

April 2, 1946.

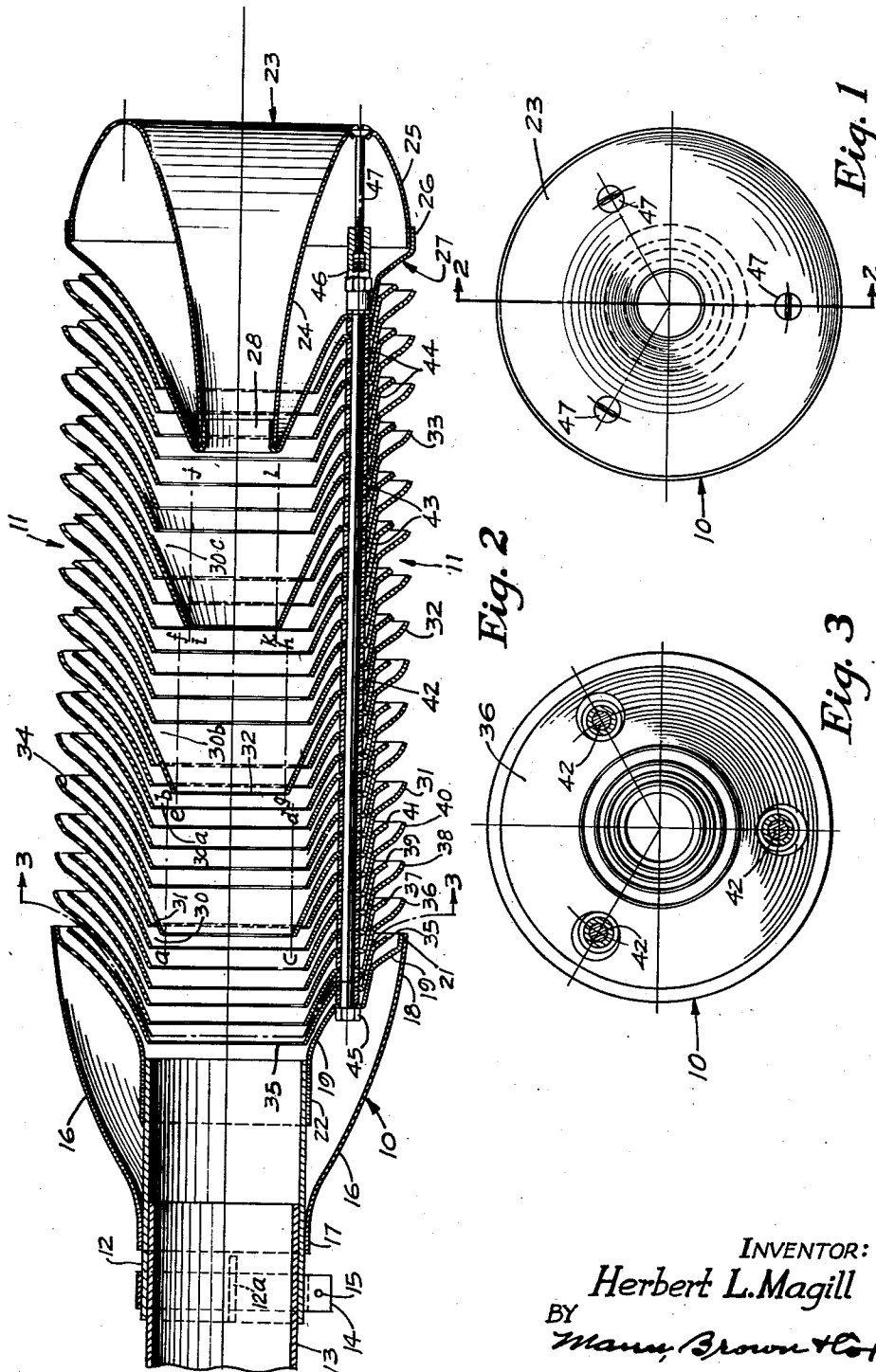
H. L. MAGILL

2,397,556

SILENCER UNIT

Filed March 2, 1944

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

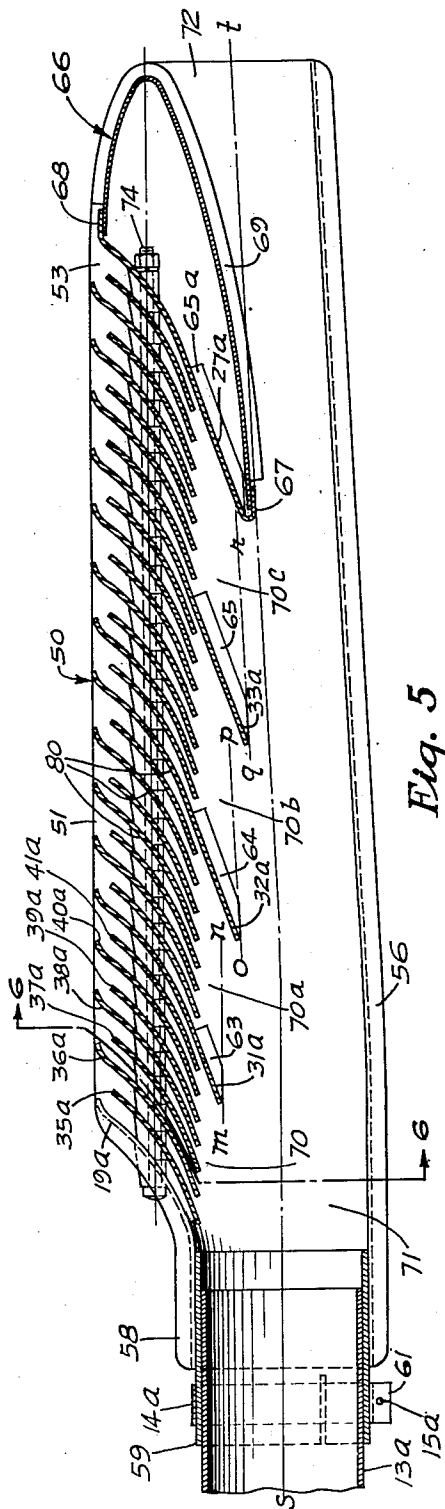


Fig. 5

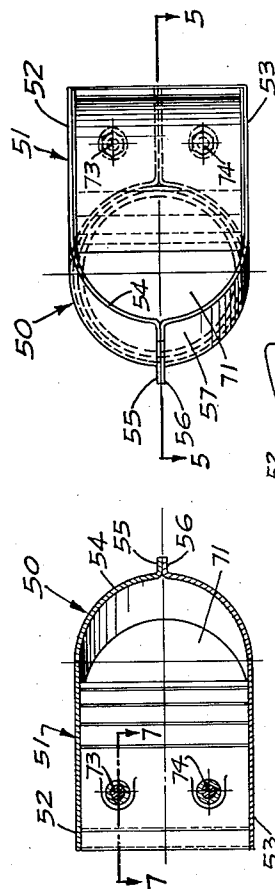
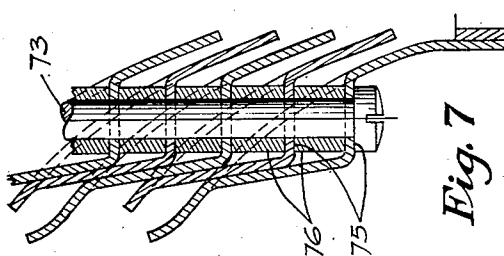


Fig. 4



UNITED STATES PATENT OFFICE

2,397,556

SILENCER UNIT

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14 Claims. (Cl. 181—60)

This invention relates to mufflers or silencer devices for reducing the force or intensity of sound incident to the discharge of gases through restricted passages under high pressure.

One of the important objects of the invention is the provision of a new and improved silencer for reducing the intensity of sound incident to the exhaust discharge of internal combustion engines.

Another object of the invention is the provision of a new and improved silencer for materially reducing the intensity of sound discharge of any gas under high pressure into the atmosphere without creating additional back pressure on the apparatus discharging the gas.

Another object of the invention is to so discharge portions of the exhaust gas laterally that in combination with the natural air stream flow around the exterior of the exhaust silencer when in motion at high speeds, a suction effect will be produced to react on the discharge exhaust flow from the engine to facilitate and improve the scavenging of the engine's cylinders and thereby tend to increase the power output of the engine.

Another object of the invention is to provide a device that will cool exhaust gases by expansion prior to release of the gases to the atmosphere, not only to avoid overheating of the device itself but also to prevent discharge into the atmosphere of flame, sparks and highly heated particles.

A further object of the invention is to provide a form of construction for the exhaust silencer that will create a minimum of aerodynamic resistance when in motion through the atmosphere, and when not in motion the lateral and rearward discharge of the exhaust gases through the anterior passages, and flowing rearwardly over the following passages, will tend to reduce pressure in those passages by entrainment of the gases therein, whereby even though the unit be not moving the engine's efficiency will be increased by reducing the back pressure of the exhaust.

