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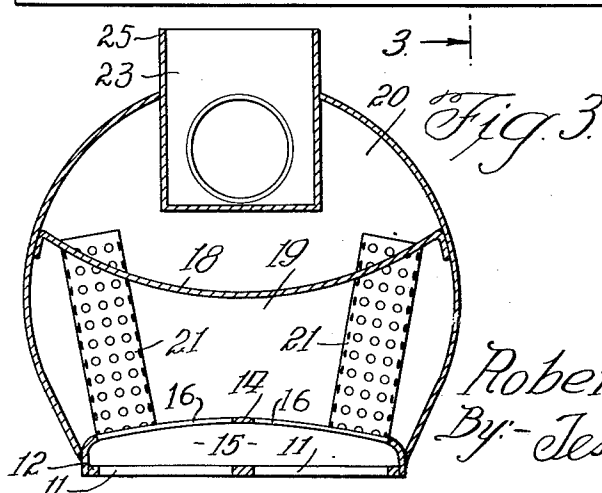
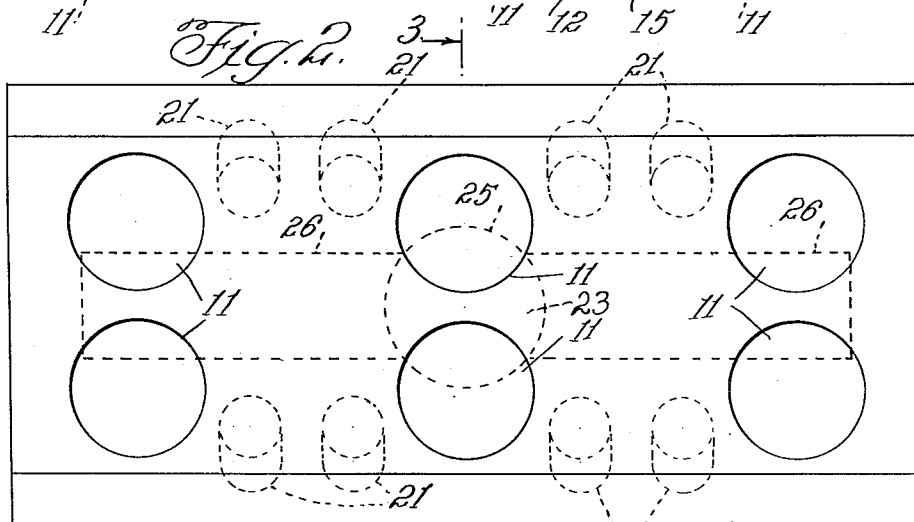
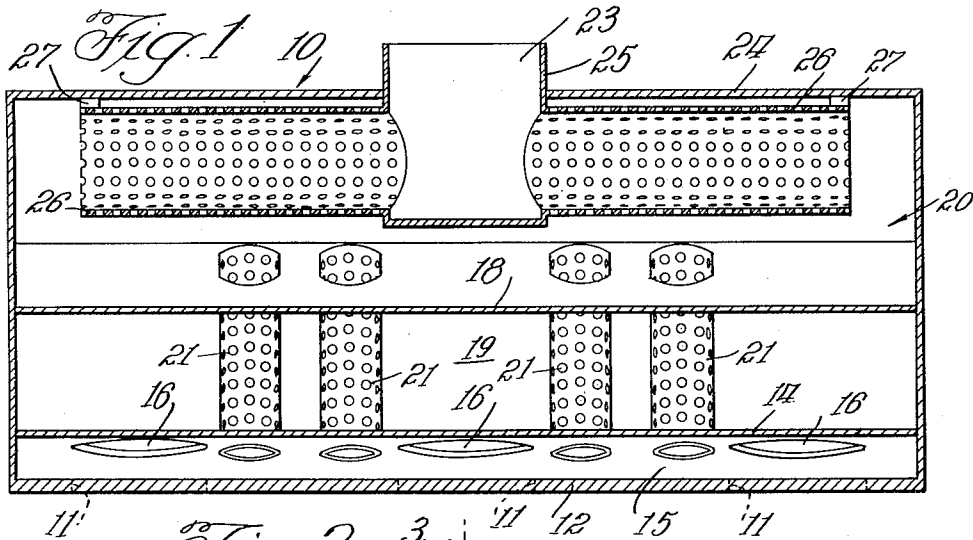
R. L. HOYLE

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Filed Nov. 16, 1942

4 Sheets-Sheet 1



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July 4, 1944.

