Oct. 25, 1932. G. NICOLICH 1,885,062

EXHAUST SILENCER FOR INTERNAL COMBUSTION ENGINES

Filed April 4, 1929 2 Sheets-Sheet 1

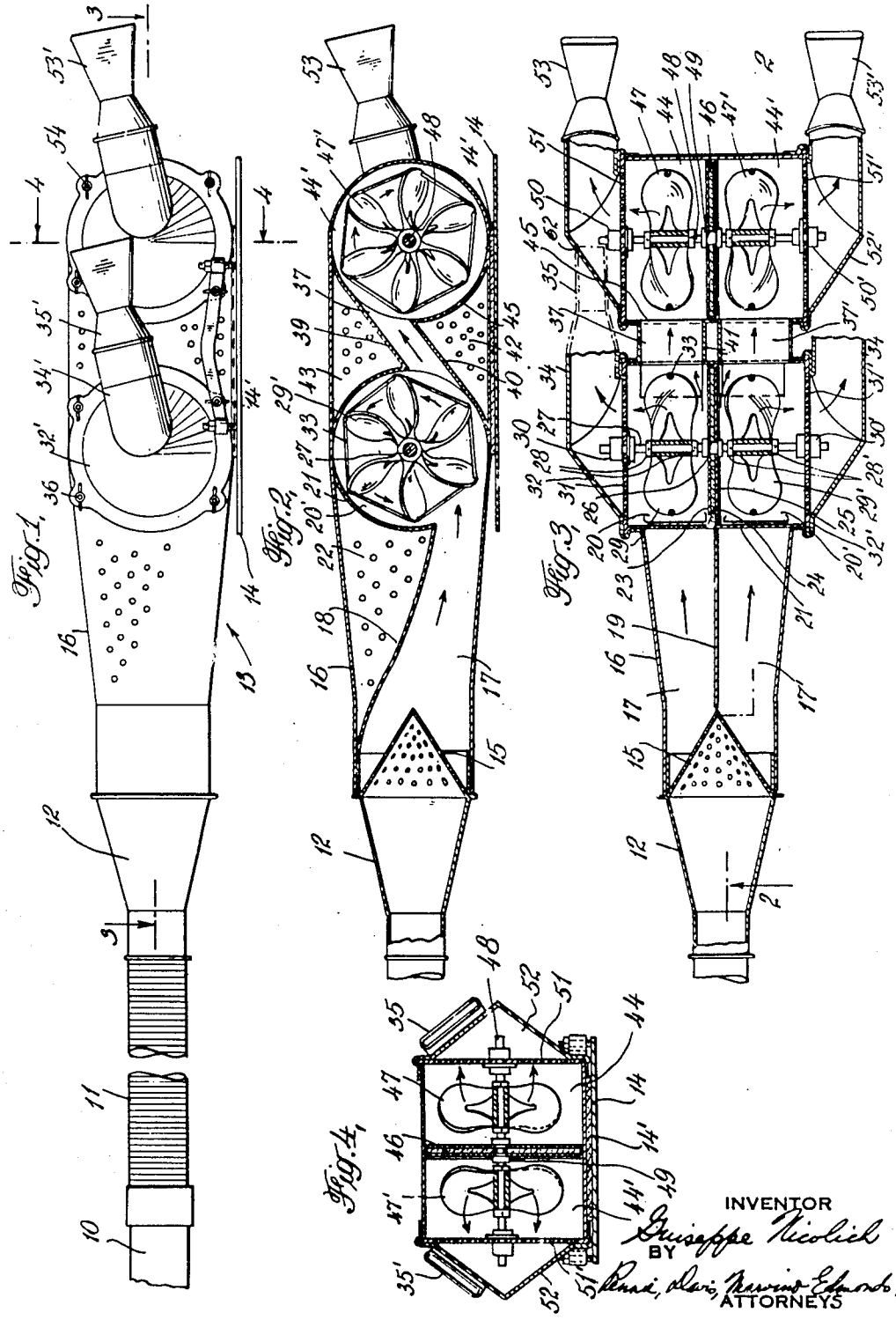


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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Fig. 5,