A still further object of the invention is the provision of a new and improved silencer that is simple in construction, inexpensive to manufacture, easily assembled, that is efficient in operation, and that may be easily and readily applied to any exhaust discharge mechanism.

Other and further objects and advantages of the invention will be suggested from the following description, taken in connection with the accompanying drawings, in which

Fig. 1 is a rear elevation of the silencer device embodying one form of the invention;

Fig. 2 is a vertical section on the line 2—2 of Fig. 1;

Fig. 3 is a section on the broken line 3—3 of Fig. 2;

Fig. 4 is a rear elevation of a modified form of construction;

Fig. 5 is a section on the line 5—5 of Fig. 4;

Fig. 6 is a section on the broken line 6—6 of Fig. 5;

Fig. 7 is a section on the line 7—7 of Fig. 6; and
Fig. 8 is a perspective view of the casing shown in Fig. 5, on a reduced scale.

While the silencer unit is adapted to be used in various relations, and on numerous constructions where it is desirable to eliminate noise incident to the escape of gas under high pressure and velocity, as exhaust from engines, discharge from guns and other firearms and the like, the embodiments selected to illustrate the invention relate more particularly to silencers for internal combustion engines for use in motor vehicles, as airplanes, land vehicles, and the like.

Referring now to the drawings, the reference character 10 designates the silencer unit, which comprises a plurality or pack of transverse plates or wall members 11 in the form of hollow truncated cones coaxially arranged and nested in spaced relation, with their small ends or inner edges all turned in the same general upstream direction. The direction from whence comes the exhaust gases, or gases under pressure, will, for convenience of description, be termed the forward end of the device, which in Fig. 2 is at the left of the drawings.

The front end of the silencer unit is provided with suitable means for attaching the unit to an exhaust pipe or the like. Any appropriate means may be employed for this purpose, depending on the nature of the exhaust construction. As shown by way of example, a tubular attaching member 12 is employed for this purpose. It is adapted to slide or telescope over the rear end of the exhaust pipe 13 of the engine. Any convenient means such as the clamp 14, comprising a strap extending around the exhaust pipe 13 and clamped by the bolt 15, may be employed for holding the silencer positioned on the exhaust pipe, the tubular member 12 being slotted at its end, as at 12^a, to permit contraction for this purpose.

A curved conical head cap or front cap member 16 is provided for reinforcing the forward end portion of the silencer unit, and for insuring a

finished appearance to the unit. The forward end of the head cap tapers to a sleeve-like portion 17, which telescopes over the tubular attaching member 12 adjacent the forward end of the latter and is rigidly attached thereto, as by spot or seam welding, or the like. The rear end of the cap member 16 is flared outwardly, as at 18, and is rigidly attached to the foremost plate 19, which in turn has its outer edge extending rearwardly and rigidly secured in the rear end of the cap member, as by welding or the like, as shown at 21. The forward end of the foremost plate 19 telescopes over the tubular attaching member 12, as at 22, and is rigidly secured thereto.

The rear end of the silencer unit is provided with a rear or tail cap member 23, which comprises a tubular cone-like forwardly extending portion 24 and a return bent portion 25 telescoped within a rearwardly extending flange 26 on the rearmost conical plate or gas diverting member 27 of the exhaust unit 11. The forward end portion of the conical plate or gas diverting member 27 extends rearwardly to form an annular projection 28 that telescopes within the end of the forwardly extending portion 24 of the cap member 23, and is clamped in position, as will presently appear.

Suitable means are provided in the unit between the front and rear cap members for diverting portions of the exhaust from the main stream, expanding each portion separately and discharging the same from the sides of the unit into the atmosphere, whereby the noise and back pressure incident to the exhaust of the conventional internal combustion engine will be reduced to a minimum.

In the construction selected to illustrate one embodiment of the invention, the mechanism disclosed comprises means at intervals along the unit that successively diverts outer annular portions of the main exhaust stream outwardly and other means for radially expanding the same in such manner that the diverted portions discharge at the sides of the unit, mingling with the atmosphere at pressure and densities approximating that of the atmosphere.

