Feb. 10, 1970 W. OTT 3,494,445

DETOXICATING AND SILENCING DEVICE

Filed July 7, 1967 2 Sheets-Sheet 1

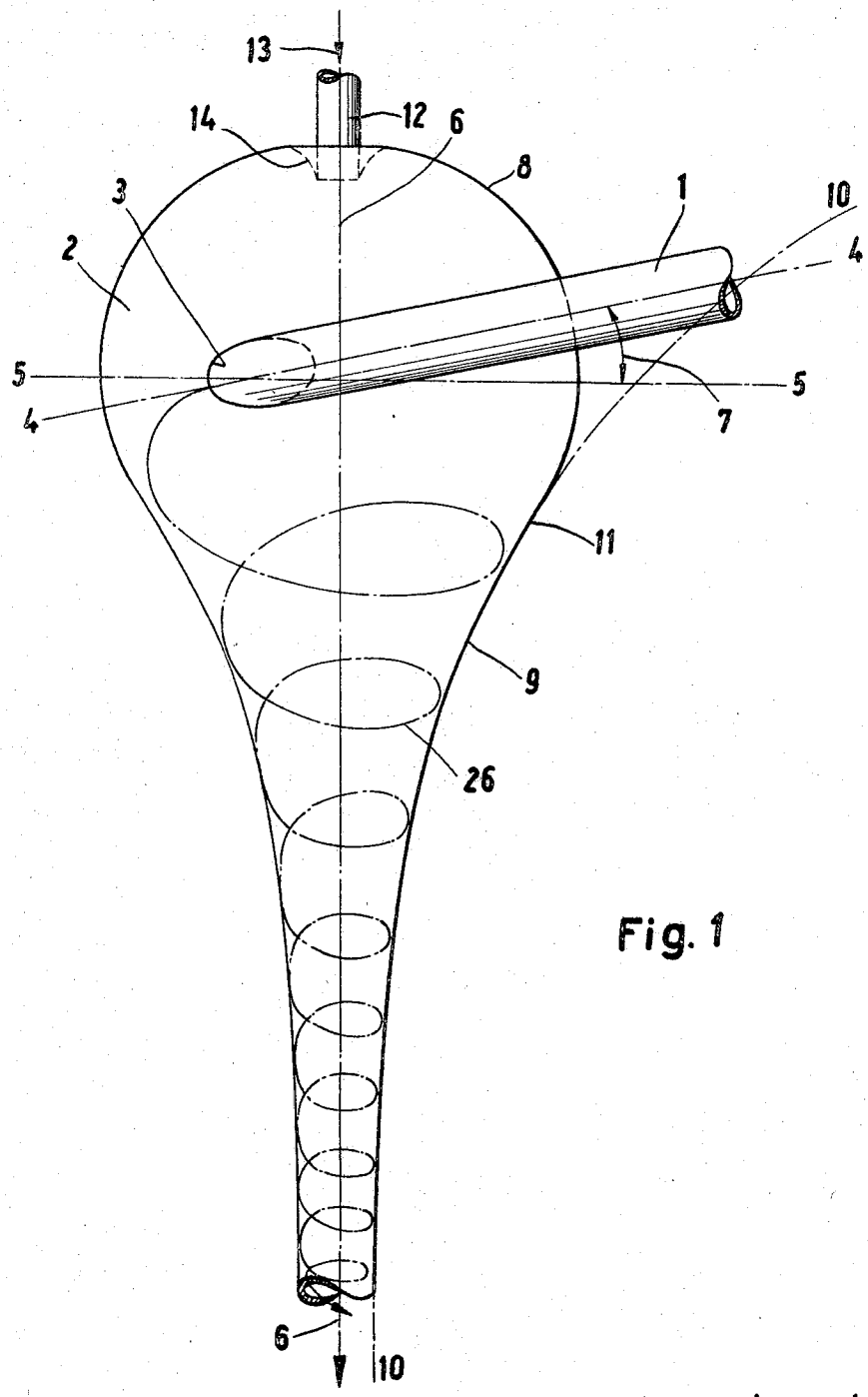

Fig. 1

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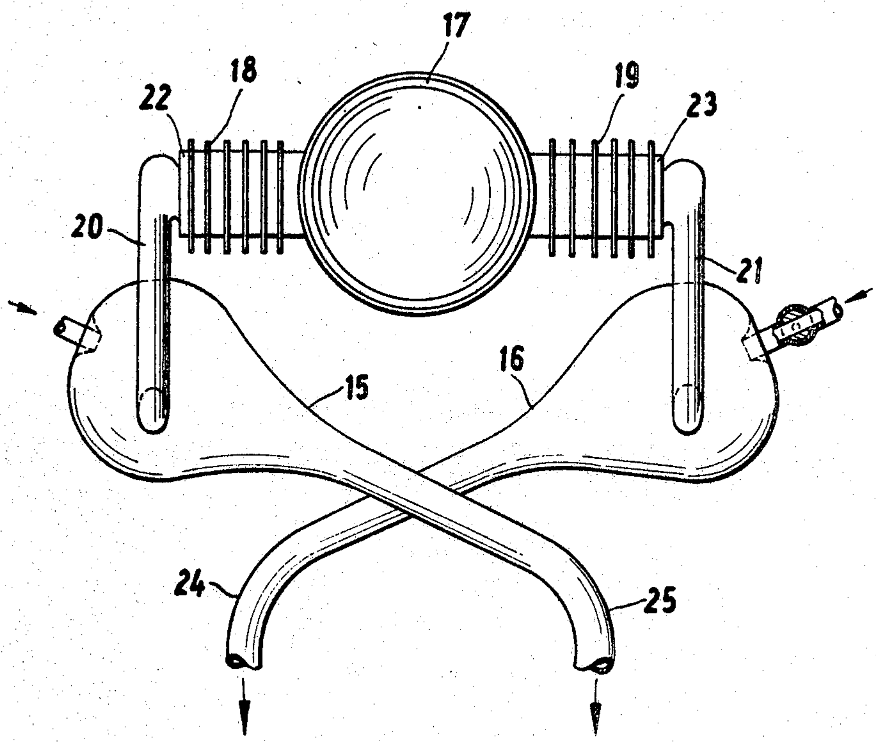
Fig. 2



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United States Patent Office

3,494,445

Patented Feb. 10, 1970

3,494,445

DETOXICATING AND SILENCING DEVICE

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Filed July 7, 1967, Ser. No. 651,735
Claims priority, application Germany, July 19, 1966, O 11,823
Int. Cl. F01n 3/04, 1/14
U.S. Cl. 181—43
10 Claims

ABSTRACT OF THE DISCLOSURE

Detoxicating and silencing devices for pulsating gas flows such as the exhaust gases from internal combination engines. Each devices comprises an elongated casing which is bulbous at one end and tapers towards a cylindrical portion at the other end. Gas enters said casing through a tangentially disposed inlet conduit.

The present invention relates to detoxicating and silencing devices primarily for detoxicating and silencing a pulsating flow of generally gaseous materials under elevated pressure, such as the exhaust gases from internal combustion engines.

A prior proposal in this field was based on the recognition that, according to the basic laws of conical sections, a line passing through the focal point of a parabola is reflected back at the wall of the parabola parallel to the focal axis of the parabola so that, when related to the three dimensional system of a paraboloid, a stream of gas which is allowed to issue at or near the focal point is re-directed parallel to the focal axis and axis