

March 15, 1960

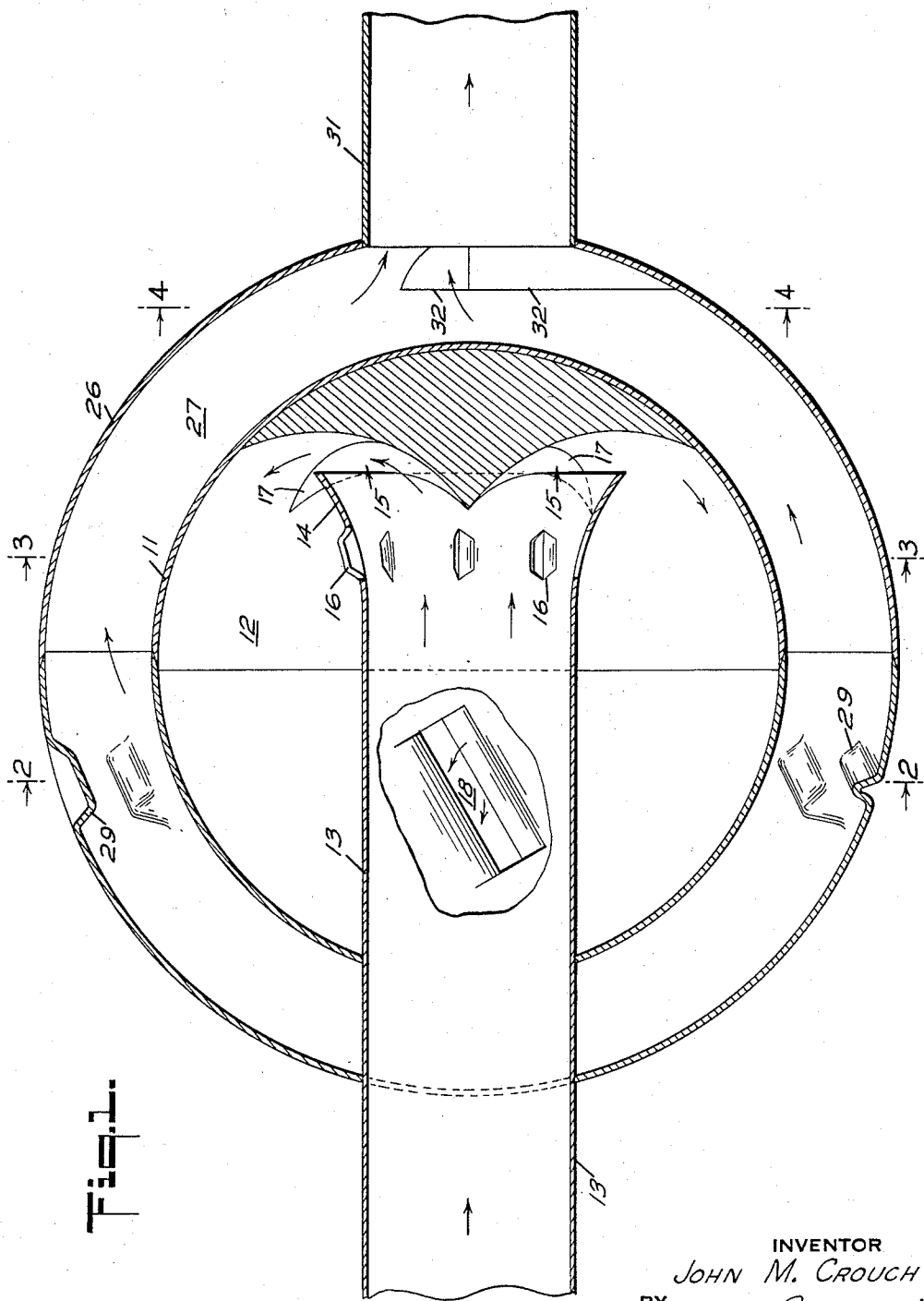
J. M. CROUCH

2,928,491

SOUND AND GAS-FLOW CONTROL UNIT

Filed Feb. 21, 1955

2 Sheets-Sheet 1



INVENTOR
JOHN M. CROUCH
BY *Gardner & Zimmerman*
ATTORNEYS

March 15, 1960

J. M. CROUCH

2,928,491

SOUND AND GAS-FLOW CONTROL UNIT

Filed Feb. 21, 1955

2 Sheets-Sheet 2

Fig. 2.

