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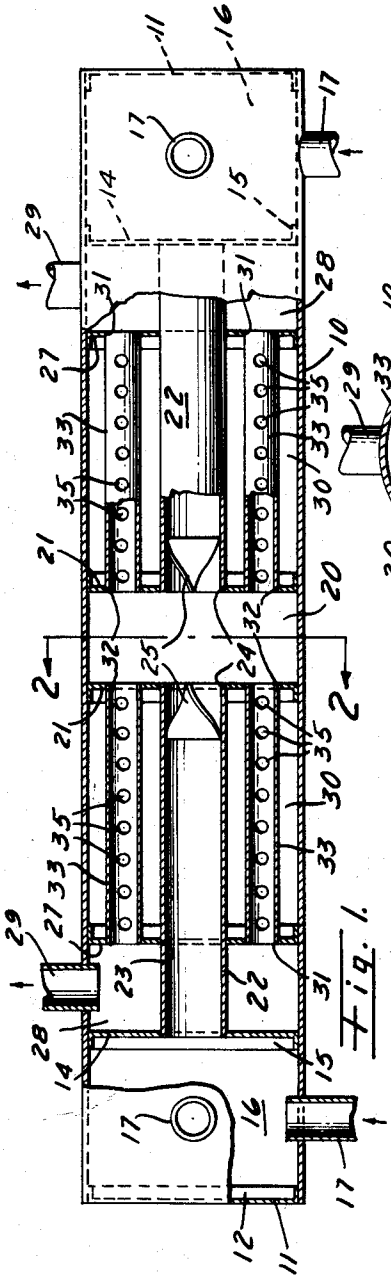


Fig. 1.

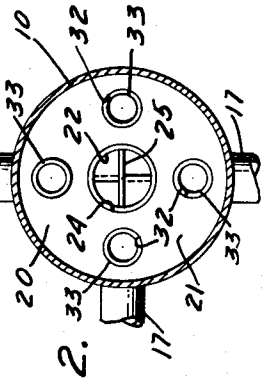


Fig. 2.

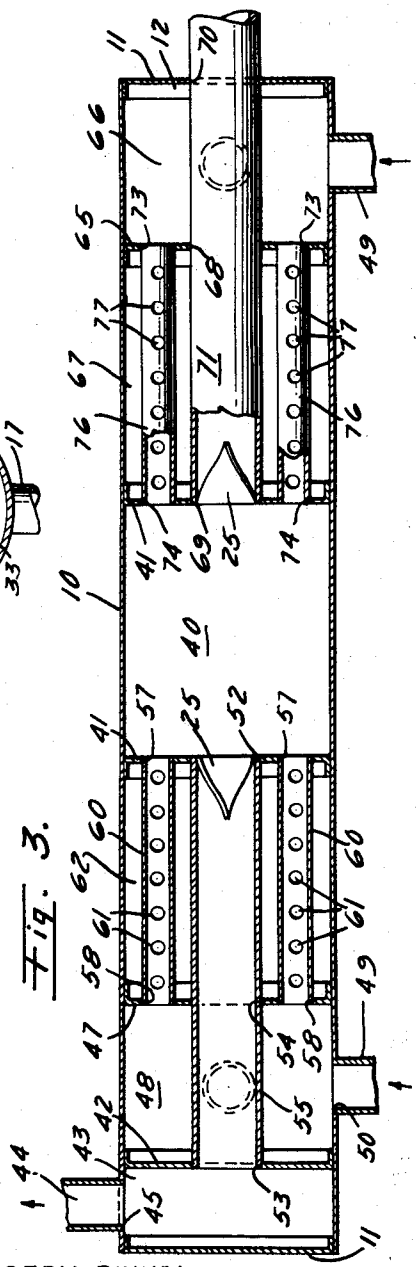


Fig. 3.

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This invention relates generally to silencing devices and relates more particularly to devices of this character for muffling the noise of exhausts of internal combustion engines.

While the invention has particular utility in the muffling of the noises of exhaust gases in internal combustion engines, and is shown and described in such connection, it is to be understood that its utility is not confined thereto.

It is an object of the invention to provide a muffler that is highly effective in silencing the noises of the pulsating gaseous current of the exhaust of internal combustion engines.

It is another object of the invention to provide a device of this character which will have a cushioning effect upon the gases passing therethrough.

It is a further object of the invention to provide a device of this character which will provide for expansion and cooling of the exhaust gases passing therethrough.

A still further object of the invention is to provide a device of this character having a minimum of back pressure.