of symmetry of the paraboloid which is formed as a rotational shape around this axis. For the same reason hollow ellipsoids have been proposed so that when a stream of gas issues near one of the two focal points and is reflected by the wall, it is re-directed to the other focal point. It was proposed that such reflections within a paraboloid or ellipsoid could result in displacements of the frequencies of the sound vibrations relative to one another so that at least a partial cancellation of sound, or silencing, would result.

It has also been proposed to construct exhaust silencers so as not only to silence but also to detoxicate the exhaust gases. According to that proposal the silencer easing is constructed essentially in the form of a hollow egg with input and output conduits arranged at specified angles so that the exhaust gas stream is formed into a three dimensional spiral having an extraordinarily high vortical speed in the vicinity of the tip of the egg. Under the influence of this movement, thermochemical decomposition takes place which at least partially detoxicates the gases. In one example there was achieved a lowering of the CO content from 9.3% to 3.4%, or from 9.4% to 2.8%. At the same time the CO_2 content rose from 8.5% to 12.4% when idling, and from 8.0% to 11.3% when under full load. The H_2 content dropped from 4.2% to 1.3% when idling and from 4.3% to 1.1% under full load. CH_4 and other hydrocarbon contents could no longer be detected. Only in special cases was the introduction of oxygen, optionally in the form of atmospheric oxygen, or other reagents required in order to achieve similar favourable conditions.