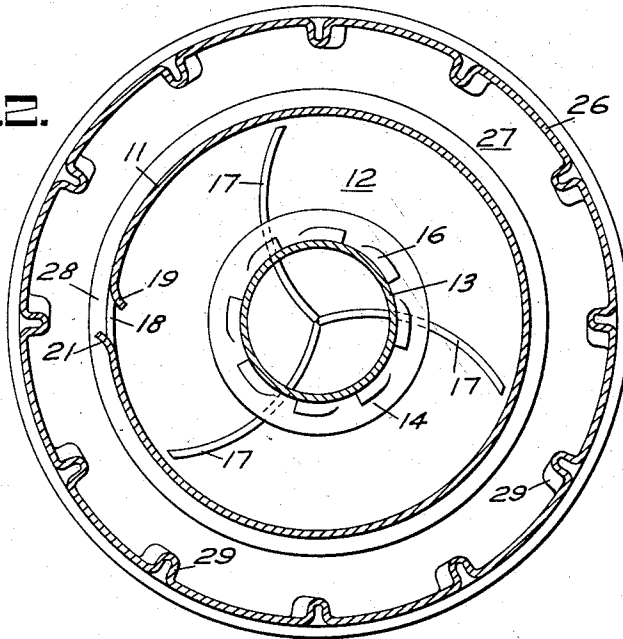


Fig. 3.

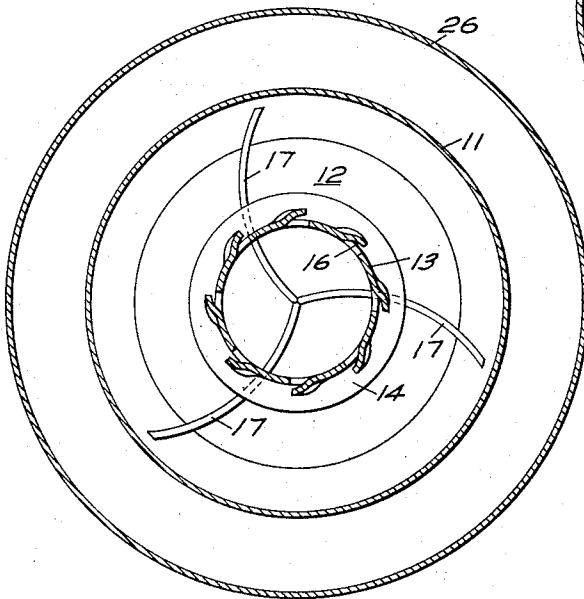
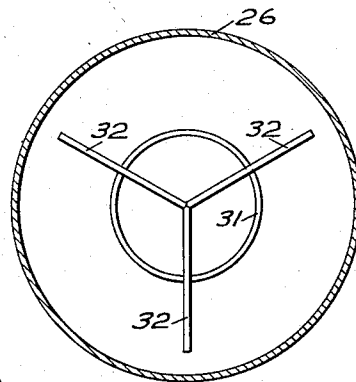


Fig. 4.

INVENTOR

JOHN M. CROUCH

BY

Gardner & Zimmerman
ATTORNEYS

1

2,928,491

SOUND AND GAS-FLOW CONTROL UNIT

John M. Crouch, Santa Cruz, Calif.

Application February 21, 1955, Serial No. 489,647

5 Claims. (Cl. 181—35)

The present invention relates to a sound and gas-flow control unit of the general type designated as mufflers or silencers and particularly adapted for muffling or silencing the exhaust of internal combustion engines and the like.

