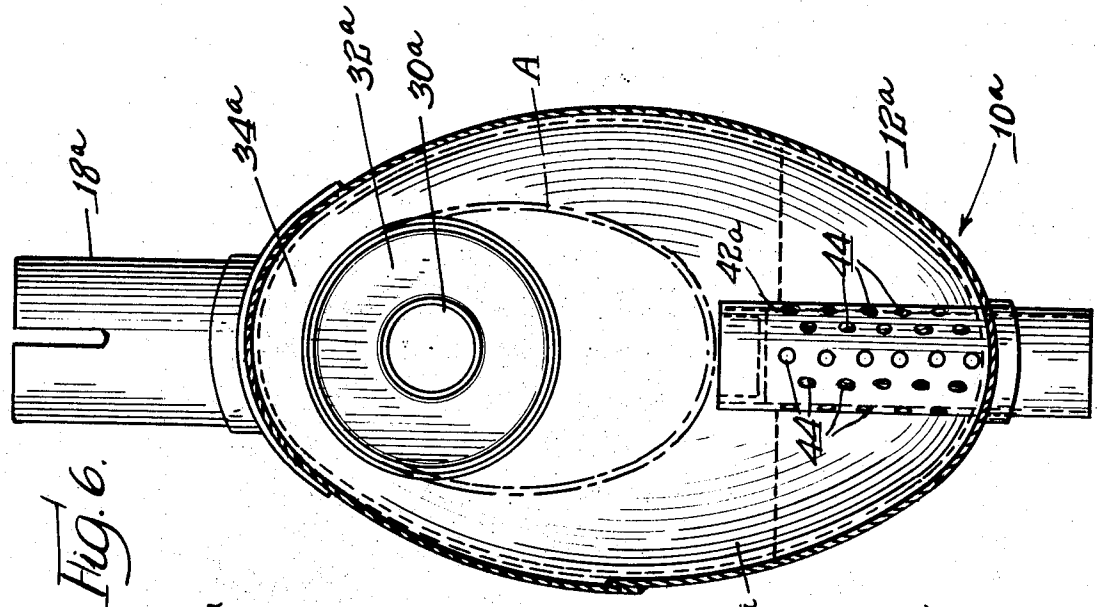


Fig. 6.