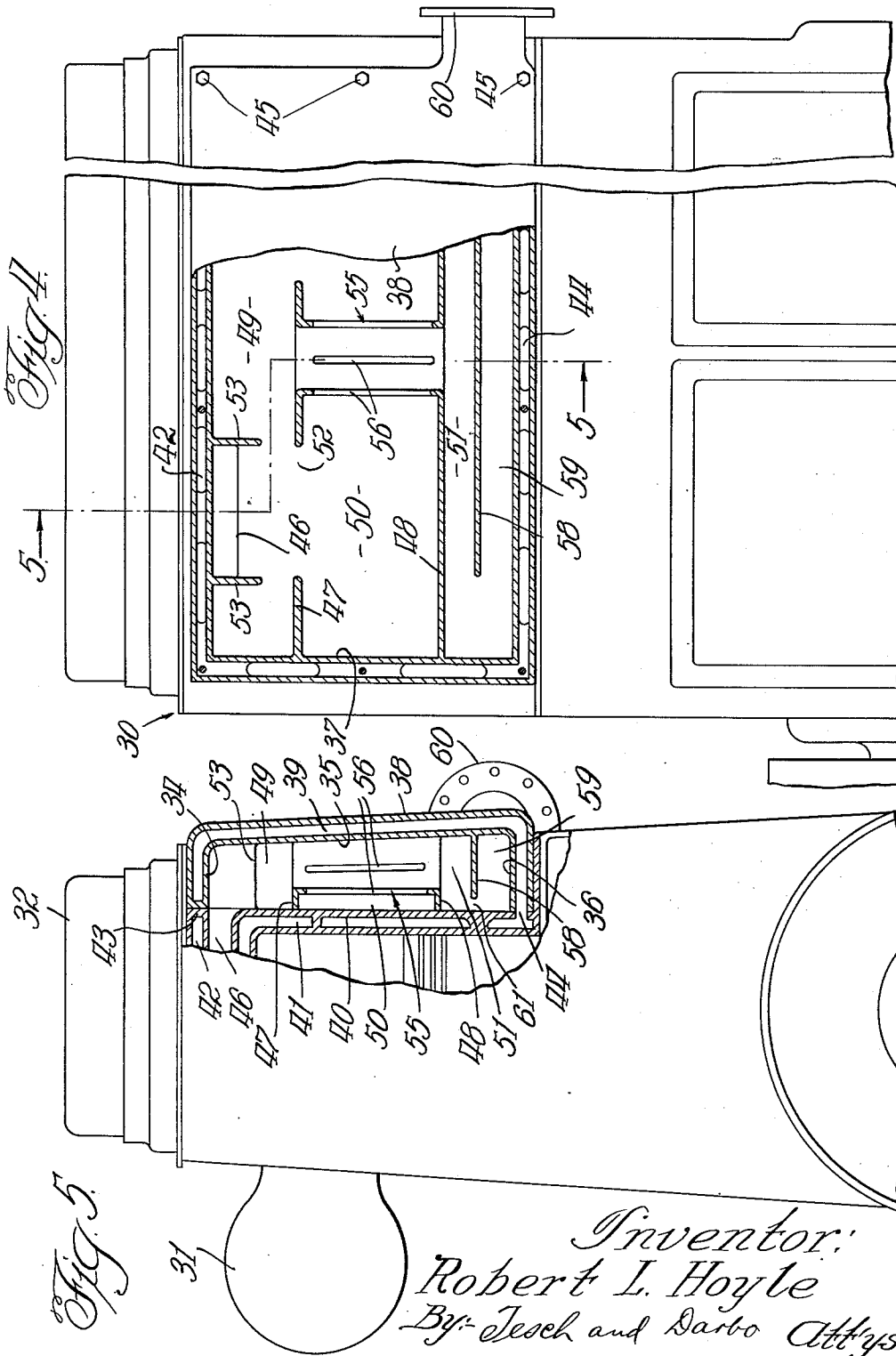
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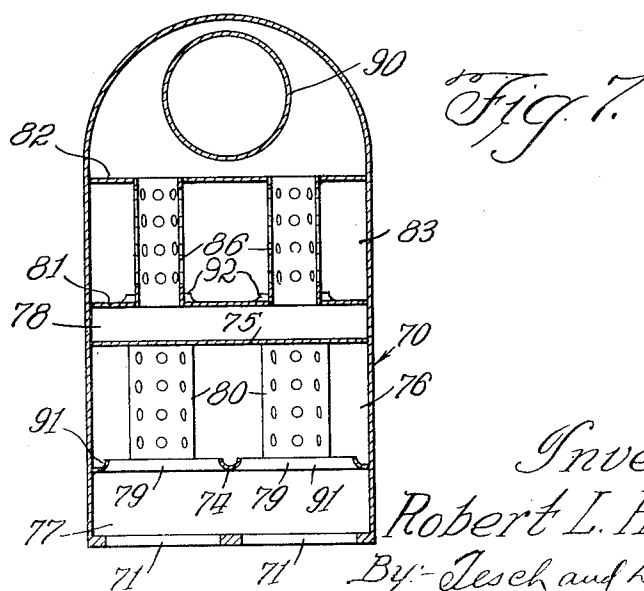
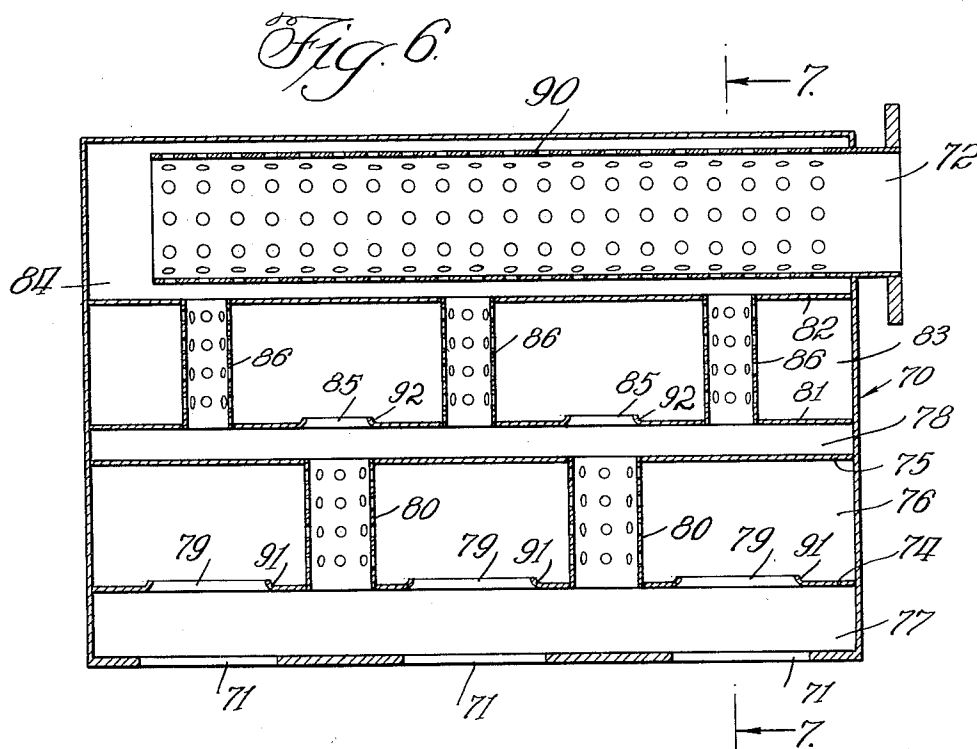
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4 Sheets-Sheet 3