It is another object of the invention to provide a device of this character of relatively small size.

It is still another object of the invention to provide a device of this character that can be installed in certain of the small cars in place of or as a replacement of the mufflers that are original equipment on said small cars.

A further object of the invention is to provide a device of this character that is compact and sturdy in construction.

A still further object of this invention is to provide a device of this character that is relatively simple in construction.

Another object of the invention is to provide a device of this character that may be produced at relatively low cost.

The characteristics and advantages of the invention are further sufficiently referred to in connection with the following detailed description of the accompanying drawings which are for illustrative purposes only and represent certain embodiments. After considering this example, skilled persons will understand that many variations may be made without departing from the principles disclosed and I contemplate the employment of any structure, arrangements or modes of operation that are properly within the scope of the appended claims.

Referring to the drawings:

FIG. 1 is a side view of a muffler embodying the present invention with portions broken away to show the interior construction;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1; and

FIG. 3 is a longitudinal section of an alternative arrangement of the device.

Referring more particularly to the drawing, the device comprises an outer shell **10** which is shown as being cylindrical although it is to be understood that it may be of other cross-sectional shape. The shell **10** is closed at the respective ends by end walls **11**, each of which is provided with a marginal flange **12** extending axially in one direction. The wall **11** is secured within the cylinder **10** by any suitable means such as welding or the like, not shown.

Spaced inwardly from each end is a partition **14**, each partition having a marginal flange **15** similar to the flange **12** of the walls **11**, and said partitions are secured within the cylinder or outer shell **10** by means of welding or the like. The walls **11** and partitions **14**, together with the parts of the shell between said walls and partitions define inlet chambers **16**, with which are connected inlet pipes **17**, which are also connected with respective cylinders of the engine. In the arrangement shown in FIGS. 1 and 2 the muffler device is for a four cylinder engine, so that each of the chambers **16** receives exhaust gases from two of the engine cylinders. Of course, the device may provide muffler means for engines having a greater number of cylinders or fewer cylinders.

Within the shell **10** and substantially midway between the ends thereof is a mixing chamber **20** defined at its ends by partitions **21**, which are spaced apart longitudially relative to the shell **10**.

Chamber **20** is connected with the respective inlet chambers **16** by means of respective conduits or pipes **22**. The outer end of each of the pipes **22** is received in an axial opening **23** in a respective partition **14**, while the opposite end of each pipe **22** is received in an axial opening **24** in a respective partition **21**. The ends of the pipes **22** are welded or brazed or otherwise secured to the respective partitions **14** and **21**.

Each of the pipes **22** is provided at its inner end with a helical vane **25**, which is secured therein by means of brazing, welding or other suitable means. The vanes **20** are shown as having a twist of approximately 90° although said vanes may be otherwise twisted according to the requirements of particular installations.

Between partitions **14** and **21** are respective partitions **27**, which are also secured to the wall of a shell **10** by means of welding, brazing or the like. Partitions **27** are disposed closer to the partitions **14** than to the partitions **21**. Partitions **14** and **27** define outlet chambers **28** having exhaust outlet pipes **29** connected therewith through openings provided therefor in the shell **10**, said pipes **29** being suitably secured in said openings by brazing, welding, or the like.

Between the partitions **21** and **27** are damping chambers **30**. About the axial openings **23** the partitions **27** are provided with a plurality of annularly spaced openings **31**, and the baffles **21** are provided with similar openings **32** which are in longitudinal alignment with corresponding openings **31** in the partitions **27**. The ends of pipes **33** are received in the respective openings **31** and **32** and are secured therein by any suitable means such as welding, brazing, or the like. The pipes **33** are of substantially smaller diameter than the pipes **22** and said pipes **33** are provided with a plurality of longitudinally spaced openings or perforations **35** whereby the interiors of said pipes **33** are in communication with the chamber **30**.

In one type of installation the inlet pipes **17** are connected to the exhaust ports of respective cylinders of a four cylinder engine (not shown). The exhaust gases from two of the cylinders are conducted through the pipes **17** to one of the inlet chambers **16**, while the exhaust gases from the other cylinders are conducted through respective pipes **17** to the other chamber **16**. These gases then pass through the respective pipes **22** and into the mixing chamber **20**, and said gases are given a swirling motion by the vanes **25**. It is to be noted that the pipes **22** are in axial alignment with each other and the exhaust gases discharge therefrom into the mixing chamber **20** head-on but with a swirling movement. There is a damping action in the mixing chamber which acts as a resonator to cut down noise.

