

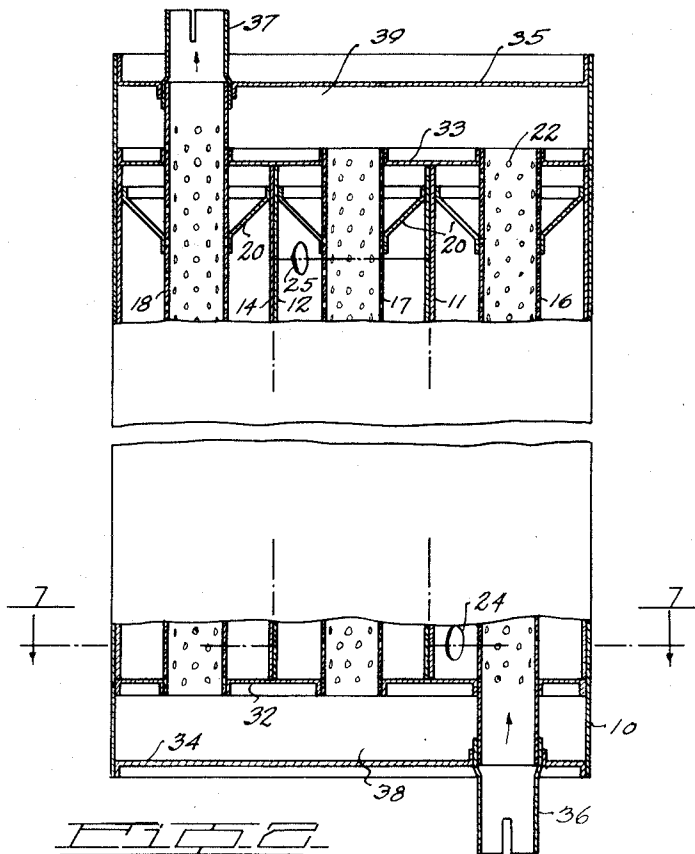
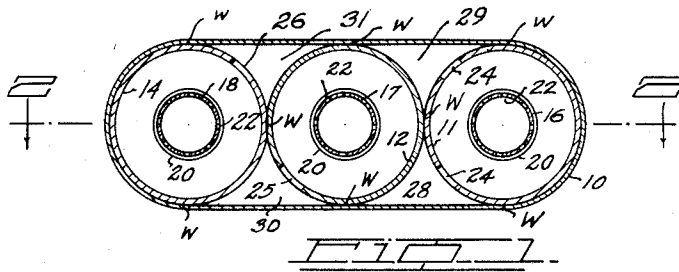
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SILENCER

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## UNITED STATES PATENT OFFICE

1,964,996

## SILENCER

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2 Claims. (Cl. 137—160)

This invention relates to silencers and more particularly to silencers used in connection with gases exhausted from internal combustion engines.

5 The silencer of this application is of the triple pass type, having an oval outer casing containing three circular double shell resonance units.

The objects and features of the present invention will be readily apparent to those skilled in the art upon reference to the following detailed description of an embodiment of the same, reference being had to the appended drawing which shows this embodiment. In this drawing,

10 Fig. 1 is a transverse elevational section of a silencer as if on the broken line 1—1 of Fig. 2; and  
15 Fig. 2 is a plan section as if on the line 2—2 of Fig. 1.

Referring to the drawing, it will be seen that the silencer there shown includes an imperforate 20 outer casing 10 of oval cross section in which are disposed in a single row and in side by side, parallel juxtaposition, three tangentially contacting circular resonance units having coextensive outer shells 11, 12, and 14, somewhat shorter 25 than the outer casing. Centrally disposed within these shells are inner through shells 16, 17, and 18, and the annular spaces between the through shells are provided with sound wave attenuating means, such as the diaphragms or cones 30 20. The through shells, throughout substantially their entire area, are covered with a plurality of minute, outwardly extruded perforations 22 communicating the through passages in these through shells with the cone-containing annular spaces therearound and within the outer 35 shells.

The outer shells 11, 12, and 14 are provided with openings or throats 24, 25, 26, communicating the interiors thereof with the four, relatively isolated, 40 sound wave attenuating chambers 28, 29, 30, 31, in the outer shell. Throats 24 and 26 for outer shells 11 and 14 are at the inlet or forward end of the silencer and open into chambers 28—29 and 31, respectively; while the throat 25 for outer 45 shell 12 is at the outlet or rearward end of the silencer and open into the chamber 30. These chambers, as can be seen, are relatively isolated by the tangential engagement of the shell surfaces with one another and with the wall of the outer 50 casing 10.

