H. P. MAXIM.

SILENCER FOR GAS ENGINES, &c.

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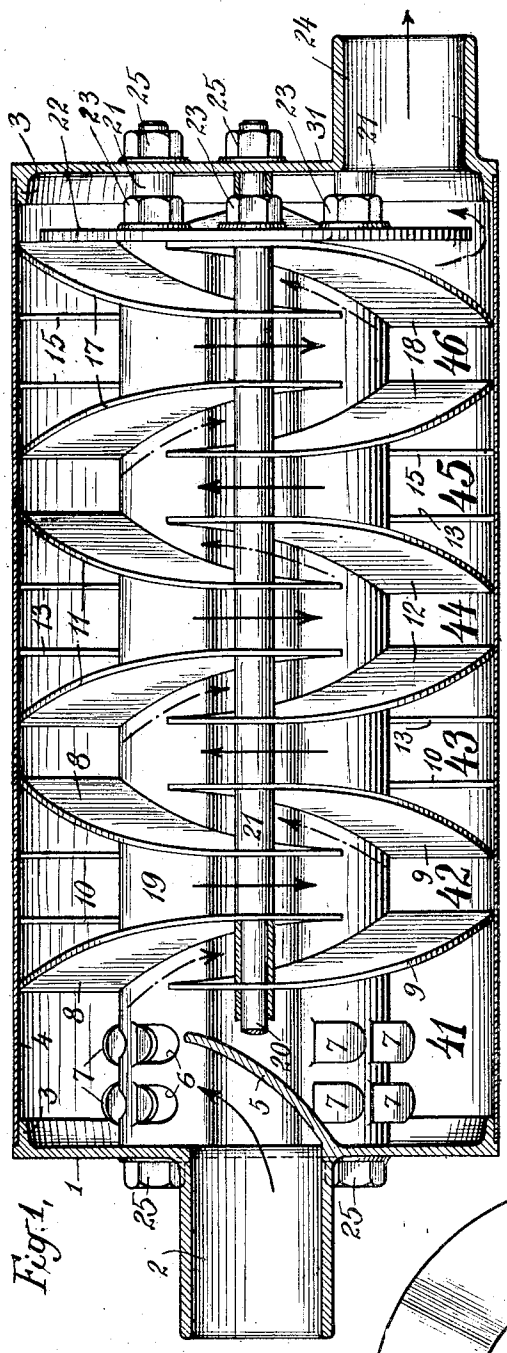


Fig. 1.

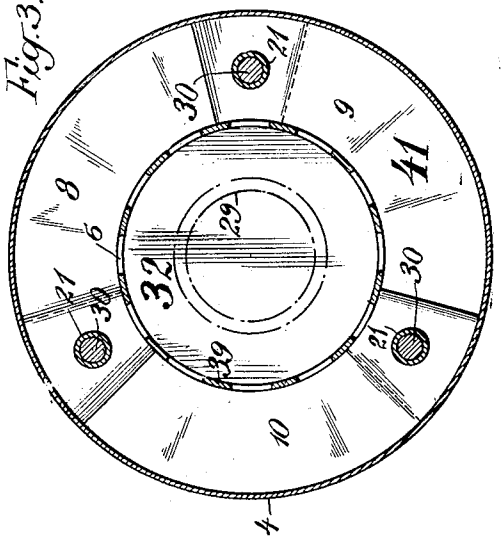


Fig. 3.

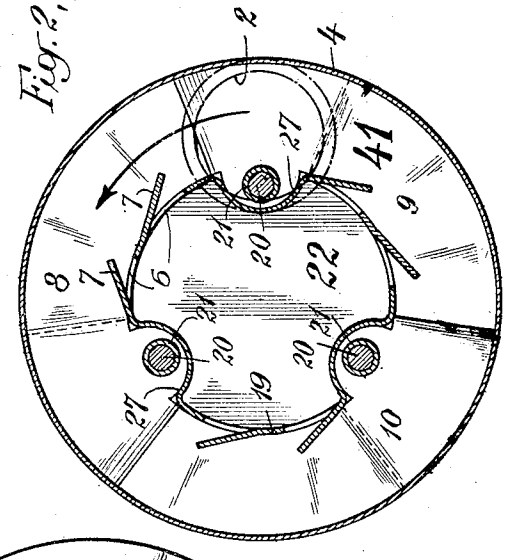


Fig. 2.