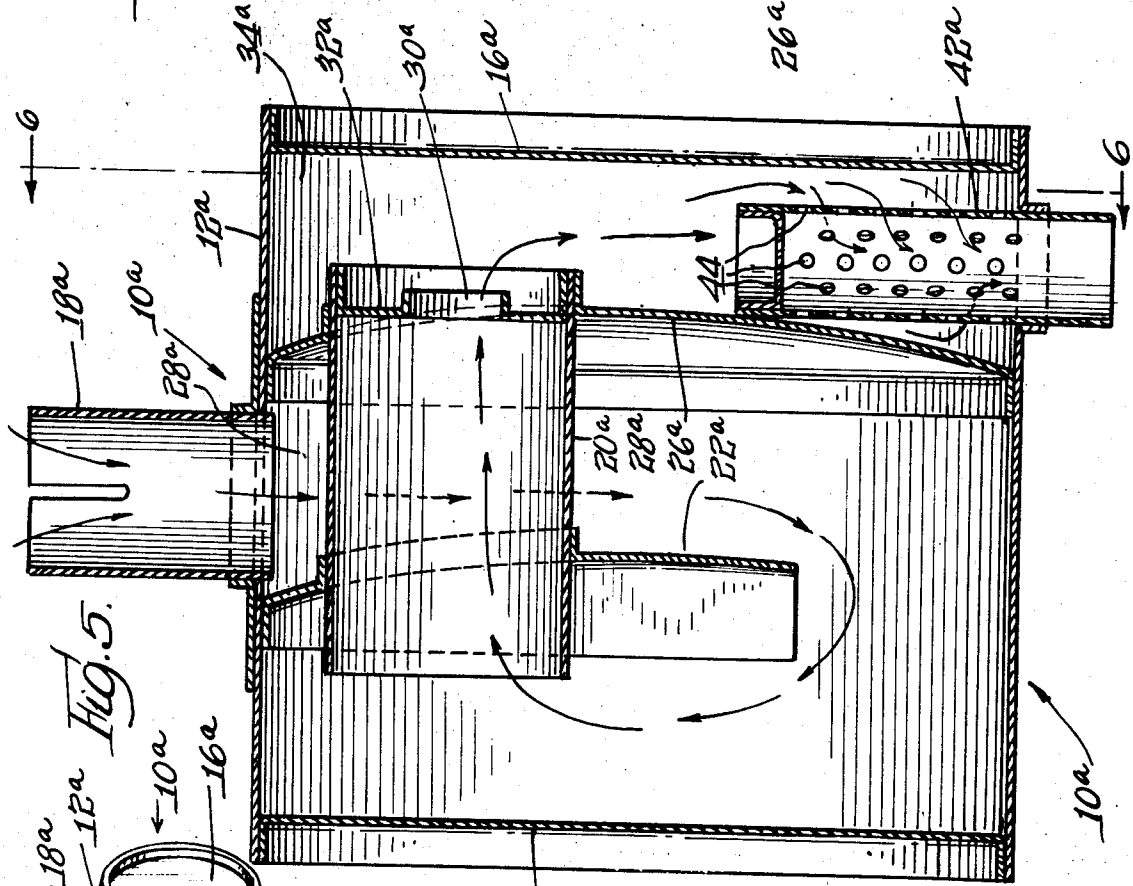


Fig. 5.

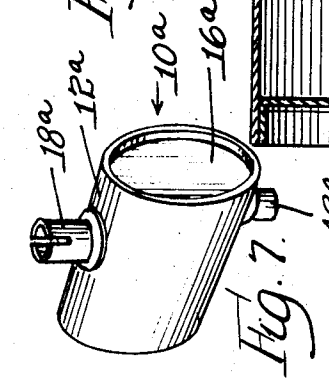
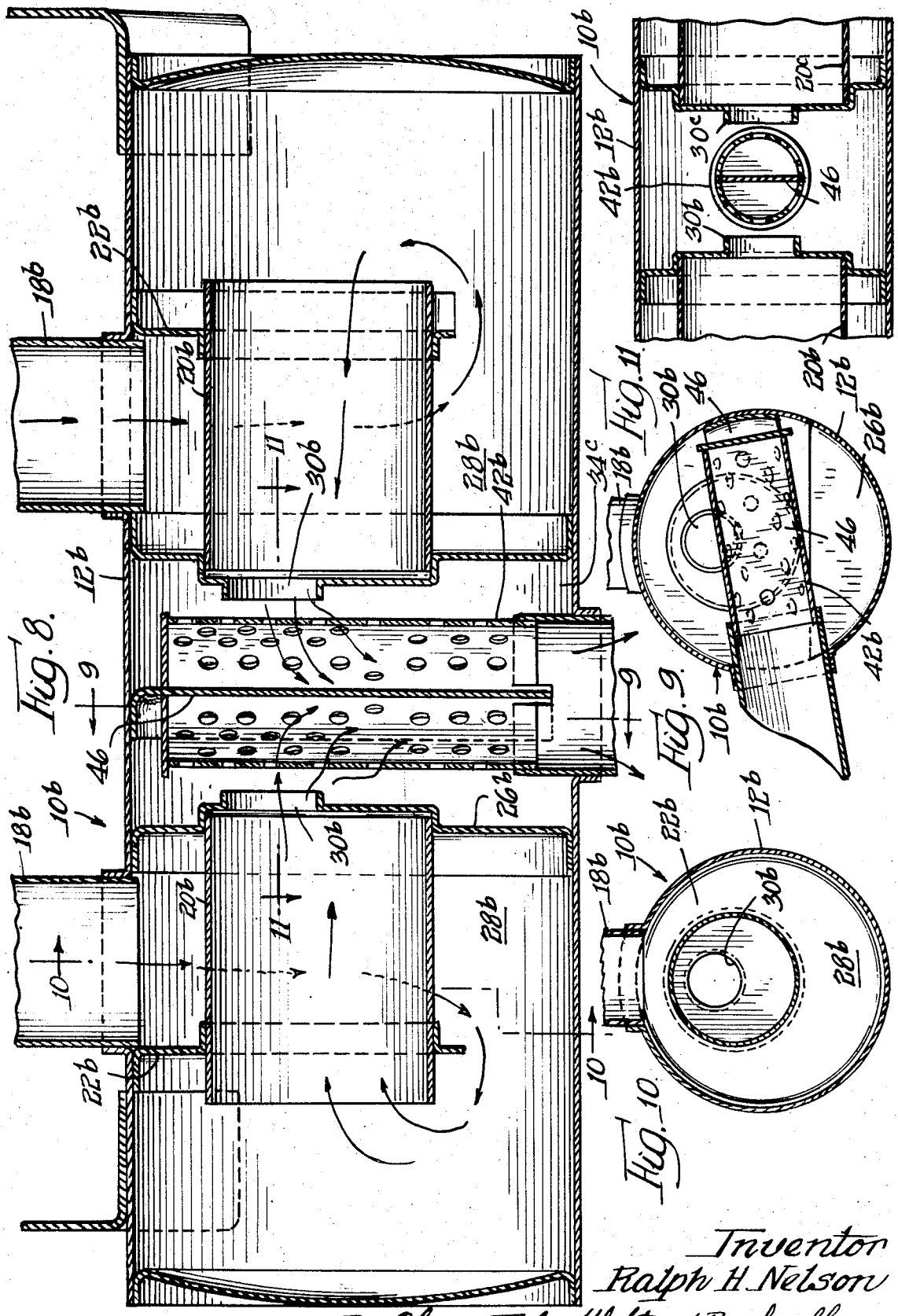


