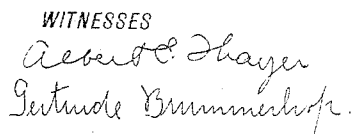


1,015,698.

2 SHEETS--SHEET 1.

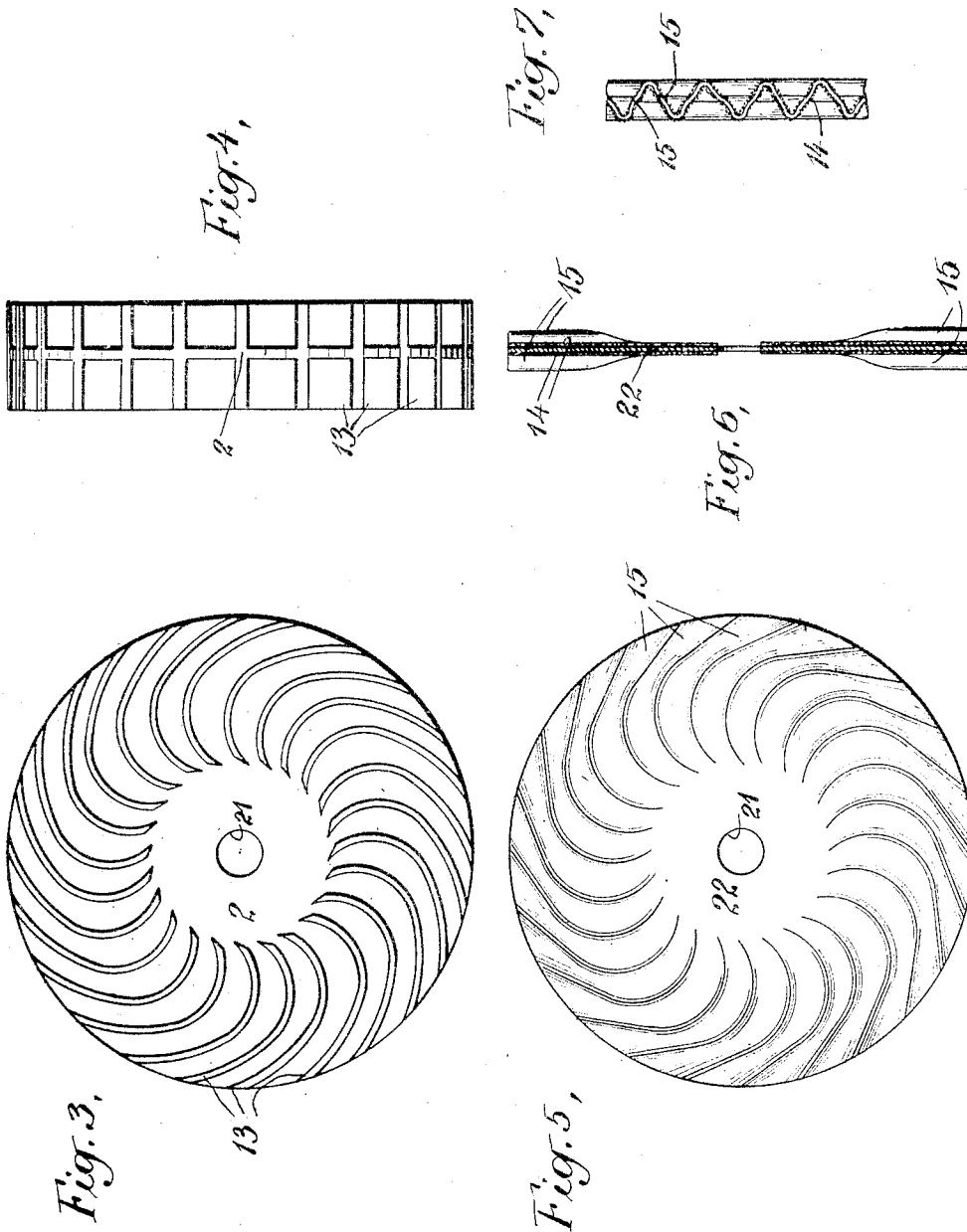



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1,015,698.

Patented Jan. 23, 1912.