The gases in the mixing chamber **20** then pass through the pipes **33** and into the outlet chambers **28**. Pulsations of exhaust gases passing through the pipes **33** are absorbed or damped by the gases in the chambers **30** by reason of the perforations **35** in said pipes **33**. Noise is thus further reduced or substantially eliminated. The exhaust

gases are also cooled during their passage through the device and such gases are discharged into the atmosphere through the pipes **29**, which may terminate at any convenient location.

The device is particularly adapted for use with certain small cars, such as the Volkswagen, and the like, and may be substituted for the muffler with which the cars come equipped or may be used as a replacement therefor.

Referring to FIG. 3, there is shown an alternative arrangement of the device which also includes a shell **10** and end walls **11**.

Adjacent the longitudinal center of the shell **10** there is a relatively large mixing or resonance chamber **40**, defined at its ends by partitions **41**, which are secured in the shell **10** by any suitable means, such as brazing, welding, or the like. Adjacent one of the end walls **11** is a partition **42** which is spaced longitudinally from the adjacent wall **11** and defines therewith and with the part of the shell **10** between same, an outlet chamber **43**, which has an outlet pipe **44** which is received in an opening **45** provided therefor in the shell **10**, said pipe being suitably secured by means of welding or brazing, or the like.

Intermediate the partition **42** and the adjacent partition **41** is a partition **47** which is spaced from the partition **42** and defines therewith, and the adjacent portion of the shell, an inlet chamber **48** which has inlet pipes **49** connected therewith to openings **50** provided therefor in the wall of the shell **10**, said pipes **49** being secured to the shell **10** by any suitable means, such as welding, brazing, or the like.

The partitions **41**, **42**, and **47** have axially aligned openings **52**, **53**, and **54** for reception of a pipe **55**, which is secured in said openings by brazing or other suitable means. Pipe **55** is also provided at its inner end with a vane **25**.

Partitions **41** and **47** also have respective aligned openings **57** and **58** for reception of pipes **60**, which are perforated by openings **61**, which provide communication between the interiors of the pipes **60** and a damping chamber **62**, defined at its ends by the partitions **41** and **47**.

At the opposite end of the shell **10** and between the other partition **41** and the adjacent end wall **11** is a partition **65** which defines the inner end of an inlet chamber **66**, and the outer end of a damping chamber **67**.

The partition **65**, adjacent partition **41** and adjacent end wall **11**, have axial openings **68**, **69** and **70**, for reception of a pipe **71** which is secured in said opening by any suitable means, such as welding, brazing, or the like. Adjacent the inner end of the pipe **71** is a vane **25**.

The partition **65** and adjacent partition **41** have openings **73** and **74** therein, spaced annularly about the axial openings for reception of pipes **76** which are perforated by openings **77** which connect the interiors of said pipes **76** with the damping chamber **67**.

The inlet chambers **48** and **66** receive exhaust gases from the cylinders with which the respective pipes **49** are connected. The exhaust gases from the chamber **48** pass through the pipes **60** into the chamber **40** and pulsations and noise are absorbed or damped by the gases in chamber **62**. The pulsation and noises are also further damped in the chamber **40**. Exhaust gases from the chamber **66** pass into the chamber **40** through the pipes **76** and noises and pulsations thereof are damped or absorbed by the gases of the chamber **67**. The gases entering chamber **40** at opposite ends thereof are in opposition to each other and there is a turbulence and mixing of said gases, which pass from the chamber **40** outwardly through the pipes **55** and **71**, respectively. The vanes **25** give swirling motion to the gases entering the respective pipes **55** and **71** and the gases which pass through pipe **55** enter the outlet chamber **43** and are discharged through the pipe **44**.

The gases which enter pipe **71** are also given a swirling motion by the vane **25** in said pipe **71**, and said pipe **71** serves as a second exhaust pipe, which discharges axially from the muffler. The respective outer ends of the pipes **44** and **71** may be located at any suitable place.

Both forms of the present invention disclosed and described herein are extremely effective in eliminating backpressure on the engine. It has been found that backpressure is completely eliminated up to approximately 45 miles per hour in Volkswagen automobiles on which they have been installed.

The present invention also substantially eliminates noise and pulsations and provides the desired cooling action for said exhaust gases.

Exhaust gases from the engine are divided or split up into several paths through the tubes. The outlet pipes or tubes have the same or greater capacity then the incoming or inlet tubes, and it is to be noted that the number of the perforated tubes and the size thereof determines the sound of the exhaust outlets.