Disposed within and traversing outer casing 10 and closing the ends of the outer shells 11, 12, and 14, are inner headers 32, 33. The inlet end inner header 32 is provided with three flanged openings 55 into which pass the open ends of the three through

shells 16, 17, and 18, with the through shell 16 being continued beyond the header 32 a considerable extent. The outlet end inner header 33 is also provided with three flanged openings and these also receive and seat the open ends of the three through shells, with through shell 18 continuing beyond the header 33 a considerable extent. 60

There are also disposed in the outer casing 10, two end headers; the inlet end header 34 is provided with a flanged opening in which is seated 65 an inlet nipple or sleeve 36 in turn receiving the extended end of through shell 16; and the outlet end and header also has a flanged opening, this receiving and seating an outlet nipple or sleeve 37 in turn receiving the extended end of through shell 18. 70

The cooperating pairs of headers form two end expansion chambers 38 and 39, the former of which is the inlet-end expansion chamber, and the latter of which is the outlet-end expansion 75 chamber. These expansion chambers communicate the through shells as follows: through shell 16 communicates with through shell 17 at their outlet ends through the outlet-end expansion chamber 39, and through shell 17 communicates with through shell 18 at their inlet-ends through 80 the inlet-end expansion chamber 38.

Various engaging parts of the silencer are welded to one another in any desired manner, at desired points, some of which are indicated by the 85 reference "W". For example, the outer shells 11, 12, and 14 are welded to one another along tangentially engaging, diametrically opposed lines "W" and the three outer shells are welded to the outer 90 casing along three pairs of diametrically opposed lines "W" where these shells engage the planar walls of the casing 10.

Non-welded, slip type, expansion joints are provided at other points, for example, at the 95 juncture between through shells 16 and 18 and the nipples or sleeves 36 and 37; and these joints permit relative movement between the through shells and these nipples or sleeves, caused by relative expansion of certain of the parts. Thus, 100 problems arising from expansion of the parts, due to heating, are well eliminated because of the slip joints provided at the junctures of the through shells and the header sleeves.

The silencer disclosed is characterized by its 105 relatively low back pressure, manifested by the fact that at no time do the coursing gases encounter such obstructions as would tend to baffle them and build up a back pressure. However, while the silencer is of the low back pressure type, 110

the impulses in them are broken up in at least two places due to the reverse turns provided by the coursing gases as they pass from shell 16 through expansion chamber 39 and into shell 17, and as they pass from shell 17, through expansion chamber 38, and into shell 13. Still further, even though the silencer is of the through type, the necessity for providing a flame preventer for the silencer is eliminated by the provision of these reverse turns which effectively break up any emerging flames.

It will be observed that the effective length of the silencer, which is the aggregated length of the through shells, is about three times the actual or overall length of the silencer, and accordingly, the silencer may be used in connection with engines requiring a long silencer, even though the longitudinal space allotted for the silencer is comparatively small.

It will also be observed that the number of chambers 28—31, in the arrangement shown, is equal to twice the number of units minus two, as contradistinguished from the number that is produced by a circular arrangement, where the number of chambers is equal to the number of units.

An important feature of the invention is the rigidity of the silencer. It will be observed that the outer casing is braced by the three tangentially disposed and mutually welded outer shells 11, 12, and 14, and that these in turn are reinforced and rigidified by the cones 20 and the through shells 16, 17, and 18. Due to this rigidity of construction, and also due to the fact that there are no pressure impulses against the outer casing, casing noises are completely eliminated.

It will further be observed that the headers are not of the stepped type, and accordingly, the assembly of the silencer is facilitated because in the assembly operations, it will not be necessary to manually locate the shells with respect to the headers. In assembling the construction disclosed, the units, each of which includes an outer shell, a through shell, and the cones therebetween, locate themselves with respect to the inner headers because the ends of the through shells seat themselves in the flanged openings of these headers. Further, not only do such units locate themselves automatically but they also maintain themselves in assembled position with respect to the headers during the welding operations and thus facilitate these welding operations.

It will be observed that each outer shell opens into a chamber in which sound waves may be attenuated, and that the construction provides four relatively isolated chambers 28, 29, 30, 31, into each of which, in one isolated zone, open the throats. In the construction disclosed, the unit 11—16 through which the gases first course opens into two of these chambers, while the other units 12—17, and 14—18, open into only one each. This arrangement provides a greater resonator volume where it is most needed, namely at the point where the gases have their greatest velocity, near the silencer inlet.