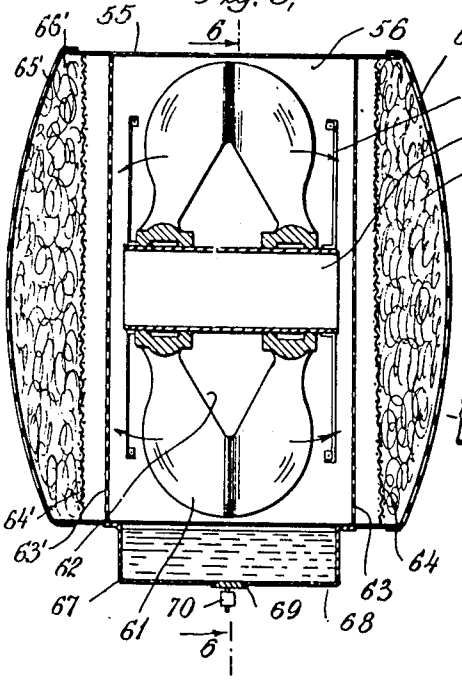


Fig. 6,

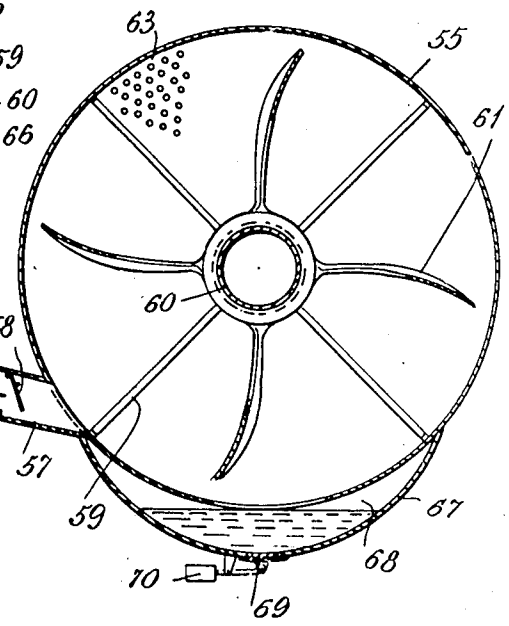
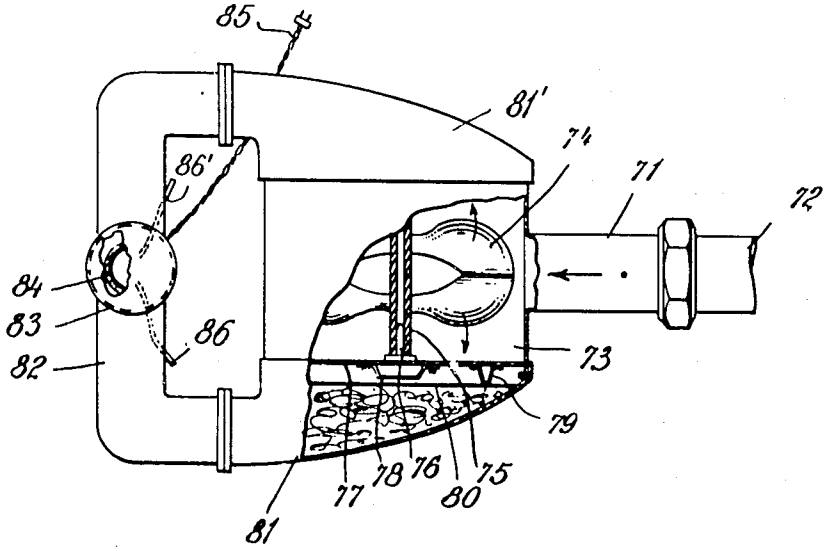


Fig. 7,



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UNITED STATES PATENT OFFICE

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EXHAUST SILENCER FOR INTERNAL COMBUSTION ENGINES

Application filed April 4, 1929, Serial No. 352,357, and in Italy January 11, 1928.

This invention relates to devices for silencing the exhaust gases of internal combustion engines and comprehends devices involving different modifications particularly adapted for silencing the exhaust gases of aeroplane, automobile, motor-boat and the like engines.