Fig. 7.

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EXHAUST MUFFLER

SUMMARY OF THE INVENTION

Mufflers heretofore in common use provide an expansion chamber into which exhaust gases are released for the purpose of controlling noise, flame suppression, and in some instances for improving engine performance. During each complete cycle of, for example, a two-stroke internal combustion engine, the exhaust gases are removed from the cylinder and the cylinder re-charged in readiness for the next cycle. Efficiency and power will be the greatest when the exchange cycle is completed at the highest possible cylinder pressure as the exhaust ports close. Bearing in mind that such engines operate at several thousand r.p.m., it will be apparent that the complete operating cycle occurs many times a second. Therefore, the exchange cycle takes place in a small fraction of a second.

During the exchange cycle of an internal combustion engine equipped with an expansion chamber for receiving exhaust gases several events occur substantially simultaneously such as a rise of pressure in the expansion chamber, the exchange of gases in the cylinder, and the lowering of pressure in the crankcase. It is important, therefore, that the expansion chamber for receiving the exhaust gases be designed to enable the engine to operate at high efficiency. The explosive noise of an internal combustion engine such, for example, as a two-cycle engine, may be reduced greatly be employing a muffler, the expansion chamber of which permits the sound waves to be properly reflected by the expansion chamber walls. A muffler which is properly "balanced" or "tuned" utilizes the pressure rise of the exhaust gases in the vicinity of the exhaust port to prevent fuel mixture from being withdrawn from the engine cylinder. In this manner, engine efficiency is maintained at a relatively high level.

The present invention, therefore, contemplates a muffler or silencer device for internal combustion engines which will function so as to increase the operating efficiency of the engine. To this end the present invention contemplates a unique and practical expansion chamber design.

It is a further object of the present invention to provide an improved exhaust control device, or muffler of the type set forth above which is of extremely simple and compact form.

More specifically, the invention contemplates improvements in mufflers for internal combustion engines, which will permit the initial exhaust gases to expand into a progressively increasing area without the necessity of employing conventional, elongate cone-type expansion chambers.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects and advantages will be more apparent from the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a central, longitudinal, sectional view of a muffler which is representative of one embodiment of the present invention;

FIG. 2 is a vertical, transverse, sectional view taken substantially along the line 2—2 of FIG. 1;

FIG. 3 is a fragmentary, horizontal, sectional view taken substantially along line 3—3 of FIG. 1;

FIG. 4 is a transverse sectional view taken substantially along the line 4—4 of FIG. 1;

FIG. 5 is a central, longitudinal, sectional view of a modified oval-type muffler contemplated by the present invention, having functional characteristics similar to the structure illustrated in FIGS. 1, 2 and 3;

FIG. 6 is a transverse, sectional view taken substantially along the line 6—6 of FIG. 5;

FIG. 7 is a reduced, perspective view of the muffler design shown in FIGS. 5 and 6;

FIG. 8 is a central, longitudinal sectional, view of a further modified form of muffler contemplated by the present invention which is particularly adaptable for use with a simultaneously firing two-cylinder engine;

FIG. 9 is a transverse, sectional view taken substantially along the line 9—9 of FIG. 8;

FIG. 10 is a transverse sectional view taken substantially along the line 10—10 of FIG. 8; and

FIG. 11 is a fragmentary horizontal sectional view taken substantially along the line 11—11 of FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The foregoing and other objects and advantages will be more apparent from the following detailed description when considered in connection with the accompanying drawings wherein FIG. 1 is a longitudinal, vertical, sectional view of an exhaust control device or muffler designated generally by the numeral 10. The muffler 10 includes a housing 12 having closure end plates 14 and 16. An inlet conduit 18 serves to direct exhaust gases from the cylinder of an internal combustion engine (not shown). Particular attention is directed to a tube-like section 20 supported by axially spaced baffle members or plates 22, 24 and 26. The axis of the tube-like section 20 is parallel and eccentrically disposed with respect to the longitudinal axis of the cylindrical housing 12.