In the form of construction shown in Figs. 1, 2 and 3, there is provided a plurality of gas or exhaust diverting members or plates 31, 32, 33 and 27, which form what will be termed gas expansion chambers 30, 30^a, 30^b and 30^c, between adjacent gas diverting members, respectively. Thus gas expansion chamber 30 lies forward of member 21, chamber 30^a extends between members 31 and 32, chamber 30^b is bounded by members 32 and 33, and chamber 30^c extends rearward from member 30 to member 27. These gas diverting members, which may be regarded as orifice means, are each more or less conical, are hollow, and are shaped like the frustrums of hollow cones with the smaller ends turned forwardly and coaxially arranged. These gas diverting members have gradually decreasing openings or internal diameters, from the front to rear of the silencer unit, at their forward ends, and all have the same external diameters at their rear or outer edges. Thus the successive entrances to the expansion chambers are progressively restricted. The rear or outer edges of these exhaust diverting plates or members are curved rearwardly or downstream, as shown at 34 in Fig. 2, for directing the exhaust gases rearwardly at their peripheral edges.

Appropriate means within the gas expanding chambers are provided for assisting in expanding

the annular streams of exhaust gases that are diverted from the main stream. As shown, an assembly of exhaust expanding members are employed between the foremost plate 19 and the forward exhaust diverting member 31, and between each two adjacent exhaust diverting members 31, 32, 33 and 27. Any suitable number of these diverting members may be employed. The gas expanding members of each assembly are substantially like those in the remaining expanding chambers, and each comprises the transverse plates or wall members 35, 36, 37, 38, 39, 40 and 41. There are two sets of these plates or gas expanding members, all of which are shaped like hollow frustrums of cones of the same internal diameters at their inner or foremost ends. The internal diameters of these smaller ends are substantially the same as that of the attaching sleeve member 12.

The plate members having the odd reference numerals are of substantially the same form and dimension, and are shorter and of less diameter at their outer or rear edges than the remaining ones. In other words, the plate members 35, 37, 39 and 41 are shorter and are of less diameter at their outer ends than the even numbered plate members 36, 38 and 40. The plate members of the first-mentioned set have their outer peripheral edges substantially straight and extending outwardly and rearwardly. The remaining plate members of each assembly are of the same outer diameter as the exhaust diverting members 31, 32, 33 and 27, and are also curved rearwardly like those members, and terminate outwardly of the outer straight edges of the plate 35, 37, 39 and 41, for directing the exhaust rearwardly over those plates. In other words, some of the transverse plates have outer edges extending beyond the outer edges of adjacent plates downstream therefrom and turned toward said adjacent plates. Thus the transverse plates define lateral escape passages for the exhaust gas, and some of the passages direct their discharge across said adjacent passage exits to promote exhaust from the adjacent passages.

The exhaust diverting plate members and the exhaust expanding plate members have similar contours, and are held in assembled or spaced nested relation by a plurality of support means in the form of bolts or rods 42, which extend through openings in radially extending portions 43 formed in each of these plate members. Any suitable number of these rods may be employed, three being shown spaced 120° apart. The plate members are held in spaced relation by spacer blocks 44 between each two adjacent discs, and at the ends of the silencer unit between the end plates and the head and tail caps, respectively. Suitable nuts 45 and 46 on the ends of the bolts 42 clamp the parts in assembled relation to form a unitary structure. The nuts 45 are preferably welded to the plate 19 in order to facilitate assembly. The nuts 46 for the rear ends of the bolts 42 may be extended and internally threaded for receiving bolts 47 for clamping the rear cap member 23 in telescopic relation to the flange 26 and rear extension 23 of the rear plate member 27.

It will thus be seen that the diverting plate members 31, 32, 33 and 27 will successively skim off or divert an annulus from the periphery of the rearwardly moving stream of exhaust gases and direct the same into the expansion chambers 30, 30^a, 30^b and 30^c, between the adjacent exhaust diverting plate members; and it will be

appreciated that this diverted gas is expanded

as it flows radially outward and rearward between the exhaust expanding plate members. Each of these gas diverting and expanding members has its inner end and intermediate portion curved rearwardly, with the inner portion of the curve at a more acute angle to the axis of the unit than the outer portions of the curve, so as to form passages between the plate members that increase materially in cross-sectional area from their inner to their outer ends or toward their outer peripheries.

In the operation of the device the exhaust gases passing rearward into the silencer unit will have an annular peripheral portion of the stream of exhaust gases escaping from the pipe 13 diverted radially outwardly into the expansion chamber 30, between the plate member 31 and the front plate member 19. When the exhaust passes beyond the tubular member 12, the entire stream expands to a certain extent because the peripheral portion of it expands into the expansion chamber immediately after it leaves the tubular member 12, and before it reaches the first diverting plate 31. The gas diverted by the plate 31 and divided by the gas expanding members into a plurality of thin streams moving at high velocity, will not only be expanded radially but will be materially increased in volume due to the increasing cross-sectional area of the passages toward the outer periphery of the silencer unit, and will therefore be first cooled and then discharged at comparatively low velocity and with very little noise, if any at all. This is considered an important feature of the invention.