The majority of prior devices adapted to reduce the noise of the exhaust of internal combustion engines only operate effectively under definite conditions such as a predetermined velocity or pressure of the exhaust gases and with an exhaust gas volume which must remain practically constant, but under all other conditions such devices are inefficient and ineffective for the intended purpose of completely silencing the explosions of the engine and build up a considerable back pressure which impairs the efficiency of the engine.

It is the principal object of this invention to provide a silencer for internal combustion engines of all kinds, which obviates the aforementioned objections to present devices, by being efficient and effective to reduce the noise of an internal combustion engine at all speeds and under all conditions of gas velocity and volume without affecting the operation of the engine in any way. A further object is to provide a device which is simple and efficient for the purpose intended, and one which is light in weight, compact, fool-proof and not likely to get out of order under the most severe operating conditions.

These and other objects are obtained in a preferred embodiment of the invention including a connection from the exhaust manifold of an internal combustion engine to one or more circular chambers containing propeller wheels adapted to be rotated at high speed by the kinetic energy of the exhaust gases, the exhaust gases being so directed as to impinge upon the tips of the blades of the propellers whereby each succeeding blade of the consequently rapidly rotating propeller subdivides the gas stream into a great number of parts which are further subdivided by the deflection thereof through a disc placed parallel to the normal gas stream before exhausting into the atmosphere, this angular deflection being produced by the peculiar shape of the blades of the propeller. For purposes of silencing the exhaust of an internal combustion engine whose exhaust gases are discharged therefrom at comparatively low speed, one propeller chamber has been found satisfactory, but for engines whose exhaust gases are discharged at very high speeds and in which the range of exhaust gas speeds varies greatly, such as in an aeroplane engine, a plurality of chambers is employed, these chambers being arranged and connected in series, the gas stream being divided in the first chamber of the series and a part thereof deflected through the perforated plate into the atmosphere while the remainder of the gas stream, still travelling at high velocity, is conducted to the succeeding chambers of each series of chambers for further subdivision and deflection into the atmosphere through the perforated plates individual to each chamber, in the manner described in connection with the single or first chamber.

It has been found that for high speed engines such as aeroplane engines, a plurality of such sets of tandem chambers are necessary, for the reason that one chamber, even if made large enough, will not subdivide the gas sufficiently to procure the silencing action intended, i. e., a plurality of small propellers in a plurality of chambers subdivide the gas stream into a greater number of parts for the same gas velocity with a consequent greater silencing action. In fact, the greater the volume of gas and the greater the velocity thereof, the greater silencing the action procured by the device of this invention, so that aeroplane engines, for example, are silenced more effectively at highest speeds when the greatest noise ordinarily results.

For a better understanding of the invention, reference is made to the accompanying drawings, in which

Figure 1 illustrates in elevation a preferred embodiment of the exhaust silencer of this invention as it may be adapted for use in silencing the exhaust of aeroplane engines;

Fig. 2 is a longitudinal section thereof as seen along the line 2—2 of Fig. 3;

Fig. 3 is a plan view thereof as seen along the line 3—3 of Fig. 1;

Fig. 4 is a transverse section thereof as seen along the line 4—4 of Fig. 1;

Fig. 5 is a transverse section of the exhaust silencer of this invention having one propeller chamber and particularly adapted for automobiles or other internal combustion engines whose exhaust gases are discharged at a comparatively low speed;

Fig. 6 is a transverse section thereof as seen along the line 6—6 of Fig. 5; and

Fig. 7 is a plan view shown in partial section of a similar silencer embodying this invention and provided with means for eliminating the harmful carbon monoxide gases contained in the exhaust gases of the engine.

In these drawings, numeral 10 designates the exhaust manifold of an aeroplane engine, not shown, this exhaust manifold 10 being connected by a gas-tight flexible tube 11 to the intake funnel 12 of the exhaust silencer 13 of this invention which is adapted to be mounted by means of plate 14 to some portion of the aeroplane such as on the underside of the fuselage or the upper plane thereof. As shown in Fig. 1, the silencer 13 is placed in the position which it would occupy when mounted on the top plane of an aeroplane, whereas if it were mounted on the underside of the fuselage, for example, it would be turned upside down and secured to the fuselage by means of plate 14. An asbestos or other thermal non-conducting sheet 14′ is interposed as a heat insulator between the silencer proper and the mounting plate 14.