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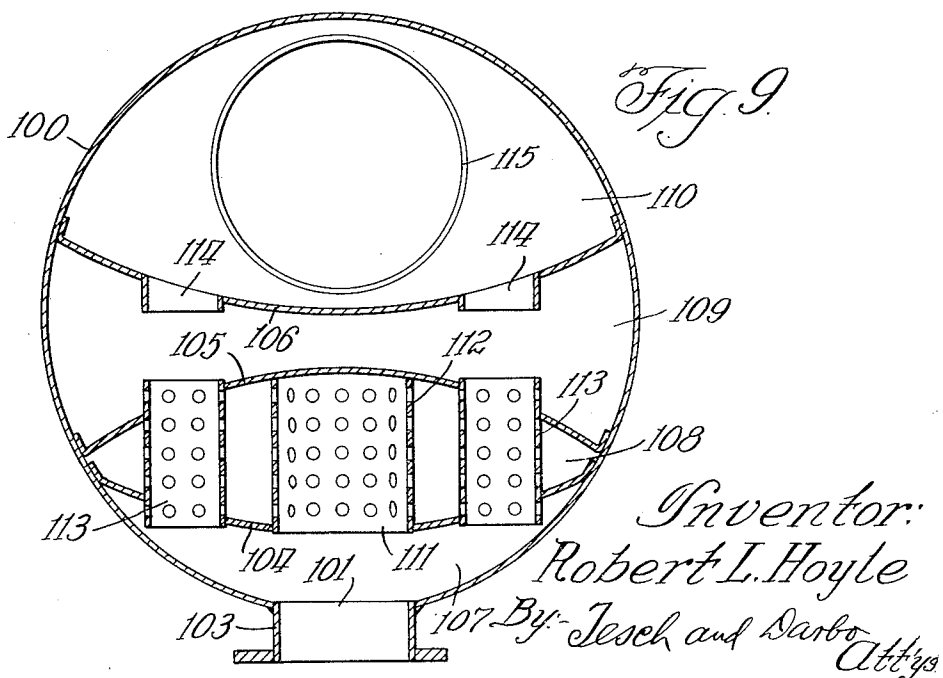
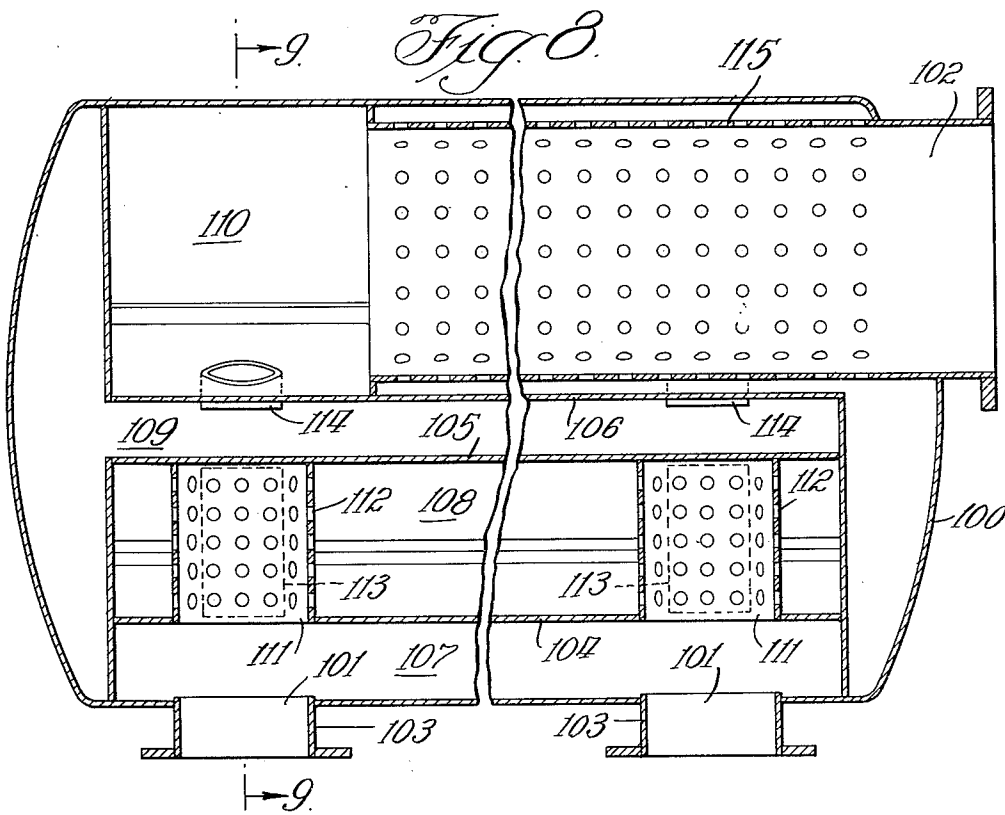
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UNITED STATES PATENT OFFICE

2,353,036

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Application November 16, 1942, Serial No. 465,665

18 Claims. (Cl. 181—40)

This invention relates to exhaust manifolds for internal combustion engines, and particularly to a structure which combines in itself the functions of a manifold and a silencer such that no further silencer or muffler is required.

In multiple cylinder engines, and especially those of the Diesel type, a throbbing occurs in many cases, which appears to be due to the interaction of the slugs of exhaust gases entering the manifold from the different exhaust ports of the engine. These slugs are discharged into the manifold at high velocity and under high pressure and cause a low pitch booming or rumble which is not only disagreeable from the standpoint of noise, but includes mechanical vibrations which may cause structural failure of the manifold.

The combination manifold and silencer of this invention eliminates this throbbing effect and at the same time effectively silences the exhaust noises of the engine. The device contains means in operative association individually with each exhaust port for dissipating or snubbing the slugs emerging from that port, before they encounter those issuing from the other exhaust ports. In this way the pulsations are dissipated and the exhaust noise is prevented, and the gases flow together without such interaction as causes throbbing. The invention also provides a construction in which the entire volume of the device is utilized for the silencing and throb-preventing functions.