It will be apparent from the foregoing that exhaust gases passing through the inlet member or conduit 18, as indicated by the directional arrows in FIG. 1, will be directed into engagement with the upper external peripheral surface of the tube-like section 20. By having the section 20 eccentrically positioned with respect to the axis of the housing 12, a circuitous expansion area 28 of progressively increasing size is presented between the outer periphery of the section 20 and the adjacent inner periphery of the housing. The tube-supporting member or baffle 24 defines one axial extremity of the expansion area 28, and the support member or baffle 22 defines the opposite axial extremity thereof. It will be noted that the lower portion of the support member 22 terminates short of the inner cylindrical surface of the housing 12 thereby permitting the flow of exhaust gases (as indicated by the directional arrows in FIG. 1) into the left open extremity of the tubular section 20. The end wall or closure member 14 functions to deflect the exhaust gas flow into the open end of section 20.

At the right extremity of the section 20 is a further stop-down arrangement in the form of a restricted aperture 30 provided in an end wall 32. From this point the gases enter a larger chamber 34 which communicates with a pair of restricted stop-down apertures 36 and 38, FIG. 4, provided in the tube supporting baffle

plate **26**. From apertures **36** and **38** exhaust gases enter a circuitous chamber **40** which communicates with an outlet conduit **42** of reduced cross section.

It will be apparent from the foregoing that the design of the muffler **10** is such as to provide a unique and highly efficient circuitous expansion area or path as the exhaust gases initially enter the housing **12**. It has heretofore been common practice to employ an elongate conical type expansion chamber for initially receiving exhaust gases. By means of applicant's improved arrangement, compactness and structural simplicity is assured and the efficiency of an internal combustion engine with which the muffler is associated is maintained at high level.

In FIGS. **5** to **7**, inclusive, a muffler **10*a*** is shown which is functionally and structurally quite similar to the previously described muffler **10**. The muffler **10*a*** includes a housing **12*a*** of oval cross sectional shape having end closure members **14*a*** and **16*a***. Exhaust gases from an internal combustion engine (not shown) are received by an inlet conduit **18*a*** and directed against the upper, outer peripheral surface of a tube-like section **20*a*** of substantially cylindrical cross sectional shape. The hollow cylindrical section **20*a*** is supported within the housing **12*a*** by suitable baffle plates **22*a*** and **26*a***. The supporting baffle **22*a***, like the previously described member **22**, terminates short of the bottom surface of the housing **12*a***.

Exhaust gases from the inlet **18*a***, as indicated by the directional arrows in FIG. **5**, are deflected laterally in opposed directions by the upper curved or arcuate outer surface of the section **20*a***, and are then received by a circuitous expansion area **28*a*** which progressively increases in size as it extends downwardly on opposite sides of the section **20*a***. It has been found in certain applications, that the aforesaid housing **12*a*** of oval transverse cross section, provides a particularly desirable expansion type chamber. The wall or baffle member **26*a*** provides an impervious surface defining one side of the circuitous area **28*a*** and the open bottom baffle member **22*a*** defines the opposite side of said area.

As indicated by the directional arrows in FIG. **5**, exhaust gases from the circuitous expansion area **28*a*** are directed to the left beneath the lower edge of the baffle plate **22*a*** and thence into the open left extremity of the section **20*a***. The end wall member **14*a*** cooperates in deflecting the flow of exhaust gases into said open extremity. From the section **20*a*** exhaust gases are directed through a restricted opening **30*a*** of an end plate **32*a*** into a chamber **34*a***. This arrangement assures desirable stop-down conditions. From the chamber **34*a*** exhaust gases enter outlet conduit **42*a*** through a pre-determined arrangement of apertures **44** thereof.

The structural arrangement of the muffler **10*b***, FIG. **8**, differs from the previously described muffler **10** in the provision of two identical inlet conduits **18*b*** as distinguished from the single inlet conduit **18** of the muffler **10**. Each of the inlet conduits **18*b*** cooperate with a companion tubular section **20*b*** positioned eccentrically with respect to the axis of a housing **12*b***. Each of the tubular sections **20*b*** are supported by baffle members **22*b*** and **26*b*** which correspond functionally with the previously described baffle members **22** and **26** shown in FIG. **1**. Restricted openings **30*b*** serve to communicate the interior of each tubular section **20*b*** with a common chamber **34*b***. Positioned within this chamber **34*b*** is a perforated, cylindrical outlet conduit **42*b***. Perforations **44*b*** in the outlet conduit **42*b*** may be of predetermined sizes and disposition to provide the required stop-down conditions within the muffler.