As shown particularly in Figs. 2 and 3, the funnel 12 is fitted with a perforated cone 15, the perforations of which are preferably of varying sizes. Because of this large conical surface, a greater number of perforations are possible and the consequent subdivision of the gas stream is increased without requiring any increase in the volume of exhaust gases passing through funnel 12. Funnel 12 is connected gas-tightly to the casing 16 of the silencer, this frame being perforated for cooling purposes and being torpedo-shaped to provide minimum air resistance and obtain a generally stream-line effect.

As shown particularly in Fig. 3, the exhaust gases emerging through the perforated cone 15 are divided into two streams passing through passages 17 and 17′, these passages being formed in casing 16 by horizontal partition 18 and vertical partition 19. Passage 17 discharges tangentially into circular chamber 20 formed by the circular sheet metal partition 21, while passage 17′ discharges into circular chamber 20′ also formed by partition 21. Partitions 18 and 21 form with the casing 16 a cooling chamber 22 in which air is circulated through the aforementioned perforations in casing 16 when the aeroplane moves through the air and as the propeller of the aeroplane deflects the air streams to the rear over the surfaces of the aeroplane and the attached silencer 13.

Chambers 20 and 20′ are separated by a partition formed of a sheet metal cup 23 in which is placed a disc 24 of asbestos or other heat insulating material over which is placed a sheet metal disc 25 secured in position by the crimped edges of the cup 23, as shown particularly in Fig. 3. Inserted through the partition 23, 24, 25 thus formed, is an oil-less journal 26 lubricated by graphite, which is unaffected by the heat of the exhaust gases, this graphite-lubricated journal being employed because, if oil were used, as a lubricant, this oil would soon burn out because of the hot gases surrounding the journal. Passing through journal 26 is a shaft 27 upon which, between collars 28, are journalled propellers 29 and 29′ located within chambers 20 and 20′, respectively. The free ends of the shaft 27 are journalled in graphite-lubricated bushings 30 and 30′ mounted in perforated discs 31 and 31′ respectively, these discs being secured in the edges of conical hoods 32 and 32′, which are mounted gas-tightly over the open sides of chambers 20 and 20′, respectively.

The blades of propellers 29 and 29′ are preferably cast integrally of Monel metal or other light and extremely strong material, the ends of the blades being trussed by wires or rods 33 so as to prevent distortion at high velocities and under high temperature of the exhaust gases. The blades of the propellers 29 and 29′ are turned outwardly so as to deflect the gas which impinges thereupon in a direction at right angles to its normal flow through passages 17 and 17′, whereby the gas is forced through perforated plates 31 and 31′ in the manner illustrated by the arrows in Fig. 3. As shown in Figs. 3 and 4, the blades of the propellers 29 and 29′ are apertured adjacent their axes to prevent resistance to rotation by eddying gases which accumulate adjacent the propeller axes.

The passages 17 and 17′ have orifices discharging tangentially into chambers 20 and 20′, these orifices having a length as seen in Fig. 2 of approximately one-fifth of the circumference of these chambers 20 and 20′, so that the exhaust gases impinge with limited constriction upon the tips of the blades of propellers 29 and 29′, which are accordingly rotated in a counterclockwise direction, as seen in Fig. 2, and at high velocity by the kinetic energy of the exhaust gases in proportion to their speed. Because of the peculiar shape of the propeller blades, as the blades pass the entrance orifices of passages 17 and 17′, each blade cuts off a portion of the gas stream issuing therefrom and deflects this portion at right angles through perforated plates 31 and 31′ to exhaust into hoods 32 and

32', respectively. Hoods 32 and 32' are preferably conical in shape as shown, and discharge into tubes 34 and 34', these tubes being fitted with constricting nozzles 35 and 35' of generally Venturi tube shape, so that the velocity of the gas is increased by constriction through these nozzles before being discharged through the emergence slots of these nozzles into the atmosphere. Hoods 32 and 32' are removably secured in place by wing nuts 36, so that they may be readily removed for inspection of the propellers and the perforated plates secured to the respective hoods.