In the accompanying drawings:

Fig. 1 is a longitudinal sectional view of one embodiment of the combined manifold and silencer of the invention;

Fig. 2 is a plan view of the device taken from the bottom of Fig. 1;

Fig. 3 is a transverse sectional view along line 3—3 of Fig. 2;

Fig. 4 is a side view of an engine with a portion thereof broken away to show a fractional longitudinal section of a different embodiment of the invention;

Fig. 5 is an end view of the engine of Fig. 4 with a portion thereof broken away to show a transverse view of the second embodiment of the invention along line 5—5 of Fig. 4;

Fig. 6 is a longitudinal sectional view of a further embodiment of the invention;

Fig. 7 is a transverse sectional view along line 7—7 of Fig. 6;

Fig. 8 is a broken longitudinal sectional view of a further modification; and

Fig. 9 is a transverse sectional view along line 9—9 of Fig. 8.

The device of Figs. 1, 2 and 3 is adapted to be applied to a six cylinder engine of the V-type and to be mounted on the top of the engine. It comprises a shell 10 having a plurality of inlet openings 11 in the inlet wall 12 thereof. Inlet wall 12 is adapted to be fastened against the engine by fastening means which are not shown, with openings 11 registering with the exhaust ports of the engine. By exhaust port is meant the opening provided in the engine for the discharge of exhaust gases. Each opening usually serves a single cylinder, but in some engines it serves more than one cylinder. If conduit sections are provided projecting beyond the surface of the engine block, either as a part of the engine or a part of the manifold, the ends of such sections constitute the exhaust ports.

Spaced interiorly of the inlet wall 12 is a partition 14 which defines an inlet space 15 within the shell 10 and adjacent inlet wall 12. Partition 14 has openings 16 therein which are in alignment with openings 11 of inlet wall 12. A second, or downstream partition 18 is spaced inwardly from upstream partition 14, and defines between the partitions a space 19, which will be called a snubbing space, and an outlet space 20 on the side of downstream partition 18 opposite the snubbing space. As is seen in Fig. 3, partitions 14 and 18 are both curved in transverse section to increase their rigidity and avoid any tendency to vibrate.

A plurality of open-ended escape conduits 21, having apertures in the walls thereof, pass through snubbing chamber 19 and partitions 14 and 18 and connect inlet space 15 with outlet space 20. Conduits 21 permit the escape of exhaust gases from inlet space 15 and snubbing space 19 to the outlet space 20.

An outlet opening 23 is provided in outlet wall 24 of the shell. An outlet snout 25 passes through outlet opening 23 and extends into outlet space 20. Said snout 25 is open at its outer end and closed at its inner end. Two open-ended, apertured outlet conduits 26 are each connected at one end thereof to opposite sides of the inwardly projecting portion of snout 25, and extend away from the snout in a direction parallel to the longitudinal dimension of the shell, stopping short of the end walls of the shell. The outer ends of outlet conduits 26 are supported by brackets 27 which are mounted upon outlet wall 24 of the shell. The outlet conduits extend across the outlet space 20 in a direction transversely of the axes of escape conduits 21.

In operation, each exhaust port of the engine is connected to one of the inlet openings 11, and

the exhaust gases emerge from the exhaust ports and pass through the openings 11 and into inlet space 15. The gases emerging from each port consist of a succession of slugs, each being under high pressure and traveling at high velocity and, therefore, possessing much inertia. The slug is projected by its inertia directly from opening 11 across the inlet space 15 and through the aligned opening 16 in upstream partition 14 and into the snubbing space 19. It displaces the air or gas present in the inlet space and this gas is free to move laterally in the inlet space, from whence it enters the ends of escape conduits 21 and passes through these conduits into the outlet space 20. The slug also displaces the gas in the snubbing space, which gas passes through the apertures in the walls of the escape conduits into these conduits and thence into the outlet space. The slug expands within the snubbing space, and for this operation it may utilize the entire volume of the snubbing space, that is, it may expand laterally substantially to the ends of the device. As a result, its pressure is reduced and its kinetic energy is dissipated to a large extent. Its free passage, in the form of a slug, out of the snubbing space is restrained by the walls of the escape conduits 21, but, at the same time, the gases are permitted to filter through the apertures in said walls and thence into the conduits.

The slug may have a trailing portion which is under less pressure and travels at a lower velocity, and, therefore, possesses less inertia than the leading portion. This trailing portion expands in inlet space 15 and for this operation is free to utilize the entire volume of the inlet space. Thence it passes into the ends of one or more of the adjacent escape conduits 21 and through these conduits into the outlet space 20, thereby by-passing the snubbing space 19. The trailing portion follows the latter path because it offers less resistance to flow than the other. The net result is that the high pressure slug is effectively snubbed and converted into a relatively steady stream issuing from the ends of the escape conduits 21 and the creation of noise is thereby prevented.

The same action is undergone by the gases emerging from each of the exhaust ports, and when they flow together in outlet space 20, there is no interference or interaction such as tends to cause throbbing. There may be some merging of gases from different exhaust ports in the snubbing space 19 or even the inlet space 15, but the merging gases are not in the form of the high pressure slugs which cause throbbing.

It is believed that the throbbing effect which sometimes occurs is caused by interference between slugs issuing from different ports, that is, the slugs from different ports coincide, or otherwise interact, while they are still under high pressure and possess great inertia, whereby the "slug-effect," or impulse, is augmented. This phenomenon occurs in a periodic pattern such as to produce the objectionable throbbing. By dissipating the kinetic energy of each slug upon its emergence from the exhaust port, and before it has had an opportunity, as a high pressure slug, to meet those issuing from the other ports, the device of this invention prevents the throbbing effect from taking place. While the above is believed to be the explanation for the improved silencing provided by the device of the present invention, the exact nature of the action is not fully understood. In actual use, the device completely eliminates the objectionable throbbing in

applications where it is present when manifold silencers of different design are used.