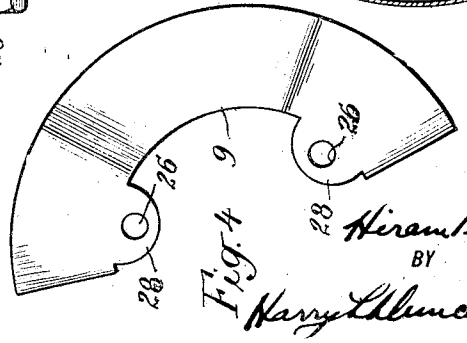


Fig. 4.

WITNESSES

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SILENCER FOR GAS-ENGINES, &c.

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To all whom it may concern:

Be it known that I, HIRAM PERCY MAXIM, a citizen of the United States, and resident of Hartford, county of Hartford, State of Connecticut, have made a certain new and useful Invention Relating to Silencers for Gas-Engines, &c., of which the following is a specification, taken in connection with the accompanying drawing, which forms part of the same.

This invention relates especially to silencers for use with automobile gas engines or the like in which the casing may comprise a substantially cylindrical casing body and a coöperating end member having an inlet opening and deflecting means to direct the gases around the end of the casing, if desired. An internal shell which may have a series of longitudinal recesses may be mounted within the casing so as to form an inner equalizing chamber and a discharge baffle plate may be used to close one end of the shell and simultaneously leave a restricted annular discharge slot or opening extending around the casing adjacent its discharge end. The parts may be conveniently held together by a series of spacing rods located in said recesses and holding said baffle plate and shell in proper coöperation with the inlet end member, a series of multiple spirally curved partitions also being if desired mounted on said spacing rods between suitable spacing sleeves thereon so as to be located between the shell and casing and form in connection therewith a series of communicating annular whirl chambers each having a plurality of retarding discharge openings. The initial whirl chamber with which the inlet opening communicates may be provided on its inner side with an annular series of accelerating discharge apertures having coöperating deflecting guides projecting into the whirl chamber to promote the periodic passage of part of the initial gas impulses into the equalizing chamber. Another end member provided with an outlet opening may be held in coöperation with the casing body by suitable extensions on the spacing rods with which fastening nuts may coöperate so as to bear on the outlet end member.

In the accompanying drawing which shows in a somewhat diagrammatic way several illustrative embodiments of this invention Figure 1 is a longitudinal section, parts being shown in elevation. Fig. 2 is a transverse section thereof. Fig. 3 is a similar transverse section showing a modification; and Fig. 4 is a detail showing one of the partitions shown in Fig. 1.

The silencer casing which preferably has a substantially cylindrical form may have any suitable shape and construction and may comprise a substantially cylindrical casing body 4 of suitable material, such as sheet steel, for cheapness and lightness. A coöperating end member such as 1 may be formed with a connecting flange 3 to engage the casing body and may be provided with a suitable inlet opening 2 of any suitable size and construction with which, if desired, an integral internal deflector 5 of any suitable shape may coöperate so as to direct the exhaust gases around the end of the casing as indicated by the arrow. An internal shell, such as 19, formed of sheet metal or the like may be mounted in any suitable way within the casing so as to form an inner equalizing chamber, and for some purposes it is desirable to form a series of longitudinal recesses, such as 27, in this shell which may be readily done by first stamping these recesses in the sheet metal before bending or forming it into generally cylindrical form. A separate plate may be used to close the end of this equalizing chamber, and if desired, a discharge baffle plate, such as 22, may also be used for this purpose and be arranged so as to leave a restricted annular discharge slot around the casing adjacent its discharge end. These parts can be readily held together by suitable spacing members or rods, such as 20, which may extend through the end 1 and have suitable heads or nuts 25 coöperating therewith and have suitable nuts 23 coöperating with the other ends of these rods so as to hold the plate 22 and casing 19 in tight coöperation with the end member 1. For some purposes it is quite desirable to have these spacing members located in the longitudinal recesses formed in the shell so that they do not project into the annular space formed between the shell and casing.

A series of partitions may be mounted in any suitable way between the shell and casing so as to form a series of communicating annular whirl chambers and by using a plurality of lapping partitions between each two whirl chambers a corresponding number of discharge openings are provided for each