The remaining main stream of exhaust gas, now slightly expanded but reduced in diameter by the initial "skimming" action of the exhaust diverting member 31, as indicated by the space between the dot and dash lines *a-b* and *c-d*, Fig. 2, flows rearwardly and will further expand in the chamber 30^a and have another annulus of the stream diverted or removed by the plate member 32, thus further reducing the stream in pressure and also in diameter, as indicated by the space between the dot and dash lines *e-f* and *g-h*, Fig. 2.

This annulus of exhaust is diverted into the expansion chamber 30^a formed between the exhaust diverting plates 31 and 32, and is further expanded due to increase in radius and in cross-sectional area of the passages between the expanding plates in this last-named chamber. Likewise, the plate member 33 further reduces the diameter of the exhaust stream, as indicated by the dot and dash lines *i-j* and *k-l*. The stream is further reduced by the plate member 27, and this reduced stream expands radially within the cap member 23.

It will be noted that the successive expansion chambers offer progressively less obstruction to the exhaust gases. In the first place, while the same number of expanding plates is employed in each of the expansion chambers 30, 30^a, 30^b and 30^c, the successive chambers are progressively increased in length with consequent increased spacing between the expanding plates. In the second place, the volume of the gas stream progressively lessens along the series of expansion chambers, so that even if the expansion chambers were of uniform size the chambers would be of increasing size relative to the volumes of gas admitted thereto. In the third place, the radial distance between the expanding plates and the gas stream entering the expansion chambers increases in the successive chambers. Thus

the space in the chambers 30^c, for instance, between the inner peripheral edges of the expansion members and the line *i-j*, is greater than the corresponding space in the preceding chamber. As a result of this arrangement the pressure in the main stream is more and more reduced, with a corresponding reduction in velocity, before it enters the rear cap member 23, where it is further expanded and discharged into the atmosphere at greatly reduced pressure and velocity.

The radial expansion of one annulus of the exhaust after another, and the continued expansion of the main exhaust stream as it passes one expansion chamber after another, prevents noise and permits an almost free expansion of the gas, whereby there is little or no back pressure on the engine, thereby adding to its efficiency.

In the form of construction described above, the silencer unit is cylindrical in shape and the exhaust is discharged from the entire periphery of the cylinder. Under certain conditions it is desirable that the exhaust from the silencer unit be discharged from a portion of the periphery of the silencer only. For instance, in the interest of safety against fire and carbon monoxide gas escaping into the vehicle, in the use of the silencer unit as a muffler for certain types of land motor vehicles, and for aircraft and the like, it is necessary, or at least desirable, that the exhaust gases be directed away from the vehicle body or away from adjacent combustible portions of the structures on which the device is employed. All forms of my invention provide an exhaust channel having at least one side open to the atmosphere, and the form above described provides an exhaust channel open to the atmosphere on all sides. The channel in the form next described is open to the atmosphere on only one side.

In the form of construction shown in Figs. 4 to 8, the silencer is of a form in which the discharge diverting and expanding members are in the shape of curved substantially rectangular plates, and the portion of the casing opposite these plates is more or less semi-circular, forming a conduit along which portions of the exhaust are discharged laterally. In this form of construction the silencer unit 50 is of a type in which portions of the gases are discharged in one direction only, which may be laterally or downwardly, depending on how the device is attached. The casing 51 of the silencer unit 50 is channel form in cross-section, having the flanges 52, 53, extending laterally in spaced relation and having a curved web portion 54. The casing is split into two sections in a plane extending midway between the flanges 52, 53, and the curved edges are provided with outwardly extending flanges 55, 56, rigidly secured together by any suitable means. The curved portions of the two sections of the silencer unit form the main exhaust conduit 71, that has its rear portion slightly inclined, or at an angle, to the forward portion, as shown in Fig. 5, and as indicated at 57 in Fig. 4.

The two sections of the silencer unit are together provided with a cylindrical sleeve portion 58, Fig. 8, which telescopes an attaching sleeve portion 59 and is rigidly attached thereto. The forward end of the casing 51, Fig. 8, has the flanges 52, 53, bent inwardly toward each other, as at 50^a and 50^b, to form a curved wall constituting the foremost expanding plate 19^a. The adjacent edges of the curved wall and sleeve portions are bent radially outwardly to form the abutting flanges 50^c and 50^d, which are rigidly se-

cured together. The attaching sleeve portion 59 is adapted to be attached to the exhaust pipe 13^a in any suitable manner, as by being clamped thereon by the strap 14^a and bolt 15^a, or by any other suitable means, as more fully described above.