In the outlet chamber, the gases issuing from the escape conduits 21 pass into the outlet conduits 20. Some of them traverse the outlet space longitudinally of the shell and enter the open ends of the outlet conduits, and others follow the more direct path from the ends of the escape conduits through the apertures of the outlet conduit. The apertured walls of the outlet conduits exert a further mild restraining action upon the gases, which does not restrict their flow appreciably, but causes them to filter through the conduit walls and exerts a further smoothing action upon any pulsations which may still be present. From the outlet conduits the gases pass into the outlet snout 25 and thence to the atmosphere, or into an exhaust pipe (not shown) which may be connected to the snout.

It will be seen from the above description that every portion of the volume of the device is utilized for the silencing and throb-preventing functions. The inlet space receives the gases which are pushed out of the way by the oncoming slug fronts, and it also receives low velocity trailing portions of the slugs. These gases spread in the inlet space and pass into the ends of the escape conduits. The entire snubbing space is utilized for the expansion and the dissipation of the energy of each slug. The escape conduits permit the free escape of gases from the inlet space and the controlled escape from the snubbing space. Finally, the outlet space cooperates with the apertured outlet conduits to contribute a further smoothing action upon the gases. The utilization of the large volume of the snubbing space by each slug, as has been described makes it possible for the device to be relatively short in the direction of movement of the gas, that is, the distance between inlet wall 12 and outlet wall 24 is shorter than it would be if partitions were provided extending from partition 14 to partition 18, or from inlet wall 12 to partition 18, in such manner as to provide a separate snubbing chamber with one or two escape conduits for each inlet opening.

With respect to the construction of the device, the inlet openings 11 in inlet wall 12 are of substantially the same size as the exhaust ports of the engine. Openings 16 in partition 14 should be of sufficient size to permit the slugs to pass therethrough unimpeded. These openings are also usually of a size equal to that of the exhaust ports of the engine. The aggregate cross sectional area of the escape conduits should be sufficient to accommodate, without substantial restriction, the gases which by-pass the snubbing space and also those which pass into the snubbing space and filter through the apertures in the walls of the escape conduits. Since the amount of gas varies with the kind of engine and the speed at which the engine is operated, the area should be such as to accommodate the expected maximum. Considerable variation is possible within the range which will give satisfactory performance. The variation may be from an area approximately equal to the aggregate area of all of the exhaust ports to one approximately equal to the area of a single exhaust port. The latter would be the case, for example, with a four cycle engine which operates at a low R. P. M., such as about 300 R. P. M. With such an engine, a single escape conduit having an area equal to that of an exhaust port would be sufficient to provide gas escape facilities. The aggregate

gate area of the apertures in the walls of escape conduits 21 should not be so much that the high pressure slugs pass unimpeded through these walls. In such case there would not be an effective snubbing action. At the same time, the aperture area should not be so small as to cause severe restriction to the gas flow. In practice, an aperture area approximately equal to from 50% to 150% of the cross sectional area of the conduit has been found to be satisfactory. The area of the apertures in the walls of the outlet conduits 26 should be such as to provide a mild restraining action which causes the gases to filter through the walls. It should not be so great as to permit the gases to project unimpeded through the conduit walls, and yet not so small as to cause a substantial restriction to flow. In practice, an aggregate area equal to from one to two times the cross sectional area of the outlet conduits is satisfactory.

In a particular application, a silencer of the type illustrated in Figs. 1, 2 and 3 was applied to a six cylinder Diesel engine of the V-type which develops a maximum brake horse power of approximately 640 at 800 R. P. M. and has a piston displacement of 567 cubic inches. For this application, the silencer was 18 inches in height, i. e., the distance from inlet wall 12 to outlet wall 24, 21 inches in width at its widest part, 46 inches in length and contained a volume of 17,100 cubic inches. The escape conduits were 8 in number and had an internal diameter of $2\frac{3}{4}$ inches. The perforations in the walls thereof were $\frac{1}{4}$ inch in diameter and spaced $\frac{7}{8}$ inch apart on centers. The two outlet conduits were 5 inches in internal diameter and the perforations pattern in the walls thereof was the same as in the escape conduits. The diameter of the inlet openings 11 and of the outlet opening 23 was 8 inches.

The device which is illustrated in Figs. 4 and 5 has a cooling liquid jacket which, when the device is mounted in place against the engine, is adapted to be connected to the cooling liquid circulation system of the engine and become a part thereof. The device is illustrated as being applied to a Diesel engine 30, which has the usual air induction header 31 and top cover 32 for the valve mechanism. The structure may be of cast metal, and comprises interior top wall 34, side wall 35, bottom wall 36 (Fig. 5) and end walls 37 (Fig. 4). An exterior wall, which will be designated by the single numeral 38, encloses the foregoing walls and is spaced therefrom to provide the cooling liquid jacket 39. The side of the shell opposite wall 35 is open. A recess is provided in the main engine casing, and the manifold shell is adapted to be inserted into the recess with the open side toward the engine, whereby the wall 40 of the engine provides the second side wall of the manifold. The manifold is fastened in place by bolts 45 which pass through openings in the manifold shell and into cooperating threaded openings in the engine. The engine is provided with the usual cooling liquid circulating system, indicated at 41 and 42. The cooling liquid jacket is closed at the edges of the manifold shell and the engine where the two meet, as indicated at 43, and mating openings are provided along these edges, as indicated at 44, whereby the cooling jacket of the manifold shell is connected to the circulating system of the engine.