All of the exhaust gases are not discharged through nozzles 35, but a portion thereof passes tangentially out of chambers 20 and 20' in the same general direction that they were introduced into the chambers through passages 17 and 17'. These remaining exhaust gases pass tangentially out of chambers 20 and 20' through respective angular passages 37 and 37' formed by sheet metal walls or horizontal partitions 39 and 40 as seen in Fig. 2, and vertical partition 41 shown in Fig. 3, these partitions forming with casing 16 air cooling chambers 42 and 43 through which the outside air circulates freely through the aforementioned perforations in the wall of casing 16 as the aeroplane passes through the air and as the aeroplane propeller blast flows over the silencer 13 as a whole. The gas stream may be considered as flowing continuously through passages 17 and 37 on one side and passages 17' and 37' on the other side, the blades of the respective propellers 29 and 29' rotated thereby, removing portions of the stream which are carried past the discharge passages 37 and 37' to be exhausted through plates 31 and 31', respectively, while that portion of the gas stream which is not removed by the blades of the propellers sweeping past discharge openings 37 and 37' flows through the passages.

Passages 37 and 37' are arranged diagonally in casing 16 and discharge tangentially into the upper portions of chambers 44 and 44', respectively, these circular chambers being formed by the rear wall of casing 16 and the arcuate partition 45, which preferably forms part of partition 40, as shown particularly in Fig. 2. Chambers 44 and 44' are separated by a heat insulated partition 46 which corresponds to partition 23, 24, 25 described above, and contain the respective propellers 47 and 47', which correspond to propellers 29 and 29', respectively. In a similar way, the shaft 48, upon which the propellers 47 and 47' are journalled, is journalled in graphite bushing 49 secured in partition 46 and at its end in graphite bushings 50 and 50' secured in perforated plates 51 and 51' mounted in hoods 52 and 52' having exhaust nozzles 53 and 53' and secured by wing nuts 54 over the open sides of chambers 44 and 44', respectively.

In operation on an aeroplane engine, the exhaust silencer of this invention described above subdivides the gas stream emerging from the exhaust manifold 10 of the engine into a plurality of small streams by means of perforated cone 15, this being the first stage of gas subdivision. The gas stream is then divided by partition 19 into two streams flowing through passages 17 and 17' to impinge tangentially upon the blades of propellers 29 and 29' mounted within chambers 20 and 20', respectively. The propellers 29 and 29' are rotated in a counter-clockwise direction as in Fig. 2 by the kinetic energy of the rapidly flowing gases and the gas stream is subdivided by the blades of these propellers during what may be termed the second subdivision stage. A portion of these two subdivided gas streams is deflected at approximately right angles by the peculiarly shaped blades of the propeller through the perforated plates 31 and 31' during what might be called the third subdivision stage, whereby that portion of the exhaust gases is silenced and is discharged through nozzles 35 and 35' into the atmosphere.

The remaining exhaust gases, still flowing at high velocity, flow through passages 37 and 37' to impinge tangentially upon the blades of propellers 47 and 47', respectively. The kinetic energy of the gas stream in turn rotates propellers 47 and 47' in a clockwise direction, that is, in a direction opposite to the direction of rotation of corresponding propellers 29 and 29', respectively. These propellers act in the same way as the aforementioned propellers, and subdivide the gas stream during the fourth subdivision stage by action of the rapidly moving blades into a plurality of portions which are deflected laterally by the turned blades through perforated plates 51 and 51' in the fifth subdivision stage to be exhausted into the atmosphere through nozzles 53 and 53' in the manner described. The silencing action in the second series of chambers 54 and 54' is the same as that described in connection with the first series of chambers 20 and 20', and the explosions of the engine are entirely silenced, especially at high crank-shaft speeds. Obviously, more than four chambers could be similarly connected in series pairs if desired, and for purposes of silencing the exhaust of an aeroplane or other high speed engine, it has been found that a plurality of chambers is necessary, these chambers being fitted with relatively small propellers whose peripheral speed is considerably greater than a larger propeller operating in a larger chamber, with the result that the tips of the blades of the smaller propeller procure a greater subdivision of the gas stream than would be the case if a large propeller, whose peripheral speed is considerably less, were used. To subdivide the gases in inverse proportion to their velocity and volume, the perforations in disc

31 may be made smaller than those in disc 51.