A plurality of gas diverting members 31^a, 32^a, 33^a and 27^a, which correspond to like numbered members of the previously described construction, are provided between the flanges 52, 53, of the casing 51, and all are secured thereto at their forward side edges by integral flanges 63, 64, and 65, 65^a. The rear gas diverting member 27^a is secured to the rear cap or tail member 66. This cap member is in the form of a loop having its end edges extending forwardly and telescoped within the rearwardly extending flanges 67, 68, of the rear gas diverting member 27^a. The cap member has flanges 69 on its edges that are rigidly connected to the flanges 52 and 53 of the casing 51, as by welding or the like.

The gas diverting members 31^a, 32^a, 33^a and 27^a are curved, as at 69, with the concave side forward, and have their outer edges curved rearwardly for directing the escaping gas rearwardly.

The front end plate or wall 19^a has its inner or forward end connected to the connector member 59, and the other gas diverting plates 31^a, 32^a, 33^a and 27^a are arranged to extend progressively inwardly toward the axis of the channel 71, from front to rear, as indicated by the dotted lines *m-n*, *o-p*, *q-r* and *s-t*, which indicate the planes of the inner edges of these members, as shown in Fig. 5 of the drawings. It will thus be seen that the exhaust gases, or gases under pressure, flowing rearwardly through the channel 71, will have a portion thereof diverted outwardly by the plate 31^a, and a further portion of the gas diverted laterally outwardly by the plate 32^a. Another portion of the remaining stream will be diverted laterally by the plate 33^a, and still another portion will be diverted outwardly from the remaining gas stream by the plate 27^a, so that only a portion of the original stream will pass the plate 27^a through the rear portion of the passage 71. The rear portion of this passage is enlarged, as at 72, so that the gas in this portion of the stream is considerably expanded immediately prior to its discharge into the atmosphere.

The space between any two adjacent gas diverting plates may be termed expansion chambers, and there are a plurality of gas expanding plates within each of these chambers. Since the gas diverting plates are substantially alike, only those between the plate or wall 19^a and the first gas diverting plate 31^a need be described.

All of the gas expanding plates 35^a, 36^a, 37^a, 38^a, 39^a, 40^a and 41^a have their inner ends in the same plane—that is, inclined toward the main passage 71 toward the rear. These gas expanding plates or members are arranged in two sets—the members of each set being substantially alike. For instance, the plates indicated by the odd numbers are alike, and those indicated by the even numbers are also alike.

All of these plates are slightly curved, with the concave face forwardly, and are arranged closer together at their inner edge portions than at their outer so as to provide passages of gradually increasing cross-sectional area toward their outer ends so as to expand the gas passing along the same. This is accomplished in the same manner as described above. One way of securing this result is to describe the curves as arcs of circles, with the centers of the circles outwardly of the

casing in such position that the inner edges of the plates are more nearly parallel with the center line of the unit, while the outer edge portions of the plates are more nearly perpendicular thereto. Such an arrangement will result in laterally extending passages very much larger in cross-section at their outer ends than at their inner ones.

The plates designated by the odd numbers, with lettered exponents, terminate short of the outer edge of the flanges 52, 53, while those plates designated by the even numbers, with lettered exponents, extend outwardly to the outer edge of the flanges 52, 53, and are bent slightly rearwardly so as to direct the escaping gas outwardly and rearwardly.

The arrangement is the same as that already described, and shown in Fig. 2, except that rectangular plates instead of circular plates are employed for the gas or exhaust expanding members.

The outer ends of these expanding members are held in spaced relation by bolts 73, 74 (see Figs. 4 and 7), which pass through local bent portions 75 formed in these plates. Suitable spacer sleeve members 76 are provided between each two adjacent plates, as in the previously described construction.

In the operation of the device, the exhaust passing rearwardly through the exhaust pipe 13^a into the silencer unit 59 will have an outer portion down to the dotted line *m-n* skimmed off or diverted into the expansion chamber 70 formed by the plate 31^a; and this portion of the exhaust will pass outwardly between the expanding plates 19^a, 35^a, 36^a, 37^a, 38^a, 39^a, 40^a, 41^a, and gas diverting plate 27^a, and in doing so it will expand and discharge outwardly and rearwardly into the atmosphere at a greatly reduced pressure, as in the previous construction. The entire gas stream will begin to expand as soon as the exhaust leaves the sleeve 58, and will continue to expand as it passes each expansion chamber in succession, as described above. The remaining portion of the gas stream passing along the passage 71, beyond the diverting disc, will expand in the next chamber 73^a, and will have another portion diverted by the plate 32^a, and this portion, represented by the space between the dotted lines *m-n* and *o-p*, will pass into the second expansion chamber 70^a, where the expansion process is repeated, and the trapped exhaust will pass out between the expanding plates into the atmosphere in the manner just described.