Mufflers adapted for exhaust gases of internal combustion engines must cope with a pulsating flow of gas from the engine and should silence the same without obstructing gas flow to the extent of building up a material gas pressure in the muffler. Back pressure built up in a restricted muffler will increase the exhaust pressure of the engine exhausting thereto and thereby prevent proper cylinder scavenging and will decrease the engine efficiency often to the extent of nullifying engineering advances in engine design.

Conventional mufflers or silencers provide a tortuous and restricted path for gas flow by the inclusion of a multitude of baffles whereby sound is reflected within the muffler; however, the restricted gas flow therethrough results in high gas pressures therein whereby engine exhaust pressure rises to the detriment of engine efficiency. Other mufflers operate to absorb sound within same with a generally straight gas flow therethrough; however, sound reduction is here again related to gas flow retardation so that either insufficient silencing results or else the engine exhaust pressure is raised.

The present invention operates to overcome the above noted difficulties of the prior art by providing a non-turbulent, or laminar, gas flow through the muffler and by silencing the exhaust through total sound reflection.

It is an object of the present invention to provide means for controlling exhaust gas flow without turbulence so as to silence the same by sound reflection.

It is another object of the present invention to provide means for producing smooth rotational gas flow through expanding and contracting means out of alignment whereby input gas pulsations are smoothed out and the sound of the same is removed by reflection without gas turbulence.

It is a further object of the present invention to provide an improved engine exhaust muffler having spherical gas expansion chambers with out-of-alignment connections therebetween.

Yet another object of the present invention is to provide an engine exhaust muffler having gas expansion nozzles directed into successive spherical chambers for laminar gas flow and having inlet and outlet connections of each chamber out of alignment.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by the said drawings and description may be adopted within the scope of the invention as set forth in the claims.

2

The invention is illustrated in the accompanying drawings wherein:

Figure 1 is a longitudinal center section of the flow control unit.

Figure 2 is a transverse sectional view taken at 2—2 of Figure 1.

Figure 3 is a transverse sectional view of the muffler taken at 3—3 of Figure 1.

Figure 4 is a transverse sectional view of the muffler taken at 4—4 of Figure 1.

Considering now the structural details of the illustrated embodiment of the invention and referring to the drawings there will be seen to be included as elements of the flow control unit a spherical member 11 defining therein a spherical expansion chamber 12 and an inlet pipe 13 extending through a wall of the sphere 11 and through the center thereof into proximity with the chamber wall opposite the point of pipe entrance. The inlet pipe 13 extends a substantial distance exteriorly of the spherical member 11 and is adapted for gastight connection to the exhaust system of an internal combustion engine for directing exhaust gases into the spherical chamber 12.

The gas inlet pipe 13 has a radially outwardly flaring inner end 14 and is provided with a plurality of hooded apertures 16 about this inner end at the beginning of the flare thereof for admitting passage of sound waves radially outward from the pipe 13. Considering sound to be wave propagated it may be shown that sound waves within a spherical chamber are repeatedly reflected from the chamber walls so as to eventually die out within the chamber. Such is here the action of the chamber 12 wherein sound waves from the flared pipe end 14 and from the pipe apertures 16 propagate themselves into impingement with the chamber walls whereat they are reflected at angles equal to that of incidence with subsequent wall impingement and reflection until substantial attenuation by repeated reflection results.

Gas flow into the chamber 12 is controlled otherwise than sound by the provision of gas impingement and direction means in the form of a plurality of vanes 17 disposed upon the chamber wall in alignment with the inner flared end 14 of the pipe 13. These vanes 17 extend radially outward of the inlet pipe 13 upon the chamber wall and are curved circumferentially of the pipe and form a peak at their juncture on an extension of the axis of the pipe. These vanes 17 thus direct the flow of gas from the pipe 13 along the inner spherical walls of the chamber in a multitude of curved trajectories thereon. Gas entering the chamber 12 through the pipe 13 thus passes through a nozzle 15 formed by the flared end 14 of the pipe 13 and the vanes 17 and is directed by the latter in spiral swirls outwardly along the spherical chamber walls.