The exhaust ports 46 of the engine discharge into the upper portion of the interior of the manifold shell. The interior of the manifold shell is provided with upstream partition 47 and

downstream partition 48 which are spaced respectively from the upper and lower walls 34 and 36 of the shell and also from each other to provide inlet space 49, snubbing space 50 and outlet space 51. Openings 52 are provided in the upstream partition 47, the longitudinal positions of said openings in the manifold shell being in registry with the exhaust ports 46. Gas-directing vanes 53 extend downwardly from the top wall 34 on either side of each exhaust port 46 part way toward the upstream partition 47 to direct the slugs emerging from each exhaust port toward the registering opening 52. Open-ended, apertured escape conduits 55 extend through the snubbing space 50 and upstream and downstream partitions 47 and 48 and connect inlet space 49 with outlet space 51. The apertures in conduits 55 are in the form of elongated slots 56, instead of the round openings shown in the escape conduits 21 of the device of Figs. 1, 2 and 3. Such apertures may be of any desired shape. A plate 58 extends inwardly from side wall 35 to a point adjacent the opposite wall 40 to form a slot 61 between its inward end and wall 40 (Fig. 4). Said plate 58 extends from the right hand end of the device (as it is shown in Fig. 4) to a point adjacent the left hand end. The space beneath plate 58 serves as outlet conduit 59 for the device, and is connected to outlet snout 60. The slot 61 provides an elongated aperture in the wall of the outlet conduit 59 which serves as a leakage path through which gases may pass from outlet space 51 into the outlet conduit all along the length of the latter, similar to the path provided by the round apertures in the walls of the outlet conduits 26 of the device of Figs. 1, 2 and 3. The partitions 47 and 48, the vanes 53 and the escape conduits 55 may all be cast integrally with the interior walls of the manifold shell. The escape conduits may be of any desired shape in transverse section, and as is indicated in Fig. 5, a portion of the wall thereof may be formed by the shell wall 35. The device of Figs. 4 and 5 operates in a manner similar to that of Figs. 1, 2 and 3. The exhaust slugs emerge from each engine port 46 in a horizontal direction and are turned downwardly within inlet space 49 by the walls 34 and 35. Vanes 53 direct them toward the registering opening 52 in upstream partition 47 and prevent them from spreading freely sideways in the inlet space. The slugs are projected across inlet space 49 and through opening 52 and into the snubbing space 50 while some of the gases having less inertia spread sideways within the inlet space and pass into the ends of escape conduits 55 and through these conduits into outlet space 51. The snubbing action is similar to that explained heretofore in connection with the device of Figs. 1, 2 and 3.

The snubbed, relatively smoothly flowing gases emerge from the escape conduits and a portion thereof passes to the left end of the outlet space 51 (as seen in Fig. 4) and thence into the outlet conduit 59, while the remainder thereof takes the more direct path through the slot 61 in the side of the outlet conduit. From conduit 59 they flow through outlet snout 60 to the atmosphere.

The modification illustrated in Figs. 6 and 7 provides two snubbing elements arranged in succession in the path of the gases through the device. The device comprises a shell 70 having inlet openings 71 adapted to register with the exhaust ports of the engine, and an outlet opening 72. The first snubbing element comprises

an upstream partition 74 spaced inwardly from the inlet wall of the device, and a downstream partition 75 spaced from partition 74, the two partitions defining a snubbing space 76 between them and an inlet space 77 and an intermediate space 78 on opposite sides of the snubbing space. Partition 74 has openings 79 therein registering with inlet openings 71, and a plurality of open-ended, apertured escape conduits 80 pass through partitions 74 and 75 and the snubbing space 76 therebetween. Escape conduits 80 are in non-alignment with inlet openings 71.

The second snubbing element comprises an upstream partition 81 spaced from partition 75 and a downstream partition 82 spaced from partition 81, said partitions forming a second snubbing space 83 therebetween and an outlet space 84 on the side of partition 82 opposite from the intermediate space 78. The upstream partition 81 of the second snubbing element has openings 85 therein in registry with the escape conduits 80 of the first snubbing element. Open-ended, apertured escape conduits 86 pass through the second snubbing space 83 and the upstream and downstream partitions 81 and 82 and connect the intermediate space 78 with the outlet space 84. Escape conduits 86 are in non-alignment with the escape conduits 80 of the first snubbing element, and may be of smaller diameter than said conduits 80, as is indicated in Figs. 6 and 7. The openings 79 and 85 leading into the snubbing spaces 76 and 83 have lips 91 at the edges thereof, turned inwardly toward said snubbing spaces. Said lips facilitate the flow of the gases through the openings and avoid any tendency for the rushing gases to set up vibration of the metal edges, which vibration may cause an objectionable, high-pitched noise.

In operation, the exhaust slugs enter the inlet space 77 of the device through inlet openings 71 and the slugs are projected, by their inertia, across inlet space 77 and through openings 79 and into the first snubbing space 76, while the gases having less inertia spread sidewise in said inlet space and pass into the ends of escape conduits 80 and thence into the second snubbing element, and thereby by-pass the first snubbing space 76. A similar action is undergone in the second snubbing element. An apertured outlet conduit 90 extends into outlet space 84 in a direction transversely to the axes of the escape conduits 86, and the gases pass from said escape conduits into the outlet conduit and out of the device in a manner similar to that described in connection with the device of Figs. 1, 2 and 3. More than two snubbing elements may be arranged in succession in the path of the gases if desired.

The embodiment illustrated in Figs. 8 and 9 consists of a shell 100 which is substantially circular in transverse section and has a series of inlet openings 101 arranged in a longitudinal row along one side and an outlet opening 102 in one end thereof. Each inlet opening has an inlet snout 103 connected thereto, said snouts being adapted to be connected to the engine ports. Spaced interiorly from the inlet openings are, arranged in succession, an upstream partition 104 and a downstream partition 105 for the snubbing element and an additional partition 106. These partitions define, in succession, proceeding from the openings 101, an inlet space 107, a snubbing space 108, an intermediate space 109 and an outlet space 110.

Upstream partition 104 is provided with a plurality of openings 111 which are aligned with the inlet openings 101. Apertured tube sections 112 are connected at one end thereof to openings 111 and extend into the snubbing space 108 and into contact with downstream partition 105. The downstream ends of tube sections 112 are closed by partition 105. A plurality of open-ended apertured escape conduits 113 which are in non-alignment with the inlet openings 101 pass through the snubbing space 108 and the partitions 104 and 105, and connect the inlet space 107 with the intermediate space 109.