In cases where it is sought to silence the exhaust of internal combustion engines whose exhaust gases travel at a relatively low speed as compared to the velocity of the exhaust gases of an aeroplane engine, a single chamber may be employed in a device of the type illustrated in Figs. 5 to 7, inclusive. Referring particularly to Figs. 5 and 6, a circular casing 55 forms a circular chamber 56, into which the exhaust gas stream discharges tangentially through the tube 57 connected to the exhaust manifold of the internal combustion engine, not shown. Tube 57 is fitted with a flap valve 58, which is normally maintained open by the gas stream flowing in the direction of the arrow shown in Fig. 2, but is closed by back pressure to prevent return flow of the gases contained in chamber 56 due to any cause. Secured to brackets 59 mounted on the inner surfaces of the housing 55 is a shaft 60 upon which is journalled the propeller 61, this propeller having oppositely turned blades so as to deflect the gases impinging on the center thereof in opposite lateral directions. The propeller blades are also apertured at 62 to prevent resistance to the motion of the propeller by eddying gases which are liable to accumulate in proximity to shaft 60. The gases are immediately deflected through perforated plates 63 and 63′, from each of which are spaced the screens 64 and 64′ respectively, which form with perforated side plates 65 and 65′ a pair of opposite chambers in which is mounted filter consisting of a mass of metal or fibre wool 66 and 66′, respectively. At the bottom of housing 55 is mounted a container 67 forming a sump 68 which communicates through an opening with circular chamber 56. This sump is provided with a discharge opening normally closed by a valve 69 hinged to the lower surface of container 67, and normally held closed by means of a weight 70.

In operation, the gases emerging from the engine pass into tube 57 through normally open flap valve 58 and impinge upon the blades of propeller 61 to cause rapid rotation thereof in proportion to the velocity of the gas stream. The rotating blades passing the entrance orifice of tube 57 subdivided the gas stream into a plurality of portions which are deflected laterally in opposite directions through perforated plates 63 and 63′, which further subdivide the gas stream and silence the explosions of the engine. In passing through the masses of wool 66 and 66′, which are preferably saturated with some chemical solution to render harmless the carbon monoxide and other noxious gases, the gases are further subdivided and are discharged through perforated side plates 65 and 65′ into the atmosphere. The oils, water and other liquids commonly contained in exhaust gases are precipitated upon perforated plates 63 and 63′, and flow downwardly into sump 68 to be collected therein until the weight thereof counterbalances the weight 60, whereby valve 69 is opened to automatically discharge the accumulated liquid.

In Fig. 7, another modification particularly adapted for internal combustion engines whose exhaust gases are discharged at relatively low speed, such as an automobile engine, is provided with the tube 71 connected to the exhaust manifold 72 of the engine, not shown. This tube 71 discharges into chamber 73, fitted with the double deflecting propeller 74, which is mounted upon a hollow shaft 75, each end of which is journalled upon a pin 76, secured to a perforated plate 77, only one of which is shown. This perforated plate is fitted with a handle 78 for ready removal thereof and of the propeller 74 for inspection, repair and the like. Perforated plate 77 is also fitted with spacers 79 which properly locate it from a second perforated plate 80, mounted in the hood 81 connected to the housing forming chamber 73. A similar set of perforated plates are mounted in the opposite side of the device and a similar hood 81′ is provided, these hoods 81 and 81′ being connected to the manifold 82, in the center of which is mounted an open stack or chimney 83, to which the exhaust gases from both sides of the device are led. Within stack 83 is mounted an electrical resistance coil 84, which is adapted to be connected by wire 85 to the generator or battery of the automobile for the purpose of causing the resistance coil to become incandescent and serve as an igniter. Discharging into stack 83 at igniter 84 are a pair of air tubes 86 and 86′ whose outer ends are placed in the air stream so as to supply air to support the combustion of the carbon monoxide gas mixed with the exhaust gases and thus render the gases harmless when they are discharged into the atmosphere through stack 83.