2 SHEETS—SHEET 2.



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HIRAM PERCY MAXIM, OF HARTFORD, CONNECTICUT.

GAS-ENGINE SILENCER.

1,015,698.

Specification of Letters Patent.

Patented Jan. 23, 1912.

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To all whom it may concern:

Be it known that I, HIRAM PERCY MAXIM, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have made certain new and useful Inventions Relating to Gas-Engine Silencers, of which the following is a specification, taken in connection with the accompanying drawings, forming part of the same.

This invention relates especially to gas engine silencers or mufflers which may comprise a built-up shell formed of a series of partitions provided with integral rims and enlarged flanges to cooperate with the rims of the adjacent nested partitions and a series of separators arranged between said partitions and provided with spiral separator passages on both sides of said separators, the diameter of said separators being less than said rims to provide annular gas whirl chambers around said separators, the surfaces of said spiral separator passages being preferably roughened as by fibrous coating material to increase the sound interfering and damping action of the multiple tortuous gas passage through the muffler.

In the accompanying drawings showing in a somewhat diagrammatic way illustrative embodiments of this invention, Figure 1 is a perspective view showing diagrammatically the movement of the gases through a section of the muffler. Fig. 2 is a longitudinal sectional view, parts being broken away. Fig. 3 is a side view of one form of separator. Fig. 4 is a corresponding longitudinal elevation. Fig. 5 is a side view of another form of separator. Fig. 6 is a corresponding longitudinal sectional view. Fig. 7 is a detail showing the edge of this separator.

As illustrated in Fig. 2 of the drawings, the muffler may be conveniently built up of a number of partitions 23 which may, if desired, be formed of sufficiently heavy stamped material provided if desired with integral rims 24 and with enlarged flanges 4 adapted to engage the rims of the adjacent partitions so as to form a secure connection when the parts are forced together, although it is of course understood that the muffler shell may be formed in other ways. Suitable separators preferably having spiral vanes or ribs may be interposed between the various partitions which are preferably provided as indicated with suitable central gas passages 3. These separators may comprise separator plates 2

having spiral or curved vanes 13 formed on either side thereof as shown in Figs. 2, 3 and 4. These separators may be provided with a central hole 21 of such size as to fit fairly closely around the bolt or connector 1 on which the parts are assembled and the separators are preferably given a considerably less diameter than the interior of the rims so as to form annular spaces or chambers beyond these separators in which annular whirls of gas are set up during the operation of the device. It is also desirable to have the separators formed with a roughened coating or surface 12 to have increased interference effects and correspondingly dampen the sound waves as they are reflected back and forth through the spiral separator passages. This roughened coating may be provided by attaching asbestos fiber or similar material to the separator in any desired way, as by partly embedding the fibers or pieces of asbestos or the like in a suitable adhesive coating of difficultly fusible japan or other enamel like material which may be hardened by heating and give a roughened somewhat fibrous or woolly surface to the separator vanes. For similar reasons, it is desirable in some cases to provide the annular chambers outside the separators with similarly roughened surfaces as by inserting therein rough asbestos paper or cloth 11 which may be woven with a reinforcing coating of wire.

Although the entire muffler may be provided with similar separators, it is desirable in some cases to provide the muffler adjacent its discharge end with separators having channels of less capacity so as to have an increased retarding effect on the irregular or intermittent gas impulses. For this purpose it is desirable in many cases to have a plurality of narrower separators between the adjacent partitions and as indicated in Fig. 2 this may be accomplished by interposing the desired number of intermediate deflectors between the adjacent partitions, these deflectors being formed of any desirable material preferably of reinforced asbestos cloth or paper which provides a desirable roughened surface. The separators for use in this connection may be conveniently stamped up out of sheet metal and have the form indicated in Figs. 2, 5, 6 and 7, the separator plate 22 being provided with curved or spirally arranged integral ribs 15 to form spiral channels and the separator being preferably provided with a similarly roughened

surface 14. These separators may of course be assembled on the central bolt 1 which may pass through the holes 21 and in some cases the entire muffler may be constructed with one or more intermediate deflectors, such as 5, between all of the partitions in the muffler. In the construction illustrated all the parts may easily be assembled by tightening up the nut 9 on the bolt 1 which may preferably be provided with the pointed deflecting head indicated in engagement with the bridge 8 of the inlet 7 which may have a threaded connection with the exhaust pipe 6 of the gas engine. The nut 9 on the other end of this bolt may cooperate with the spider or bracket 10 secured in any desired way to the adjacent partition.