The large volume of the chamber 12 provides for expansion of the gas entering the same whereby the gas is cooled and consequently reduced in volume. In this respect note that the sphere 11 is formed of a rigid material having good heat conducting qualities such as metal whereby heat is conducted away from the gas thereby. Also the above described nozzle 15 provides a smooth nonturbulent, and thus laminar, flow of gas within the chamber whereby no pressure is built up by turbulence of the gas.

The gas escapes from the chamber 12 through an outlet port 18 formed as a slit in the sphere 11 and displaced out of alignment with the pipe and entirely unsymmetrically disposed with respect to the same. This outlet port 18 may be situated some ninety degrees or more about the circumference of the chamber 12 from the vanes 17 and as here shown includes a lip 19 extending inwardly of the chamber on the side thereof adjacent the flared end of the pipe 13 with a similar lip 21 extending exteriorly

3

of the sphere 11 on the opposite side of the port. By the above noted disposition of the outlet port and the vanes 17 directing gas flow about the chamber there is thus provided a multitude of paths of gas flow in the chamber 12 between inlet and outlet with each path having a different length. Some particles of gas entering the chamber travel one way about the spherical interior thereof to the outlet port 18 while other gas particles are directed in a myriad of alternate directions about the chamber, and with the outlet port being offset with respect to the inlet pipe these gas paths are generally of unequal length. As a consequence, the gas concentration in each exhaust pulsation does not leave the chamber simultaneously but instead is spread out over a time interval so that some of same leaves the chamber during the subsequent paucity of exhaust gas between scavenging of cylinders in the engine.

The flow of gas through the outlet port 18 of the chamber 12 is thus much more even than that of the gas entering the chamber; however, it has been found that pulsations may yet occur when the chamber is connected to certain types of internal combustion engines or under certain operating conditions thereof so that there may be provided, as shown, a second spherical member 26 having a greater diameter than the first sphere 11 and disposed concentrically thereabout. This second sphere 26 defines a chamber 27 between same and the outer surface of the inner sphere 11 with this chamber 27 thus having the configuration of a spherical shell. The lips 19 and 21 on opposite sides of the outlet port 18 do not extend radially of the inner sphere 11, but instead are inclined, as shown. These lips may be formed by folding two portions of the inner sphere with one extending inward and one outward thereof and the distance between the lips 19 and 21 increases outwardly of the inner sphere 11 so that they form at the outlet port 18 a nozzle 28 through which the gases pass. In passing through this nozzle 28 of first decreasing and then increasing cross section, as the nozzle 15 at the end of inlet pipe 13, the gas velocity increases so the gas is in effect accelerated therethrough. Upon the inner surface of the outer sphere 26 there are formed a plurality of directing vanes 29, formed, for example, by locally deforming the wall of the outer sphere 26 inwardly to form inwardly extending walls or the like, as shown in Figure 2. These vanes 29 on the outer sphere 26 are spaced about the circumference thereof immediately outward of the nozzle 28 and are disposed in general parallelism with the nozzle slit or outlet port 18. These vanes thus operate to direct gas from the nozzle 28 in curved trajectories about the outer wall of the outer chamber 27.

For the escape of gas from the outer chamber 27 there is provided an outlet pipe 31 which may lie on an axial extension of the muffler inlet pipe 13 and which communicates with the interior of the outer chamber 27 entirely out of alignment and unsymmetrically disposed with respect to the nozzle 28 directing gas into the chamber. Over the inner end of the outlet pipe 31 there are disposed a number of vanes 32 extending radially outward of the pipe 31 beyond the circumference thereof from the axis of same and serving to redirect gas into the outlet pipe 31 and to retard sound passage into the pipe 31.

This second chamber 27 operates in the same manner as the inner chamber 12 in that gas flows in curved paths of differing length thereabout from the nozzle 28 to the outlet pipe 31 whereby the gas is accelerated, cooled, and reduced in volume while pulsations in the flow are further smoothed out so that a substantially steady flow of gas leaves the outlet pipe 31. Noise is likewise substantially eliminated in the outer chamber by reflection from spherical walls so that a substantially complete silencing effect is achieved.