chamber and the lapping ends of these partitions may be so directed as to retard the discharge of gases through the openings thus formed without reversing the natural direction of movement in the whirl chamber so that these discharge openings have a considerable retarding action in this way. As shown in the drawings each set of these partitions may be formed of three substantially semi-circular sheet metal partitions, such as 8, 9, 10, (see Fig. 4), each of the partitions being preferably though not necessarily provided with inwardly projecting supporting lugs, such as 28, in which may be formed the holes 26 to accommodate the spacing rods or members. These partitions may be conveniently formed by stamping them from sheet steel or the like and they may be firmly supported in the desired position by the use of suitable spacing sleeves, such as 21, on these supporting rods between which the partitions may be securely clamped, preferably having been first bent into the desired substantially spiral form. A similar series of these partitions also numbers 8, 9, 10 in Fig. 1 of the drawing may be arranged on the other side of this whirl chamber 42, the pitch of the spiral partitions being oppositely directed in this instance and one or more similar sets of such partitions may be arranged farther along toward the outlet end of the casing, such as the partitions 11, 12 and 13, and 15, 17 and 18. In this way any desired number of communicating whirl chambers may be provided between the casing and shell, such as 41, 42, 43, 44, 45 and 46 and by the use of these reversely directed spiral partitions multiple retarding discharge openings are formed from each chamber to the succeeding one, so that the direction of movement of the discharge gases must be reversed as the gases pass from each chamber to the next. Therefore an important equalizing and evening action is secured in this way, since the high velocity gas impulses cause such energetic whirling action in each whirl chamber as to momentarily retard the discharge of gas therefrom, so that six or eight communicating whirl chambers of this character exert an important equalizing and evening action on the ordinary gas engine exhaust.

Further equalization of the exhaust may be secured by allowing the entering exhaust gases to have access to the equalizing chamber which may be given a considerable capacity as compared with each of the whirl chambers and this may be done by forming a series of suitable apertures or openings allowing communication between the equalizing chamber and the first one or two of the whirl chambers of the series. It is also desirable to provide in this connection accelerating apertures which through coöperating deflecting guides, for instance, are adapted to promote the periodic passage of part of the initial gas impulses into the equalizing chamber where the gases are first admitted to one of the whirl chambers as in Fig. 1. As therein indicated the discharge apertures 6 may each be provided with deflecting guides, such as 7, which project into the path of the whirling gases in the adjacent whirl chamber 41 so as to considerably promote the passage of part of these gases into the equalizing chamber 22 within when the initial high velocity gas impulse enters the whirl chamber. The exhaust gases are thus more or less forcibly driven into the equalizing chamber so long as they circulate in the direction indicated by the full line arrows around this initial whirl chamber so that during this period a considerable part of the sharp puff or gas impulse enters the equalizing chamber and is subsequently discharged therefrom during the later period when the impulse or peak of the exhaust wave has passed, thus allowing the direction of the gas in this whirl chamber to reverse and thus promote the withdrawal of part of the gas from the equalizing chamber. The exhaust gases by this action and by the crowding out of part of the gas from the initial whirl chamber by static pressure are thus forced through the retarding discharge passages in the direction indicated by the dot and dash arrow so as to enter the succeeding whirl chamber around which they circulate as indicated by the full line arrow. The normal movement and discharging action is similar in each case and the normal direction of rotation in each whirl chamber is indicated by the full line arrow in conection therewith in Fig. 1, while the reverse discharge movement is indicated by the corresponding dot and dash arrow. Finally the exhaust gases pass through the restricted discharge slot around the baffle plate 22 so as to emerge from the casing through any suitable outlet which may be formed in connection therewith such as the outlet 24 on the end plate or member 31 which may have a similar connecting flange 3 for coöperation with the casing body 4. This end member may be secured in position in any suitable way, as for instance, by suitable extensions formed on the main spacing rods 20 with which suitable nuts, such as 25, may coöperate so as to tightly secure in position this outlet end member after the other parts of the silencer have been assembled and the casing put in position thereover.

By this arrangement the sharp irregular gas impulses are smoothed or evened out and the character of the exhaust is considerably equalized so as to be much more uniform when finally discharged from the silencer and no longer objectionable because of its noise. The various sound elements in the

original gas engine exhaust have furthermore been largely or practically silenced or eliminated by reflection and interference action on the various surfaces of the partitions and by circulation around the passages forming the succession of whirl chambers. This noise silencing action may when necessary be considerably increased by admitting cooling water with the exhaust gases which also reduces the volume of the gases by promoting the heat dissipation from the silencer casing.

Fig. 3 shows a somewhat modified arrangement in which the internal shell 39 is given a substantially cylindrical form and the inlet opening 29 for the gas engine exhaust may as shown be arranged centrally so that the entering exhaust gases have direct access to this inner equalizing chamber 32 by being preliminarily discharged thereinto. An annular series of apertures such as 6 may be provided by which the exhaust gases may pass from this equalizing chamber into one or more of the initial whirl chambers, such as 41, formed by the partitions 8, 9 and 10. These partitions may, if desired, be mounted on supporting rods, such as 30, which may be arranged within the annular space between the shell and casing and thus somewhat more firmly support the partitions and somewhat retard or reduce the movement of the gases around these whirl chambers.