The arrangement disclosed in FIG. 3 is particularly advantageous on the Volkswagen and Porsche automobiles, in that it allows the extension of the outlets beyond the bumper guards or out at the sides of the car.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description and it is believed that it will be apparent that various changes may be made in the form, construction and arrangement of the parts of the invention without departing from the spirit and scope thereof or sacrificing all of its material advantages, the arrangements hereinbefore described being merely for purposes of illustration.

I claim:

1. In a muffler for internal combustion engines: an elongated cylindrical shell closed at the ends by end walls; a plurality of transverse partitions secured within the shell and defining, with respective portions of the shell, a mixing chamber adjacent the longitudinal center of the shell, a damping chamber at each side of the mixing chamber, outlet chambers adjacent the respective outer ends of the damping chambers, and inlet chambers between the outlet chambers and the respective end walls, the transverse partitions in the cylindrical shell having axially aligned openings therein and the partitions defining the respective damping chambers being provided with a plurality of aligned openings between the axial openings and the outer peripheries thereof, and spaced annularly apart, said openings being of smaller diameter than the diameter of the axially aligned openings; a pair of pipes for each inlet chamber, said pipes being secured in openings provided therefor in the shell and being adapted to be connected with respective exhaust ports of an internal combustion engine; an exhaust outlet pipe for each of the outlet chambers, each of said pipes being secured in an opening provided therefor in the shell; a conduit disposed in the openings in the partitions at respective sides of the mixing chamber to thereby connect each of the inlet chambers with the mixing chamber; spiral vanes secured in the respective conduits adjacent the inner ends thereof, and perforated tubes in aligned smaller openings to connect the mixing chamber with the respective outlet chambers.

2. In a muffler for internal combustion engines: an elongated hollow shell closed at the ends by end walls; a plurality of transverse partitions secured within the shell and defining, with respective portions of the shell, a mixing chamber adjacent the longitudinal center of the shell, a damping chamber at each side of the mixing chamber, outlet chambers adjacent the respective outer ends of the damping chambers, and inlet chambers between the outlet chambers and the respective end walls of the cylindrical shell, the transverse partitions in the cylindrical shell having axially aligned openings therein, and the partitions defining the respective damping chambers being provided with a plurality of aligned openings therein between the axial openings and the outer peripheries of said partitions, said openings being of smaller diameter than the diameter of the axially aligned openings; a plurality of inlet pipes connected with each inlet chamber; an exhaust outlet

pipe for each of the outlet chambers; a conduit disposed in the openings of the partitions at each side of the mixing chamber to thereby connect each of the inlet chambers with the mixing chamber; a spiral vane secured in each conduit adjacent the inner end thereof, and perforated tubes in said smaller openings connecting the mixing chamber with the respective outlet chambers.

3. In a muffler for internal combustion engines: an elongated hollow shell closed at the ends by end walls; a plurality of transverse partitions secured within the shell and defining, with respective portions of the shell, a mixing chamber adjacent the longitudinal center of the shell, a damping chamber at each side of the mixing chamber, outlet chambers adjacent the respective outer ends of the damping chambers, and inlet chambers between the outlet chambers and the respective closed ends of the cylindrical shell, each inlet chamber having at least one inlet and each outlet chamber having an outlet; the transverse partitions in the cylindrical shell having axially aligned openings therein and the partitions defining the respective damping chambers being provided with a plurality of aligned openings therein between the axial openings and the outer periphery of said partitions and of smaller diameter, said smaller openings being annularly spaced apart; a conduit disposed in the axial openings of the partitions at each side of the mixing chamber to thereby connect each of the inlet chambers with the mixing chamber, and perforated tubes in said smaller openings connecting the mixing chamber with the respective outlet chambers.

4. In a muffler for internal combustion engines: an elongated cylindrical shell closed at the ends by end walls; a plurality of transverse partitions secured within the shell and defining, with respective portions of the shell, a mixing chamber adjacent the longitudinal center of the shell, a damping chamber at each side of the mixing chamber, outlet chambers adjacent the respective outer ends of the damping chambers, and inlet chambers between the outlet chambers and the respective closed ends of the cylindrical shell, each inlet chamber having an inlet and each outlet chamber having an outlet; means connecting each inlet chamber with the mixing chamber with the outlets of said means in opposition to each other; and means connecting the mixing chamber with each of the outlet chambers, said means having openings therein connecting the interiors of said means with the interiors of said damping chambers.

5. The invention defined by claim 4, wherein the means connecting the inlet chambers with the mixing chamber have means therein for imparting a swirling motion to gases passing therethrough.