It will be seen that the various modifications of the device of the exhaust silencer of this invention are efficient and effective for silencing the explosions of an internal combustion engine with which they may be associated without affecting the efficiency or operation of the engine by producing back pressure or resistance to the normal discharge of the gases, the effectiveness of the apparatus being proportional to the amount of noise produced by the engine, that is, the noisier the exhaust, the more effective the silencing action of the device of this invention.

While several modifications of the invention have been illustrated and described for silencing the exhaust gases of internal combustion engines of several kinds, it is to be understood that the invention is not limited to such disclosures, but is susceptible of many variations in form and detail, which may be obtained by substitution of portions of the

several modifications disclosed or by alterations and combinations thereof.

I claim:

1. In an internal combustion engine exhaust silencer the combination of a casing having a circular chamber, a multi-bladed wheel rotatably mounted in said chamber, the blades of said wheel being turned outwardly, at least one stationary perforated member mounted on said chamber adjacent the blades of said wheel and substantially parallel to the plane of rotation thereof, a reducing discharge nozzle communicating with said member and a tube leading from the exhaust pipe of the engine tangentially of said wheel into said chamber.

2. In an internal combustion engine exhaust silencer, the combination of a circular casing, a substantially straight tube connected to the exhaust pipe of the engine and communicating tangentially with the interior of said casing, a multi-bladed wheel rotatably mounted in said casing, the blades of said wheel extending substantially to said tube, at least one stationary perforated member mounted adjacent the blades of said wheel and substantially parallel to the plane of rotation thereof, said wheel being adapted to be rotated by the exhaust gas stream to deflect the gas laterally through said member, and a Venturi discharge nozzle communicating with said member.

3. In an internal combustion engine exhaust silencer, the combination of a circular casing, a substantially straight tube connected to the exhaust pipe of the engine and communicating tangentially with the interior of said casing, a multi-bladed wheel rotatably mounted in said casing, the blades of said wheel extending substantially to said tube, and a Venturi discharge nozzle communicating with the interior of said casing, said wheel being adapted to be rotated by the exhaust gas stream to deflect the gas laterally through said nozzle.

4. In an internal combustion engine exhaust silencer, the combination of a circular casing, a substantially straight tube connected to the exhaust pipe of the engine and communicating tangentially with the interior of said casing, a multi-bladed wheel rotatably mounted in said casing, the blades of said wheel adapted to extend substantially to said tube, at least one stationary perforated member mounted adjacent the blades of said wheel and substantially parallel to the plane of rotation thereof, and a reducing nozzle mounted over said member, said wheel being adapted to be rotated by the exhaust gas stream to deflect the gas laterally through said member and nozzle.

5. In an internal combustion engine exhaust silencer, the combination of a casing having a chamber, a multi-bladed wheel mounted for rotary movement therein, a passage leading from the exhaust pipe of the engine tangentially into said chamber, at least one other chamber, a multi-bladed wheel mounted for rotary motion therein, a passage tangentially interconnecting said chambers, and lateral outlet ports for each of said chambers.

6. In an internal combustion engine exhaust silencer, the combination of a casing having a chamber, a multi-bladed wheel mounted for rotary movement therein, a passage leading from the exhaust pipe of the engine tangentially into said chamber, at least one other chamber, a multi-bladed wheel mounted for rotary motion therein, a passage tangentially interconnecting said chambers, lateral outlet ports for each of said chambers, and perforated members in said outlet ports.

7. In an internal combustion engine exhaust silencer, the combination of a casing having a chamber, a multi-bladed wheel mounted for rotary movement therein, a passage leading from the exhaust pipe of the engine tangentially into said chamber, at least one other chamber, a multi-bladed wheel mounted for rotary motion therein, a passage tangentially interconnecting said chambers, lateral outlet ports for each of said chambers, and discharge nozzles connected to said outlet ports.

8. In an internal combustion engine exhaust silencer, the combination of a casing having a chamber, a multi-bladed wheel mounted for rotary movement therein, a passage leading from the exhaust pipe of the engine tangentially into said chamber, at least one other chamber, a multi-bladed wheel mounted for rotary motion therein, a passage tangentially interconnecting said chambers, lateral outlet ports for each of said chambers, perforated members in said outlet ports, and discharge nozzles connected to said outlet ports.