The partition 106 is provided with a plurality of lipped openings 114 which are in alignment with the escape conduits 112 of the first element. An open-ended apertured outlet conduit 115 is connected to outlet opening 102 and extends longitudinally into outlet space 110, stopping short of the end of the shell opposite outlet opening 102.

The operation of this device is similar to that described heretofore in connection with the foregoing embodiments. In the snubbing element, the slugs undergo the snubbing action described heretofore. A slight restraining action is exerted upon them by the apertured walls of tubes 112, but the action in the snubbing space is closely similar to that in the other forms in which tubes 112 are omitted. The gases emerge from the ends of the escape conduits 113 and expand in the intermediate space 109. Thence they pass through the lipped openings 114 and into the outlet space where they undergo further expansion. Some of them pass through the open end of the outlet conduit 115 and the remainder filter through the apertured walls of this conduit and then pass through the conduit and out of the device.

While but a few embodiments of the invention are set forth, it is understood that these are only illustrative of the invention and that many structural modifications may be made within the scope of the invention. For example, the devices of Figs. 1, 2 and 3, and of Figs. 6 and 7 may be adapted for use with an engine in which the exhaust ports are arranged in a single line, in which case the entrance openings would be in a single row instead of in two rows. Also, in the devices of the said figures, a central partition may run longitudinally through the inlet spaces and the snubbing spaces, between the two rows of inlet openings, whereby the gases from one row of exhaust ports will not mingle with those from the other row until they reach the outlet space of the device. In such construction, the snubbing space available to each inlet opening is of adequate size to provide satisfactory silencing.

The device has been described as being adapted for connection to the exhaust ports of an engine, but it is also adapted for connection to the intake ports. When an intake valve closes, a surge occurs in the in-flowing air and fuel mixture, and this surge travels upstream and is dissipated and absorbed by the construction described, with accompanying silencing.

I claim:

1. A manifold for internal combustion engines, comprising a shell having a plurality of inlet openings in a wall thereof adapted individually for connection to the ports of an engine, a partition spaced inwardly from said wall and defining an inlet space, said partition having open-

ings therein substantially in alignment with said shell inlet openings, a second partition spaced inwardly from said first partition and defining a snubbing space between said partitions and an outlet space on the side of said second partition opposite from said snubbing space, a plurality of apertured, open-ended escape conduits passing through said snubbing space and connecting said inlet space with said outlet space, said conduits being in non-alignment with said shell inlet openings, a wall of said shell having an outlet opening therein, one or more open-ended apertured outlet conduits connected to said outlet opening and extending into said outlet space, and being arranged transversely of said escape conduits.

2. A manifold for internal combustion engines, comprising a shell having a plurality of inlet openings in a wall thereof adapted individually for connection to the ports of an engine, a partition spaced inwardly from said wall and defining an inlet space, said partition having openings therein substantially in alignment with said shell inlet openings, a second partition spaced inwardly from said first partition and defining a snubbing space between said partitions and an outlet space on the side of said second partition opposite from said snubbing space, a plurality of apertured, open-ended escape conduits passing through said snubbing space and connecting said inlet space with said outlet space, said conduits being in non-alignment with said shell inlet openings, a wall of said shell having an outlet opening therein, one or more open-ended apertured outlet conduits connected to said outlet opening and extending into said outlet space.

3. A manifold for internal combustion engines, comprising a shell having an outlet opening and a plurality of inlet openings, said inlet openings being adapted individually for connection to the ports of an engine, a partition within said shell cooperating with the walls of said shell to define an inlet space adjacent said inlet openings said partition having openings therein substantially in alignment with said shell inlet openings, a second partition spaced inwardly from said first partition and defining a snubbing space between said partitions and an outlet space on the side of said second partition opposite from said snubbing space, a plurality of apertured, open-ended escape conduits passing through said snubbing space and connecting said inlet space with said outlet space, said conduits being in non-alignment with said shell inlet openings, said outlet space being in communication with said shell outlet opening.

4. A manifold in accordance with claim 3 in which conduit sections are provided connecting the inlet openings individually with the ports of the engine.

5. A manifold for internal combustion engines, comprising a shell having an outlet opening, a partition within said shell and defining an inlet space in said shell adapted to be arranged in communication with the ports of said engine, said partition having openings therein substantially in alignment with said ports, a second partition spaced inwardly from said first partition and defining a snubbing space between said partitions and an outlet space on the side of said second partition opposite from said snubbing space, one or more apertured, open-ended escape conduits passing through said snubbing space and connecting said inlet space with said outlet space, 75

said conduits being in non-alignment with said ports, and means for providing communication between said outlet space and said shell outlet opening.

6. A manifold for internal combustion engines, comprising a shell, a partition within said shell cooperating with the walls of said shell to provide an inlet space in said shell adapted to be arranged individually in communication with the ports of said engine, said partition having openings therein substantially in alignment with said ports, a second partition spaced inwardly from said first partition and defining a snubbing space between said partitions and an outlet space on the side of said second partition opposite from said snubbing space, a plurality of open-ended, apertured escape conduits passing through said snubbing space and connecting said inlet space with said outlet space, said conduits being in non-alignment with said engine ports, a wall of said shell having an outlet opening therein communicating with said outlet space.

7. A manifold for internal combustion engines, comprising a shell, upstream and downstream partitions within said shell and extending lengthwise of said shell and cooperating with the walls of said shell to form a snubbing space between said partitions and inlet and outlet spaces on opposite sides of said snubbing space, said inlet space being adapted to be arranged adjacent and in communication individually with the ports of said engine, said upstream partition having openings therein, the positions of said openings lengthwise of said shell being in registry with said ports, open-ended, apertured escape conduits passing through said snubbing space and connecting said inlet space with said outlet space, said escape conduits being displaced lengthwise of said shell with respect to said ports, a wall of said shell having an outlet opening therein communicating with said outlet space.