6. In a muffler for internal combustion engines: a hollow shell closed at the ends by end walls; a plurality of transverse partitions spaced longitudinally apart and secured within said shell, said partitions defining a central chamber located adjacent the longitudinal center of the shell, and outwardly of each end thereof intermediate chambers, and outer chambers; respective conduit means between the outer chambers and the central chamber; a spiral vane in each of said conduit means; and other conduit means between the central chamber and ambient atmosphere, respective conduit means extending through the respective intermediate chambers and certain of said conduit means being perforated so as to be connected with said intermediate chambers, said chambers and conduit means defining a plurality of pathways from inlets to outlets, the central chamber being common to both said passageway means.

7. In a muffler for internal combustion engines: an elongated cylindrical shell closed at the ends by end walls; a plurality of transverse partitions spaced longitudinally apart and secured within said shell, said partitions defining a central mixing chamber located adjacent the longitudinal center of the shell, and outwardly of each end thereof intermediate chambers, and outer chambers; conduit means between the outer chambers and the mixing chamber; and other conduit means between the mixing chamber and ambient atmosphere, respective conduit means extending through the respective intermediate chambers and certain of said conduit means being perforated so as to be connected with said intermediate chambers, said chambers and conduit means defining a plurality of pathways from inlets to outlets of the muffler, the mixing chamber being common to both said passageway means.

8. In a muffler for internal combustion engines: a shell closed at the ends by end walls; a plurality of transverse partitions spaced longitudinally apart and secured within said shell, said partitions defining a central chamber located adjacent the longitudinal center of the shell, and outwardly of each end thereof intermediate chambers, and outer chambers; conduit means between the outer chambers and the central chamber; and other conduit means between the central chamber and ambient atmosphere, respective conduit means extending through the respective intermediate chambers and certain of said conduit means being perforated so as to be connected with said intermediate chambers, said chambers and conduit means defining a plurality of pathways through the shell.

9. In a muffler for internal combustion engines: a hollow shell; transverse walls defining in sequence in said shell four chambers, a first chamber having an inlet and the next succeeding chamber having an outlet, the transverse walls defining said next succeeding chamber and the following chamber having axial openings therein and the transverse walls defining the ends of the last mentioned chamber having a plurality of smaller openings therein arranged annularly in said walls between the axial openings thereof and the peripheries thereof, respective smaller openings in one of said walls being in alignment with respective openings in the other of said walls; a conduit disposed within the axial openings and connecting the chamber having the inlet with the chamber next succeeding the chamber having the walls with the smaller openings therein; and perforated conduits secured in respective aligned smaller openings.

10. The invention defined by claim 9, including means in the conduit in the axially aligned openings for imparting a swirling motion to fluid passing through said conduit.

11. In a muffler for internal combustion engines: an elongated shell closed at the ends by end walls; a plurality of transverse partitions secured within the shell and defining, with the central portion of the shell, a mixing chamber adjacent the longitudinal center of said shell, damping chambers at the respective ends of said mixing chamber, inlet chambers outwardly of said damping chambers, and an outlet chamber at the outer side of one of said inlet chambers, said partitions having axially aligned openings therein and a plurality of aligned openings between the axial opening and the peripheries of said partitions, the latter openings being spaced annularly apart in the respective partitions and being of smaller diameter than the diameter of the axially aligned openings, the end wall opposite the inlet chamber also having an opening in axial alignment with the other axially aligned openings; a conduit disposed in the axial openings of the partitions at one side of the mixing chamber connecting said mixing chamber with the outlet chamber; a conduit in the axial openings in the partitions and end wall at the other side of said mixing chamber connecting the latter with ambient atmosphere; and perforated tubes in said smaller openings connecting the inlet chambers with the mixing chamber.

12. The invention defined by claim 11, wherein the conduits in the axially aligned openings have spiral vanes disposed therein.

13. In a muffler for internal combustion engines: a hollow shell; walls within said shell defining in succession an outlet chamber, an inlet chamber, and a damp-

ing chamber, the wall at the inner side of the outlet chamber and the walls defining the damping chamber being provided with longitudinally aligned openings therein and the walls defining the damping chamber also having a plurality of annularly spaced openings therein disposed between the larger openings and the peripheries of said walls, and respective openings in said walls being in alignment; a conduit in the first mentioned openings; smaller perforated conduits in aligned smaller openings, said perforations providing communication with the damping chamber; and means providing a chamber connecting the outlets of the smaller conduits with the inlet of the larger conduit.

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