Likewise, the remaining portion of the exhaust will expand as it passes the expansion chamber 70^b, and will have a part thereof diverted by the plate 33^a, and this part, represented as the space between the lines *o-p* and *q-r*, will be trapped in the expansion chamber 70^b and pass outwardly between the expanding plates, as already described.

The same process will occur at the rear end of the unit, where the gas diverting plate 27^a will divert a portion of the remaining stream, as represented by the dotted lines *q-r* and *s-t*. This gas will be diverted into the expansion chamber 70^c and pass outwardly between the plates therein, as described above.

The entire stream expands to a certain extent as it passes from one chamber to the other, so that the central stream, by the time it reaches the rear end of the silencer unit, has its velocity greatly reduced, and is further expanded and its velocity decreased still more in passing through the rear cap member 66, so that it is finally dis-

charged, with little or no noise, into the atmosphere.

In both forms of construction high speed movement of the silencer unit through the air, with portions of the exhaust diverted laterally and rearwardly from the casing, tends to create a partial vacuum within the rear cap member and in the rear of the unit, which will materially assist in scavenging the engine cylinders, thereby increasing the power output of the engine. Even though the unit be motionless, the passage of the laterally and rearwardly discharged gas from the front portion of the unit across the lateral passages toward the rear will tend to create a partial vacuum in those passages, due to the principle of entrainment of gases.

The number of diverting plates may each or both be increased or decreased in either form of construction, as may be desired. While in the constructions shown the diverting and expanding members are of certain forms, it is understood that the structures disclosed are by way of example only and that other forms may be utilized so long as they provide means for expanding the gas or for reducing its velocity prior to its discharge into the atmosphere.

It will thus be seen that the main stream of exhaust gas is reduced in volume and pressure at intervals as it moves toward the rear, and that the portions diverted from the main stream, as well as the main stream itself, are expanded prior to their discharge into the atmosphere, so that the lateral discharges, as well as the greatly reduced main discharge, will be expanded to such an extent that the pressure will not be much above that of the atmosphere, whereby the exhaust will be almost, if not entirely, noiseless.

It is thought from the foregoing, taken in connection with the accompanying drawings, that the construction and operation of my device will be apparent to those skilled in the art, and that changes in size, shape, proportion or detail may be made without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a muffler for releasing a compressed gaseous stream to the atmosphere, means providing a channel for said stream, said channel being open to the atmosphere along at least one side, and a plurality of transverse plates dividing said open side of the channel into a plurality of lateral passages from said channel to the atmosphere, said plates at their inner edges curving upstream to relatively acute angles to the axis of said channel and overlapping at their inner ends to restrict the inner ends of said passages, said plates curving outward to substantially less acute angles to the axis of said channel thereby spreading apart to progressively increase the cross-sectional areas of said lateral passages for substantial expansion of the gas therein prior to escape of the gas to the atmosphere.

2. In a muffler for releasing a compressed gaseous stream to the atmosphere, means providing a channel for said stream, said channel being open to the atmosphere along at least one side, and a plurality of transverse plates dividing said open side of the channel into a plurality of lateral passages from said channel to the atmosphere, said plates at their inner ends being inclined upstream at acute angles to the axis of said channels and spreading apart at their outer ends, at least some of said plates extending laterally beyond adjacent plates downstream therefrom and being turned downstream at their outer

ends to divert escaping gas across the edges of said adjacent plates.

3. In a muffler for releasing a compressed gaseous stream to the atmosphere, means providing a channel for said stream, said channel being open to the atmosphere along at least one side, and a plurality of transverse plates dividing said open side of the channel into a plurality of lateral passages from said channel to the atmosphere, said plates at their inner ends being inclined upstream, at least some of said plates at their outer edges extending laterally beyond adjacent plates downstream therefrom and having said outer edges turned toward said adjacent plates to divert escaping gas across the edges of said adjacent plates.

4. In a muffler for releasing a compressed gaseous stream to the atmosphere, a plurality of transverse plates forming at least one side of a channel for said stream, said plates having their inner edges spaced along the periphery of said stream longitudinally of the stream to form lateral escape passages to the atmosphere, said plates at their inner edges being inclined upstream at acute angles to the axis of the stream and spreading apart toward their outer edges for expansion of the laterally escaping gas, and a plurality of orifice means spaced along said channel in the zone of said plates dividing said channel into a series of expansion chambers communicating with the atmosphere through said escape passages, each of said expansion chambers being defined peripherally by the inner edges of a plurality of said transverse plates.