The sharp intermittent impulses of the gas engine exhaust are received in the muffler and distributed about the first separator so as to be given a spiral motion between its vanes and form a rapidly moving annular whirl of gas within the chamber 19 outside this separator, the gas being crowded longitudinally along this chamber and being sufficiently slowed down so as to be able to reverse its direction and pass down the spiral passages between the vanes on the other side of this separator as indicated by the dotted line in Fig. 1. The gases then pass through the central passage in the adjacent partition and are immediately conducted outward through the spiral passages in the next separator which is preferably reversed, as indicated in Fig. 1, so as to minimize choking at this central part of the tortuous passage through the muffler. For this reason the separators are preferably so arranged that the spiral vanes facing toward the inlet end of the muffler are alternately right-handed and left-handed, although of course this is not necessary in all cases. The high velocity annular whirls of gas in each of the chambers 19 outside the separators have considerable inertia because of their high velocity and thus exert a considerable aspirating effect, tending to draw the gas out through the spiral passages discharging into these annular chambers. It will also be noted that the receiving sides of these chambers 19 are of somewhat larger area because of the greater diameter of the flanges 4, so that the more rapidly moving part of the gas whirl tends to remain at this receiving end of the chamber, the relatively slower moving gas being more readily crowded over to the other side of the chamber to pass inward down the spiral separator passages. When this muffler action has sufficiently reduced the velocity of the intermittent impulses or puffs of the engine exhaust so as to considerably even out the gas discharge and also reduce the gas volume through cooling action, it is not necessary to have the effective area of

the tortuous multiple passages through the muffler as large, and as indicated this may be accomplished with a correspondingly increased muffling effect by the use of separators having correspondingly less axial length or thickness, several being if desired arranged in the same chamber between adjacent partitions.

This muffler besides greatly reducing the violence of the intermittent gas impulses or puffs of the engine exhaust also greatly deadens the sound vibrations or noise by the damping effect of the constant reflection and interference in the spiral passages which seems to be materially promoted by the use of the roughened or fibrous surface of these muffler passages. At the same time the back pressure is not excessive, since the muffler seems to very materially even out the sharp intermittent puffs or gas impulses constituting the usual gas engine exhaust. The gas is not therefore discharged from the muffler in such a way as to then produce the sharp objectionable noises characteristic of unmuffled gas engine exhausts and the emission of such noise as is developed in the muffler or other connected parts of the apparatus is minimized by the absorption of the sound vibrations within the muffler passages as indicated.

Having described this invention in connection with a number of illustrative embodiments, forms, proportions, constructions and arrangements of parts, to the details of which disclosure the invention is not of course to be limited, what is claimed as new and what is desired to be secured by Letters Patent is set forth in the appended claims.

1. The gas engine muffler comprising a series of partitions provided with central passages and having integral rims and enlarged flanges to cooperate with the rims of the adjacent nested partitions; an inlet to be connected with the engine exhaust and provided with a bridge, a bolt having a conical spreading end cooperating with said bridge, separators arranged between said partitions and provided with plates having central holes to accommodate said bolt and provided with spiral passages on both sides of said plates, said separators having less diameter than said rims and flanges to provide annular gas whirl chambers around said separators, a number of the separators adjacent the discharge end of said muffler being formed of stamped sheet metal and having deflectors arranged between the several separators between adjacent partitions to give increased muffling action, the surfaces of said spiral separator passages being roughened by a coating of fibrous asbestos and there being a rough coating of fibrous asbestos on the inner surfaces of said annular chambers outside said separators.

2. The gas engine muffler comprising a series of partitions having central passages and provided with integral rims and enlarged flanges to cooperate with the rims of the adjacent nested partitions, an inlet to be connected with the engine exhaust, a bolt connected with said inlet and extending through the muffler, separators between said partitions and provided with plates having central holes to accommodate said bolt and provided with spiral passages on both sides of said plates, said separators having less diameter than said rims and flanges to provide annular gas whirl chambers around said separators, a number of the separators adjacent the discharge end of said muffler being formed of stamped sheet metal and having deflectors arranged between the several separators between adjacent partitions to give increased muffling action, the surfaces of said spiral separator passages being roughened with fibrous material.