It will be understood, however, that other throat arrangements with respect to the chambers might well be chosen, as desired, with varying results. For example, unit 11—16 might open into chambers 28—29, and unit 14—18 into chambers 30—31; or unit 11—16 might open into chamber 28; unit 12—17 into chambers 29—30, and unit 14—18 into chamber 31, etc.

Further, the throats of the various units might

be at both ends thereof, rather than at one end, if desired, in certain instances.

Further, it will be seen that the inlet 36 opens directly into a silencer unit and that there is produced no turbulence, as would be the case if the inlet 36 opened into an expansion chamber.

Still further, it will also be observed that while in the silencer shown, the sequence of the coursing of the gases is through unit 11—16, then unit 12—17, then unit 14—18, the construction may be such that any other sequence may be chosen, this being effected merely by providing the extended end and the inlet sleeve 36 on any other desired one of the inner shells and by providing the extended end and the outlet sleeve 37 on any one of the remaining shells. For example, the construction might be such that the sequence of the coursing of the gases might be through unit 11—16, then unit 14—18, then unit 12—17; or through unit 12—17, then unit 11—16, then unit 14—18; or through unit 12—17, then unit 14—18, then unit 11—16; or through unit 14—18, then unit 12—17, then unit 11—16; or through unit 14—18, then unit 11—16, then unit 12—17.

The silencer here shown is novel over the silencer of application Serial No. 644,852, in certain details of construction, here first shown, which details produce novel results, here defined.

For example, the silencer here shown provides a greater cross sectional area and accordingly a greater volume for each unit of vertical dimension than the silencer there shown.

Further, the silencer here shown provides more resonator chambers 28—31 than the silencer there shown, for the same number of resonator units, and this increase in the number of resonator chambers is found to be desirable.

Further, in the silencer here shown, at certain portions, namely at the ends of the oval, there are two thicknesses of metal, whereas in the silencer of application Serial No. 644,852, at no portion of the silencer, except along the tangential contacting lines, is there more than one thickness of metal; and increasing the number of thicknesses of metal enhances the rigidity of the outer casing wall.

Still further, the herein disclosed arrangement of the parts permits the use of larger outer shells and cones for the units than is the case with a correspondingly vertically dimensioned silencer disclosed in application Serial No. 644,852. In the silencer of that application, if a 6" outer casing is used, the three outer shells will have diameters of about 2¾". In the instant silencer, however, if a 6" outer casing is used, the intermediate shells will be approximately 6". Therefore, it is found that without increasing the vertical dimension of the silencer, a gain of about 120% in the diameter and of about 400% in the volume of the outer shells of the units is effected by arranging these shells in an oval outer casing rather than in a circular outer casing. This result may be expressed in a slightly different way, as follows: by arranging the units in an oval casing, rather than a circular casing, a reduction in vertical dimension of over 50% can be effected without reducing the volume of the silencer units.

It will further be observed that as many throats and/or cones, may be provided as desired, to accomplish the desired results.

Now having described an embodiment of the invention of this application, reference will be had to the following claims for a determination of the scope of the invention.

## I claim:

1. In a silencer of the retroverted passage type, means providing expansion chambers at the ends thereof, means providing an inlet and an outlet therefor, and means mechanically connecting the chambers and providing parallel through flow units, the units being of curved cross-section and being in relative mutually-bracing engagement with one another and with the casing, and each being lined with means forming part of the unit-providing means for providing sound wave attenuation, the units being shaped to provide isolated resonator chambers outside of them but inside the casing, with each resonator chamber communicating with the interior of a unit, each expansion chamber communicating the interiors of two units at their ends, the units lying in a single row and having their axes disposed in substantially a common plane.

2. In a silencer of the retroverted passage type, an outer casing of substantially oval cross section,

means providing expansion chambers at the ends thereof, means providing an inlet and an outlet therefor, and means mechanically connecting the chambers and providing parallel through flow units, the units being of curved cross-section and being in relative mutually-bracing engagement with one another and with the casing, and each being lined with means forming part of the unit-providing means for providing sound wave attenuation, the units being shaped to provide isolated resonator chambers outside of them but inside the casing, with each resonator chamber communicating with the interior of a unit, each expansion chamber communicating the interiors of two units at their ends, the units lying in a single row and having their axes disposed in substantially a common plane, and the outer ones of the row of the units having walls which lap a considerable area of the wall of the outer casing to reinforce them.

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