5. In a muffler, a construction as set forth in claim 4 in which said orifice means are progressively restricted.

6. In a muffler for releasing a compressed gaseous stream to the atmosphere, means providing a channel for said stream, said channel being open to the atmosphere on at least one side and being open to the atmosphere at its end, said channel being unobstructed along its axis, a plurality of transverse plates along said open side of the channel dividing said open side into a plurality of closely spaced lateral discharge passages, said plates at their inner edges curving upstream to relatively acute angles to the axis of said channel and overlapping at their inner ends to restrict the inner ends of said passages, said plates spreading apart toward their outer edges to permit expansion of gas in said discharge passages.

7. In a muffler for releasing a compressed gaseous stream to the atmosphere, means directing said stream along a discharge path open laterally to the atmosphere, support means extending longitudinally of said path spaced laterally from the axis of the path, a plurality of transverse plates mounted on said support means adjacent said path, and a plurality of spacers mounted on said support means to hold said plates spaced apart to define a series of lateral discharge passages, the inner edges of said plates being directed upstream and positioned relatively close together, said plates spreading apart toward their outer edges to permit expansion of gas in said discharge passages.

8. In a muffler for releasing a compressed gaseous stream to the atmosphere, means directing said stream along a discharge path open laterally to the atmosphere, support means extending longitudinally of said path spaced laterally from the axis of the path, a plurality of transverse plates mounted on said support means adjacent said path, and a plurality of spacers

mounted on said support means to hold said plates spaced apart to define a series of lateral discharge passages, the inner edges of said plates being directed upstream and positioned relatively close together, said plates spreading apart toward their outer edges to permit expansion of gas in said discharge passages, some of said plates extending inward further than the majority of the plates thereby defining expansion chambers along said path.

9. In a muffler for releasing a compressed gaseous stream to the atmosphere, means directing said stream along a discharge path open laterally to the atmosphere, support means extending longitudinally of said path spaced laterally from the axis of the path, a plurality of transverse plates mounted on said support means adjacent said path, and a plurality of spacers mounted on said support means to hold said plates spaced apart to define a series of lateral discharge passages, the inner edges of said plates being directed upstream and positioned relatively close together, said plates spreading apart toward their outer edges to permit expansion of gas in said discharge passages, some of said plates extending inward further than the majority of the plates thereby defining expansion chambers along said path, the successive entrances to said chambers being progressively restricted.

10. In a muffler for releasing a compressed gaseous stream to the atmosphere, a series of expansion chambers having inlet and outlet openings along the axis of said stream, each of said expansion chambers having at least one side open to the atmosphere and having a series of lateral wall members dividing said open side into a series of lateral discharge passages, the inner edges of said wall members being directed upstream.

11. In a muffler for releasing a compressed gaseous stream to the atmosphere, a series of expansion chambers having inlet and outlet openings along the axis of said stream, the successive inlet openings being progressively restricted, each of said expansion chambers having at least one side

open to the atmosphere and having a series of lateral wall members dividing said open side into a series of lateral discharge passages, the inner edges of said wall members being directed upstream.

12. In a muffler for releasing a compressed gaseous stream to the atmosphere, a series of expansion chambers having inlet and outlet openings along the axis of said stream, each of said expansion chambers having at least one side open to the atmosphere and having a series of lateral wall members dividing said open side into a series of lateral discharge passages, the inner edges of said wall members being directed upstream, the outer edges of said wall members being directed downstream whereby the discharge from one passage tends to lower the pressure at the outer end of the adjacent passage downstream therefrom.

13. In a muffler for releasing a compressed gaseous stream to the atmosphere, a series of expansion chambers having inlet and outlet openings along the axis of said stream, each of said expansion chambers having at least one side open to the atmosphere and having a series of lateral wall members dividing said open side into a series of lateral discharge passages, the inner edges of said wall members being directed upstream, the outer edges of some of said wall members extending outward beyond the outer edges of adjacent wall members downstream therefrom and being turned toward said adjacent wall members for diversion of discharge gases toward the adjacent wall members.

14. In a muffler for releasing a compressed gaseous stream to the atmosphere, a casing forming a channel open along one side, transverse diverting plates spaced along said open side of the casing for diverting gases from said channel, and transverse expanding plates positioned between said diverting plates to form escape passages in which the diverted gases are expanded and from which the expanded gases are discharged into the atmosphere.

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