This invention has been described in connection with a number of illustrative embodiments, forms, proportions, materials, constructions, numbers and arrangements of parts, to the details of which disclosure the invention is not of course to be limited, since

What is claimed as new and what is desired to be secured by Letters Patent is set forth in the appended claims.

1. In silencers adapted for use with gas engines or the like, a casing body, a cooperating end member having an inlet opening and an integral internal deflector to direct the exhaust gases around the end of said casing, an internal shell having a series of longitudinal recesses and mounted within said casing to form an inner equalizing chamber, a discharge baffle plate closing one end of said shell and leaving a restricted annular discharge slot extending around the casing, a series of spacing rods located in said recesses and holding said baffle plate and shell against said end member, a series of multiple spirally curved partitions located between said shell and said casing and having integral supporting lugs mounted between spacing sleeves on said spacing rods to form a series of communicating annular whirl chambers each having a plurality of retarding discharge openings into the succeeding chamber, the initial whirl chamber with which said opening communicates being provided on its inner side with an annular series of accelerating discharge apertures having coöperating deflecting guides projecting into said whirl chamber to promote the periodic passages of part of the initial gas impulses into said equalizing chamber, an end member provided with an outlet opening and coöperating with said casing body and held in position thereon by nuts coöperating with extensions on said spacing rods.

2. In silencers adapted for use with gas engines or the like, a casing body, a cooperating end member having an inlet opening and an internal deflector to direct the exhaust gases around the end of said casing, an internal shell having a series of longitudinal recesses and mounted within said casing to form an inner equalizing chamber, a discharge baffle plate closing one end of said shell, a series of spacing rods located in said recesses and holding said baffle plate and shell against said end member, a series of multiple spirally curved partitions located between said shell and said casing and having integral supporting lugs mounted between spacing sleeves to form a series of communicating annular whirl chambers each having a plurality of retarding discharge openings into the succeeding chamber, an end member provided with an outlet opening and coöperating with said casing body and held in position thereon by nuts coöperating with extensions on said spacing rods.

3. In silencers adapted for use with gas engines or the like, a casing body, a coöperating end member having an inlet opening and an internal deflector to direct the exhaust gases around the end of said casing, an internal shell having a series of longitudinal recesses and mounted within said casing to form an inner equalizing chamber, a discharge baffle plate closing one end of said shell, a series of spacing rods located in said recesses and holding said baffle plate and shell against said end member, a series of spirally curved partitions located between said shell and said casing and mounted between spacing sleeves on said spacing rods to form a series of communicating annular whirl chambers, an end member provided with an outlet opening and coöperating with said casing body and held in position by extensions on said spacing rods.

4. In silencers adapted for use with gas engines or the like, a casing, a coöperating end member having an inlet opening, an internal shell having a series of longitudinal recesses and mounted within said casing to form an inner equalizing chamber, a discharge baffle plate closing one end of said shell and leaving a restricted annular discharge slot extending around the casing, a series of spacing rods located in said re-

cesses and holding said baffle plate and shell against said end member, a series of multiple spirally curved partitions located between said shell and said casing and mounted between spacing sleeves on said spacing rods and having integral supporting lugs for engagement with said spacing rods to form a series of communicating annular whirl chambers each having a plurality of retarding discharge openings into the succeeding chamber, the initial whirl chamber with which said opening communicates being provided on its inner side with an annular series of accelerating discharge apertures having coöperating deflecting guides projecting into said whirl chamber to promote the periodic passage of part of the initial gas impulses into said equalizing chamber and an end member provided with an outlet opening and coöperating with said casing and held in position by said spacing rods.

5. In silencers adapted for use with gas engines or the like, a casing, a coöperating end member having an inlet opening, an internal shell having a series of longitudinal recesses and mounted within said casing to form an inner equalizing chamber, a plate closing one end of said shell, a series of spacing rods located in said recesses and holding said plate and shell against said end member, a series of multiple spirally curved partitions located between said shell and said casing to form a series of communicating annular whirl chambers each having a plurality of retarding discharge openings, the initial whirl chamber with which said opening communicates being provided on its inner side with a series of accelerating discharge apertures having coöperating deflecting guides projecting into said whirl chamber to promote the periodic passage of part of the initial gas impulses into said equalizing chamber and an end member provided with an outlet opening and coöperating with said casing.