However on practical operation of such previously proposed devices it has been found that they are highly sensitive and that optimum values of detoxication and silencing can only be achieved if they are relatively accurately matched to the particular prevailing motor conditions as regards volume or size, construction and arrangement.

It is the object of the present invention to provide a detoxicating and silencing device which basically retains

the advantages presented above, but which in addition is relatively insensitive to particular conditions, i.e. is relatively independent of the nature, size and construction of the internal combustion engine or other source of exhaust gases which precedes it.

According to the present invention, there is provided a device primarily for detoxicating and silencing a pulsating flow of generally gaseous material under elevated pressure, such as the exhaust gases from an internal combustion engine, comprising an elongated casing which is generally bulbous at one end and tapers towards a substantially cylindrical portion at the other end, an input conduit for generally gaseous material communicating substantially tangentially with the interior of said casing at the bulbous end thereof, said cylindrical portion defining an output conduit, wherein, over the region of the casing lying substantially between the input conduit and said other end of the casing, the line of intersection of the casing with any plane including the longitudinal centre-line of the casing is a second or higher order or transcendent curve convex towards said centre-line.

A particularly effective construction of the device results if said second order curve is part of a hyperbola.

Preferably, said region of the casing is a hollow body of revolution axially symmetrical about the longitudinal centre-line, one said line of intersection serving as the generatrix of the body.

There is greater freedom of choice as regards the possible shape of a second region of the casing lying substantially between the input conduit and said one end of the casing, i.e. normally the region lying between the boundary of the first region and said one end of the casing. Over this second region, the line of intersection of the casing with any plane including the longitudinal centre-line of the casing is preferably a second order curve concave towards said centre-line. Said second order concave curve may optionally be circular, elliptical, parabolic or ogival.

An injector conduit may be provided communicating with the interior of the casing at the bulbous end thereof. Such a conduit is for the supply of a flow of generally gaseous working materials such as air, steam, oxygen-enriched air or oxygen. This conduit is suitably co-axial with the longitudinal centre-line of the casing. This addition of working materials, even air, results in an improvement of the detoxicating properties of the silencer in that the carbon monoxide content abruptly drops below the limit which according to present experience is still permissible without leading to the level of atmospheric pollution at which health damage can occur.

Two embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a longitudinal section through a detoxicating and silencing device constructed in accordance with the invention, and

FIG. 2 illustrates the arrangement for a double-piston motor with two opposed cylinders.

Referring to FIG. 1, there is shown an input conduit for the exhaust gases from an internal combustion engine. The conduit **1** communicates generally tangentially with the interior of a casing **2** through the aperture **3**. The axis **4**—**4** of the conduit **1** makes an acute angle **7** with a plane marked **5**—**5** which extends perpendicular to the longitudinal centre-line **6**—**6** of the silencer casing **2**.

The casing **2** is in the form of a hollow hemi-sphere **8** and part of a hollow hyperboloid **9** which is generated as a body of rotation about the axis **6**—**6** by rotation of the generatrix hyperbola **10**—**10** about the axis **6**—**6**, which is the axis of symmetry. The casing sections **8** and **9** merge with one another at **11** without a step or discontinuity.

An injector conduit **12** for the supply of additional working materials ends within the part **8** of the casing and is co-axial with the centre-line **6—6**. In general, supply of air in the direction of the arrow **13** suffices. The conduit **12** projects somewhat beyond the casing section **8** inside the silencer, with flared guide surfaces **14** being provided to assist occurrence of an injector effect and which results in it not being necessary to introduce the additional working materials under excess pressure. This does not exclude the use of excess pressure, especially not in the case of water, for example, being sprayed in or a post-combustion being carried out.

Referring now to FIG. 2 there is shown an arrangement of two silencers **15, 16**, constructed in accordance with the invention, in conjunction with a double-piston internal combustion engine having a crank casing **17** and cylinders or cylinder rows **18** and **19**. The axes of these cylinders are arranged about the crank circle displaced by 180°. This leads to the illustrated possibility of so arranging the exhaust gas input conduits **20, 21** between the cylinder heads **22, 23** and the silencer casings **15, 16** that they run essentially parallel to one another. At the same time the centre-lines of the silencers cross so that it is possible to arrange, with relatively little space requirement, for the output conduits **24, 25** for the largely detoxicated exhaust gases to extend in the usual manner.