8. A manifold in accordance with claim 7 in which the openings in the upstream partition are of a cross sectional area substantially equal to that of the engine ports.

9. A manifold in accordance with claim 7 in which the apertures in the walls of the escape conduits have an aggregate area equal to from 50% to 150% of the aggregate cross sectional area of the said escape conduits.

10. A manifold in accordance with claim 7 in which means are provided in the shell for directing gases emerging from the engine exhaust ports toward the openings in the upstream partition.

11. A manifold in accordance with claim 7 in which the shell is separate from the engine and adapted to be removably fastened to the engine and the walls of the shell cooperate with the walls of the engine to form the manifold enclosure.

12. A manifold in accordance with claim 7 in which the inlet space is adapted to be arranged adjacent and in communication with the inlet ports of the engine.

13. A manifold in accordance with claim 7 in which tubes having apertured walls are connected at one end thereof to the openings in the upstream partition which are in alignment with the engine ports and extend toward the downstream partition.

14. A manifold for internal combustion engines, comprising a shell, upstream and downstream partitions within said shell extending lengthwise thereof and cooperating with the walls of said shell to form a snubbing space between

said partitions and inlet and outlet spaces on opposite sides of said snubbing space, said inlet space being adapted to receive gases emerging from the exhaust ports of said engine, said upstream partition having openings therein, the positions lengthwise of said shell of said openings in said upstream partition being in registry with said exhaust ports, open-ended, apertured escape conduits passing through said snubbing space and connecting said inlet space with said outlet space, said escape conduits being displaced lengthwise of said shell with respect to said exhaust ports, a wall of said shell having an outlet opening therein communicating with said outlet space, and a liquid cooling jacket surrounding said shell.

15. A manifold for internal combustion engines, comprising a shell, upstream and downstream partitions within said shell extending lengthwise thereof and cooperating with the walls of said shell to form a snubbing space between said partitions and inlet and outlet spaces on opposite sides of said snubbing space, said inlet space being adapted to receive gases emerging from the exhaust ports of said engine, said upstream partition having openings therein, the positions lengthwise of said shell of said openings in said upstream partition being in registry with said exhaust ports, open-ended, apertured escape conduits passing through said snubbing space and connecting said inlet space with said outlet space, said escape conduits being displaced lengthwise of said shell with respect to said exhaust ports, a wall of said shell having an outlet opening therein communicating with said outlet space, said engine having a circulating liquid cooling system, said shell being detachably fastened to said engine and having a liquid cooling jacket adapted to be connected to said engine cooling system upon being fastened in place.

16. A manifold for internal combustion engines, comprising a shell having an outlet opening in a wall thereof and a plurality of inlet openings in a second wall thereof, said inlet openings being adapted individually for connection to the ports of an engine, a plurality of snubbing elements within said shell arranged in succession in the path of exhaust gases, each of said snubbing elements comprising an upstream and a downstream partition extending across said shell and defining a snubbing space therebetween, said partitions being spaced from one another and the upstream partition of the first snubbing element being spaced from the inlet wall of said shell to define an inlet space and the downstream partition of the last snubbing element being spaced from a different wall of said shell to define an outlet space, said upstream partitions each having a plurality of openings therein, a plurality of open-ended, apertured escape conduits passing through each snubbing space and the upstream and downstream partitions defining said space, the openings of the upstream partition of the first snubbing element being in alignment with the shell inlet openings and the openings in the upstream partition of each succeeding snubbing element being in alignment with the escape conduits of the preceding snubbing element, the escape conduits of the first snubbing element being in non-alignment with the shell inlet openings and the escape conduits of each succeeding snubbing element be-

ing in non-alignment with the conduits of the preceding snubbing element, said outlet space being in communication with said outlet opening.

17. A manifold for internal combustion engines, comprising a shell having an outlet opening in a wall thereof, a plurality of snubbing elements within said shell arranged in succession in the path of exhaust gases, each of said snubbing elements comprising an upstream and a downstream partition extending across said shell and defining a snubbing space therebetween, said partitions being spaced from one another and the upstream partition of the first snubbing element being recessed with respect to one side of said shell to define an inlet space adapted to receive the gases emerging from the exhaust ports of said engine, and the downstream partition of the last snubbing element being spaced from a wall of said shell to define an outlet space, said upstream partitions each having openings therein, a plurality of open-ended, apertured escape conduits passing through each snubbing space and the partitions defining said space, the openings of the upstream partition of the first snubbing element being in alignment with the engine exhaust ports and the openings in the upstream partition of each succeeding snubbing element being in alignment with the escape conduits of the preceding snubbing element, the escape conduits of the first snubbing element being in non-alignment with the engine exhaust ports and the escape conduits of each succeeding snubbing element being in non-alignment with the escape conduits of the preceding snubbing element, said outlet space being in communication with said outlet opening.

18. A manifold for internal combustion engines, comprising a shell having an elongated lengthwise dimension and having an outlet opening in a wall thereof, a plurality of snubbing elements within said shell arranged in succession in the path of exhaust gases, each of said snubbing elements comprising an upstream and a downstream partition extending lengthwise of said shell and defining a snubbing space therebetween, said partitions being spaced from one another and the upstream partition of the first snubbing element being recessed with respect to one side of said shell to define an inlet space adapted to receive the gases emerging from the exhaust ports of said engine, and the downstream partition of the last snubbing element being spaced from a wall of said shell to define an outlet space, said upstream partitions each having openings therein, a plurality of open-ended, apertured escape conduits passing through each snubbing space and the partitions defining said space, the positions lengthwise of said shell of the openings in the upstream partition of the first snubbing element being in registry with said engine exhaust ports and the openings in the upstream partition of each succeeding snubbing element being in alignment with the escape conduits of the preceding snubbing element, the escape conduits of the first snubbing element being in non-alignment with the shell inlet openings and the escape conduits of each succeeding snubbing element being in non-alignment with the escape conduits of the preceding snubbing element, said outlet space being in communication with said outlet opening.

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