It will be understood from the foregoing description of the mufflers **10** and **10*a***, that exhaust gases are directed by the inlet conduits **18*b*** in the manner indicated by the directional arrows in FIG. **8**. Also directional arrows indicate the manner in which the upper periphery of the tubular sections **20*b*** will direct the flow of gases into a circuitous expansion area **28*b***, corresponding with the previously described expansion areas **28** and **28*a***. A bracket **46**, FIG. **8**, supports the outlet conduit **42*b*** which conduit may be in the nature of abutting half cylindrical sections.

From the foregoing it will be apparent that the present invention contemplates the provision of a very practical and highly efficient, compact muffler or silencer. By positioning the tube-like structures eccentrically with respect to the axis of the muffler housing, a very effective circuitous expansion chamber or path of progressively increasing size is provided without requiring an increase in overall length of the muffler. As indicated by the dot and dash lines A in FIG. **6**, the tube-like section **20*a*** may have an oval cross-sectional shape as distinguished from the cylindrical shape shown by solid lines. Experience has indicated that in some instances improved operating conditions result from mufflers equipped with oval shaped tube-like sections mounted within an oval shaped housing. The above described muffler designs serve to assure proper stop-down conditions so as to effectively reduce engine exhaust noises. Also mufflers constructed in accordance with the above described features will enable the development of pressure conditions in the vicinity of the outlet ports of cylinders of internal combustion engines which will contribute materially to the operational efficiency thereof. As previously mentioned, it is important to have exhaust gases speedily removed and the fuel mixture contemporaneously delivered to the engine cylinder. Therefore, increase in pressure in the vicinity of the muffler inlet conduit to prevent escape of fuel mixture from the cylinder discharge port is extremely important. Mufflers constructed in accordance with the teachings of the present invention function to assure such desirable pressure conditions in timed relation with the reciprocation of the piston within an associated cylinder.

I claim:

1. An exhaust muffler for internal combustion engines and the like including a housing providing a chamber for receiving exhaust gases, inlet means for directing exhaust gases into said chamber, a tube-like section positioned within said chamber having a substantially imperforate external peripheral surface which, in cooperation with the adjacent inner peripheral surface of said housing, presents a circuitous exhaust gas expansion area surrounding said tube-like section of progressively increasing size, said inlet means positioned so as to direct exhaust gases against the external periphery of said tube-like section, and outlet means for directing exhaust gases from said

housing, said tube-like section having opposite open extremities, one for receiving exhaust gases from said circuitous area and the other open extremity for directing gases passing through said tube-like section to an area in the vicinity of said outlet means.

2. An exhaust muffler for internal combustion engines and the like as set forth in claim 1, wherein the cross sectional shape of the tube-like section conforms substantially with the cross sectional shape of the housing in which it is positioned.

3. An exhaust muffler for internal combustion engines and the like as set forth in claim 1, wherein said housing is substantially cylindrical in shape.

4. An exhaust muffler for internal combustion engines and the like as set forth in claim 1, wherein the tube-like section positioned within the chamber is substantially cylindrical in shape.

5. An exhaust muffler for internal combustion engines and the like as set forth in claim 1, wherein said said housing is substantially oval in cross sectional shape.

6. An exhaust muffler for internal combustion engines and the like as set forth in claim 5, wherein said tube-like section positioned within said chamber is substantially cylindrical in cross sectional shape.

7. An exhaust muffler for internal combustion engines and the like as set forth in claim 1, wherein the longitudinal axis of said tube-like section is substantially parallel and eccentrically disposed with respect to the axis of said housing.

8. An exhaust muffler for internal combustion engines and the like including a housing providing adjacently positioned chambers for receiving exhaust gases, inlet means for directing exhaust gases into one of said chambers, inlet means for directing exhaust gases into the other chamber, a tube-like section positioned within each of said chambers, each of said tube-like sections having an external peripheral surface which in cooperation with the adjacent complementary inner peripheral surface of said housing present circuitous exhaust gas expansion areas of progressively increasing size, each of said areas communicating with one of said inlet means, and common outlet means communicating with said circuitous gas expansion areas.

9. An exhaust muffler for internal combustion engines and the like as set forth in claim 8 wherein said common outlet means is interposed between said adjacently positioned chambers.

10. An exhaust muffler for internal combustion engines and the like as set forth in claim 8 wherein said common outlet means includes a perforated tube-like section.

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