Although the apparatus of the present invention has been described in connection with its adaptability for use

4

as an internal combustion engine muffler, it will be readily appreciated that the same apparatus may be used with equal efficiency wherever a need arises for either smoothing out a pulsating gas flow or for muffling the noise of discharged gas or vapor, or both.

It will also be appreciated that when using a plurality of chambers, instead of arranging the spheres concentrically and thereby increasing the diametrical extent of the unit, they may be placed in series with efficient results.

What is claimed is:

1. A sound and gas-flow control unit comprising means defining a spherical gas expansion chamber, gas inlet means including a pipe extending diametrically into said chamber admitting gas into said chamber, said pipe having a plurality of apertures therein adjacent only the discharge end thereof, vanes in said chamber interposed between the chamber wall and the end of said pipe directing gas flow along the spherical chamber wall for laminar flow, and an aperture defining gas outlet means in a wall of and communicating with said chamber and having a substantially smaller cross-sectional extent than the outlet of said inlet pipe.

2. Apparatus as set forth in claim 1 in which said outlet means is disposed on a diameter of said chamber spaced from the diameter containing the axis of said pipe and a diameter perpendicular thereto.

3. A sound and gas-flow control unit comprising at least two concentric spherical housings defining a first spherical chamber and a second annular chamber having unobstructed means communicating therebetween, a gas inlet pipe extending diametrically into the first and inner of said chambers past the center thereof for directing therein a pulsating flow of gas, a plurality of vanes disposed in the first of said chambers aligned with said inlet pipe for directing gas flow about the chamber walls in smooth flow, said gas inlet pipe being out of alignment with the means communicating between chambers whereby gas flows substantially evenly through the latter, a plurality of vanes in the second of said chambers directing gas flow over the spherical walls thereof, and outlet means in said second chamber out of alignment with the means communicating between chambers whereby gas silently exhausts therefrom.

4. A muffler for internal combustion engines having a pulsating flow of hot exhaust gas comprising a pipe adapted for connection to engine exhaust to conduct said gas flow, a pair of concentric spheres each defining chambers connected by an unobstructed opening therebetween, said gas inlet pipe extending into the innermost of said chambers adjacent a wall thereof and offset with respect to the opening between chambers, means within said innermost chamber forming with said inlet pipe a gas expansion nozzle directing gas flow uniformly about the spherical chamber walls whereby gas flows substantially evenly into the outer chamber, gas directing means in said outer chamber directing gas flow about the spherical walls thereof, and an outlet pipe communicating with the chamber defined within the outer sphere, said pipe being offset with respect to the inter-chamber opening.

5. A muffler comprising a first hollow sphere, an inlet pipe adapted for connection to a gas source and extending within said first sphere into proximity with the inner surface of a wall thereof, vanes disposed within said first sphere aligned with the pipe end and forming therewith a nozzle through which gas accelerates and directing gas flow substantially uniformly over the interior spherical walls, a second hollow sphere disposed concentrically of said first sphere having an outlet pipe, said first sphere having an opening through the wall thereof communicating with the interior of said second sphere and disposed in offset relation to said inlet and outlet pipes thereof respectively, said opening including a nozzle through which gas accelerates into said second sphere,

and vanes in said second sphere directing the gas to swirl over the interior surface thereof whereby gas pulsations are removed and a steady gas flow results through said outlet pipe.

References Cited in the file of this patent

UNITED STATES PATENTS

734,878	Jamison	July 28, 1903	
787,860	Sharpe	Apr. 18, 1905	10
991,515	Karminski et al.	May 9, 1911	
1,049,433	Winslow	Jan. 7, 1913	

5

1,074,627
2,012,331
2,732,026
2,806,548

21,554
554,601
139,414
992,706

Kenney ----- Oct. 7, 1913
Alexander ----- Aug. 27, 1935
Folts ----- Jan. 24, 1956
Carroll ----- Sept. 17, 1957

FOREIGN PATENTS

Great Britain ----- 1901
Germany ----- June 23, 1932
Australia ----- Nov. 14, 1950
France ----- July 11, 1951