3. The gas engine muffler comprising a series of partitions having central passages and provided with integral rims and enlarged flanges to cooperate with the rims of the adjacent nested partitions, an inlet to be connected with the engine exhaust, a bolt connected with said inlet and extending through the muffler, separators arranged between said partitions and provided with plates having central holes to accommodate said bolt and provided with spiral passages, said separators having less diameter than said rims and flanges to provide annular whirl chambers around said separators, the surfaces of said spiral separator passages being roughened by fibrous coating material.

4. The gas engine muffler comprising a series of partitions having central passages and provided with integral rims and enlarged flanges to cooperate with the rims of the adjacent nested partitions, an inlet to be connected with the engine exhaust, a bolt connected with said inlet and extending through the muffler, separators arranged between said partitions and provided with plates having central holes to accommodate said bolt and provided with spiral passages, said separators having less diameter than said rims and flanges to provide annular whirl chambers around said separators.

5. The gas engine muffler comprising a shell provided with a series of partitions having central passages, separators arranged between said partitions and provided with spiral passages, said separators having less diameter than said shell to provide annular gas whirl chambers around said separators, the surfaces of said spiral separator passages being roughened with fibrous coating material.

6. The gas engine muffler comprising a

shell provided with a series of partitions having central passages and separators arranged between said partitions and provided with spiral passages, said separators having less diameter than said shell to provide annular gas whirl chambers around said separators.

7. The gas engine muffler comprising a shell provided with a series of partitions having central passages, separators arranged between said partitions and provided with plates and spiral passages on both sides of said plates, said separators having less diameter than said shell to provide annular gas whirl chambers around said separators, a number of the separators adjacent the discharge end of said muffler being formed of stamped sheet metal and having deflectors arranged between the several separators between adjacent partitions to give increased muffling action.

8. The gas engine muffler comprising a shell provided with a series of partitions having central passages, separators arranged between said partitions and provided with plates provided with spiral passages on both sides of said plates, said separators having less diameter than said shell to provide annular gas whirl chambers around said separators receiving the outwardly moving gas from the separator passages on one side of each separator and delivering said gas in reverse direction into the inwardly extending spiral passages on the other side of said separator, said spiral separator passages and annular whirl chamber being provided with a roughened fibrous coating.

9. The gas engine muffler comprising a shell provided with a series of partitions having central passages, separators arranged between said partitions and provided with plates provided with spiral passages on both sides of said plates, said separators having less diameter than said shell to provide annular gas whirl chambers around said separators receiving the outwardly moving gas from the separator passages on one side of each separator and delivering said gas in reverse direction into the inwardly extending spiral passages on the other side of said separator.

10. The gas engine muffler comprising a shell provided with a series of partitions having central passages, separators arranged between said partitions and provided with plates and with spiral separator passages on both sides of said plates, said separators having less diameter than said shell to provide annular gas whirl chambers around said separators receiving the outwardly moving gas from the spiral separator passages on one side of each separator and delivering said gas in the opposite direction into the inwardly extending spiral passages

- on the other side of said separator, the spiral separator passages on adjacent separators extending in the same direction to minimize choking at the central portions of the tortuous passage through said muffler, a number of the separators adjacent the discharge end of said muffler being formed with separator passages of less area to give increased muffling action.
11. The gas engine muffler comprising a shell provided with a series of partitions having central passages, separators arranged between said partitions and provided with plates and with spiral separator passages on both sides of said plates, said separators having less diameter than said shell to provide annular gas whirl chambers around said separators receiving the outwardly moving gas from the spiral separator passages on one side of each separator and delivering said gas in the opposite direction into the inwardly extending spiral passages on the other side of said separator, the spiral separator passages on adjacent separators extending in the same direction to minimize choking at the central portions of the tortuous passage through said muffler, a number of the separators adjacent the discharge end of said muffler being formed with separator passages of less area to give increased muffling action, the surfaces of said spiral separator passages being roughened to promote sound interference and damping action.
12. The gas engine muffler comprising a

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