9. In an internal combustion engine exhaust silencer, the combination of a housing containing a series of chambers, a tube leading from the exhaust pipe of the engine tangentially into the first chamber, passages tangentially connecting the chambers in series, a multi-bladed wheel in each of said chambers adapted to be rotated by the gas stream to deflect gas laterally out of the corresponding chamber, and a discharge nozzle for each of said chambers.

10. In an internal combustion engine exhaust silencer, the combination of a housing containing a series of chambers, a pipe, leading from the exhaust pipe of the engine tangentially into the first chamber, a multi-bladed wheel mounted for rotary movement by the exhaust gas stream in each chamber, gas passages connecting said chambers in series and discharging tangentially into each chamber, and a gas subdividing nozzle mounted substantially parallel to the plane of rota-

tion of each of said wheels, said wheels being adapted to be rotated by the gas stream and deflect the gas laterally through said nozzles.

11. In an internal combustion engine exhaust silencer, the combination of a casing having a group of substantially circular chambers, a tube connected to the exhaust pipe of the engine and communicating tangentially with each of said chambers, a multi-bladed wheel rotatably mounted in each of said chambers with the tips of the blades adapted to project substantially to said tube, and nozzles arranged axially of said wheels, the blades of said wheels being turned to deflect a portion of the gases passing through said tube laterally through said nozzles.

12. In an internal combustion engine exhaust silencer, the combination of a casing having a group of substantially circular chambers, tube means connected to the exhaust of the engine and communicating tangentially with each of said chambers, a multi-bladed wheel rotatably mounted in each of said chambers with the tips of the blades adapted to project substantially to said tube means, at least one perforated member arranged parallel to the plane of rotation of each of said wheels so as to be swept thereby, the blades of said wheels being turned to deflect a portion of the gases passing through said tube means laterally through the perforations in said member.

13. In an internal combustion engine exhaust silencer, the combination of a casing having a series of substantially circular chambers, tube means connected to the exhaust pipe of the engine and communicating tangentially with each of said chambers, a multi-bladed wheel rotatably mounted in each of said chambers with the tips of the blades adapted to project substantially to said tube, at least one stationary perforated member arranged parallel to the plane of rotation of each of said wheels so as to be swept thereby, and a nozzle mounted over each of said members, the blades of said wheels being turned to deflect a portion of the gases passing through said tube laterally through said members and the corresponding nozzles.

14. In an internal combustion engine exhaust silencer, the combination of an elongated casing, partitions in said casing forming at least two circular chambers, a tube leading from the exhaust pipe of the engine tangentially into the first chamber, a tube in said casing forming a passage between one side of the first chamber and the diagonally opposite side of the second chamber, a multi-bladed wheel mounted in each chamber for rotation in opposite directions in response to the exhaust gas flow through said tubes, a stationary perforated plate mounted at a side of each chamber parallel to the plane of rotation of each wheel so as to be swept thereby, and a nozzle connected to each of said plates, the blades of each wheel being turned to deflect the exhaust gases laterally through the corresponding plate and nozzle.

15. In an internal combustion engine exhaust silencer, the combination of a casing having a chamber, a multi-bladed wheel mounted for rotary movement therein, a passage leading from the exhaust pipe of the engine tangentially into said chamber, at least one other chamber, a multi-bladed wheel mounted for rotary motion therein, a passage tangentially interconnecting said chambers, and Venturi discharge nozzles communicating with said chambers.

16. In an internal combustion engine exhaust silencer the combination of a casing having a circular chamber, a multi-bladed wheel rotatably mounted in said chamber, the blades of said wheel being shaped to direct the gases axially outwardly in both directions, at least one stationary perforated member mounted adjacent said chamber substantially parallel to the plane of rotation of said wheel, a reducing discharge nozzle communicating with said member and a tube leading from the exhaust pipe of the engine tangentially of said wheel into said chamber.

In testimony whereof I affix my signature.

GIUSEPPE NICOLICH.