It has been found that a device constructed as shown in FIG. 1 leads to significant insensitivity to particular conditions as regards the precise nature, size and construction of the internal combustion engine with which it is associated in operation. At the same time significant advantageous as regards detoxication and silencing were found. In one example the CO content dropped to 0.5% or 0.6% when idling. When air was introduced through conduit **12** the CO content dropped to 0.3% or 0.4%. At 4000 r.p.m. the figure was as low as 2.3% or 2.2% without addition of air and 0.7% or 0.6% with the addition of air. At 2000 r.p.m. the CO content was 1.9% without and 0.5% with air. At the same time the fuel consumption of the engine was reduced by from 15% to 25%. Measurement of the decibels also indicated that the silencing ability was very good. Moreover the exhaust and coolant temperatures of the engine showed no increase.

The above effects are attributable to the fact that in order to constrain the stream of exhaust gases to flow in the form of a three-dimensional helix of reducing diameter, as shown at **26** in FIG. 1, a relatively high proportion of the gas stream energy is absorbed, so that the exhaust noise is greatly dampened. At the same time, the high vortical speeds, in conjunction with the temperature at which the silencer operates, lead to the above-mentioned thermo-chemical detoxicating reactions. These reactions may be further favoured by thermal insulation of the silencer casing and by constructing the casing of bright iron, whereby to exert a catalytic effect to favour these reactions.

I claim:

1. A device primarily for detoxicating and silencing a pulsating flow of generally gaseous material under elevated pressure, such as the exhaust gases from an internal combustion engine, comprising an elongated casing which is generally bulbous at one end and tapers towards a substantially cylindrical portion at the other end, an input conduit for generally gaseous material communicating substantially tangentially with the interior of said casing at the bulbous end thereof, said cylindrical portion defining an output conduit, wherein, over the region of the casing lying substantially between the input conduit and said other end of the casing, the line of intersection of the casing with any plane including the longitudinal centre-line of the casing is a second or higher order or transcendent curve convex towards said centre-line.

2. A device according to claim **1** wherein said second order curve is part of a hyperbola.

3. A device according to claim **1** wherein over at least said region, the casing is a hollow body of revolution axially symmetrical about the longitudinal centre-line, one said line of intersection serving as the generatrix of the body.

4. A device according to claim **1** wherein, over a second region of the cavity lying substantially between the input conduit and said one end of the casing, the line of intersection of the casing with any plane including the longitudinal centre-line of the casing is a second order curve concave towards said centre-line.

5. A device according to claim **4** wherein said second order concave curve is part of a circle.

6. A device according to claim **4** wherein said second order concave curve is part of an ellipse.

7. A device according to claim **4** wherein said second order concave curve is part of a parabola.

8. A device according to claim **4** wherein said second order concave curve is ogival.

9. A device according to claim **1** including an injector conduit for the supply of a flow of generally gaseous additional working materials, said conduit communicating with the interior of said casing at the bulbous end thereof coaxially with the longitudinal centre-line of the casing.

10. Apparatus primarily for detoxicating and silencing two or more pulsating flows of generally gaseous material under elevated pressure, such as the exhaust gases from a multi-cylinder internal combustion engine having cylinders or rows of cylinders displaced about a crank circle, comprising a plurality of devices, each device being associated with one said displaced cylinder and each device comprising an elongated casing which is generally bulbous at one end and tapers towards a substantially cylindrical portion at the other end, an input conduit for generally gaseous material communicating substantially tangentially with the interior of said casing at the bulbous end thereof, said cylindrical portion defining an output conduit, wherein, over the region of the casing lying substantially between the input conduit and said other end of the casing, the line of intersection of the casing with any plane including the longitudinal centre-line of the casing is a second order curve convex towards said centre-line, and wherein the devices are disposed with their longitudinal centre-lines lying at an angle to one another in spaced planes, the input conduits extending substantially parallel to one another.

References Cited

UNITED STATES PATENTS

940,031	11/1909	Krotz.	
1,217,021	2/1917	Lebedeff	181—51
1,564,931	12/1925	Boysen	181—58
2,057,304	10/1936	Saint-Jacques	181—58
2,370,259	2/1945	Rippingille.	
2,386,305	10/1945	Flickinger	181—43

FOREIGN PATENTS

17,282	1/1930	Australia.
573,669	3/1924	France.
592,649	5/1925	France.
639,486	3/1928	France.

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U.S. Cl. X.R.

181—40, 58, 60