6. In silencers adapted for use with gas engines or the like, a casing, a coöperating end member having an inlet opening, an internal shell having a series of longitudinal recesses and mounted within said casing to form an inner equalizing chamber, a plate closing one end of said shell, a series of spacing rods located in said recesses and holding said plate and shell against said end member, a series of multiple spirally curved partitions located between said shell and said casing to form a series of communicating annular whirl chambers each having a plurality of retarding discharge openings, the initial whirl chamber with which said opening communicates being provided with a series of accelerating discharge apertures to promote the periodic passage of part of the initial gas impulses into said equalizing chamber and an end member provided with an outlet opening and coöperating with said casing.

7. In silencers adapted for use with gas engines or the like, a casing, a coöperating end member having an inlet opening, an internal shell mounted within said casing to form an inner equalizing chamber to which the entering exhaust gases have access, a discharge baffle plate closing one end of said shell and leaving a restricted annular discharge slot extending around the casing, a series of spacing rods holding said baffle plate and shell against said end member, a series of multiple lapping spirally curved partitions located between said shell and said casing and mounted between spacing sleeves on said spacing rods to form a series of communicating annular whirl chambers each having three retarding discharge openings into the succeeding chamber, the initial whirl chamber being provided on its inner side with a series of apertures into said equalizing chamber, an end member provided with an outlet opening and coöperating with said casing and held in position thereon by nuts coöperating with extensions on said spacing rods.

8. In silencers adapted for use with gas engines or the like, a casing, a coöperating end member having an inlet opening, an internal shell mounted within said casing to form an inner equalizing chamber to which the entering exhaust gases have access, a discharge baffle plate closing one end of said shell, a series of spacing rods holding said baffle plate and shell against said end member, a series of multiple lapping spirally curved partitions located between said shell and said casing and mounted between spacing sleeves on said spacing rods to form a series of communicating annular whirl chambers each having three retarding discharge openings into the succeeding chamber, the initial whirl chamber being provided with a series of apertures into said equalizing chamber, an end member provided with an outlet opening and coöperating with said casing and held in position by said spacing rods.

9. In silencers adapted for use with gas engines or the like, a casing, a coöperating end member having an inlet opening, an internal shell mounted within said casing to form an inner equalizing chamber to which the entering exhaust gases have access, a discharge baffle plate closing one end of said shell, a series of spacing rods holding said baffle plate and shell against said end member, a series of multiple lapping spirally curved partitions located between said shell and said casing and mounted between spacing sleeves on said spacing rods to form a series of communicating annular whirl chambers having discharge openings

into the succeeding chamber, the initial whirl chamber being provided with a series of apertures into said equalizing chamber, an end member provided with an outlet opening and coöperating with said casing.

10. In silencers adapted for use with gas engines or the like, a casing, a coöperating end member having an inlet opening, an internal shell mounted within said casing to form an inner equalizing chamber to which the entering exhaust gases have access, a plate closing one end of said shell, a series of spacing rods holding said plate and shell against said end member, a series of lapping spirally curved partitions located between said shell and said casing and mounted on said spacing rods to form a series of communicating annular whirl chambers having discharge openings into the succeeding chamber, the initial whirl chamber being provided with a series of apertures into said equalizing chamber, an end member provided with an outlet opening and coöperating with said casing.

11. In silencers adapted for use with gas engines or the like, a casing comprising end members having an outlet and an inlet opening, an internal shell mounted within said casing to form an inner substantially cylindrical equalizing chamber to which the entering gases have access, a series of multiple lapping curved partitions mounted on spacing members between said shell and said casing to form a series of communicating annular whirl chambers each having a plurality of retarding discharge openings into the succeeding chamber, the initial whirl chamber being provided on its inner side with an annular series of apertures into the equalizing chamber and a discharge baffle plate mounted within said casing adjacent to the discharge opening therefrom and having a restricted annular discharge slot extending around said casing beyond said shell.

12. In silencers adapted for use with gas engines or the like, a casing comprising end members having an outlet and an inlet opening, an internal shell mounted within said casing to form an inner equalizing chamber to which the entering gases have access, a series of multiple lapping curved partitions mounted between said shell and said casing to form a series of communicating annular whirl chambers each having a plurality of retarding discharge openings into the succeeding chamber, the initial whirl chamber being provided with a series of apertures into the equalizing chamber and a discharge baffle plate mounted within said casing adjacent the discharge opening therefrom and having a restricted annular discharge slot extending around said casing beyond said shell.

13. In silencers adapted for use with gas engines or the like, a casing comprising end members having an outlet and an inlet opening, an internal shell mounted within said casing to form an inner equalizing chamber to which the entering gases have access, a series of curved partitions mounted between said shell and said casing to form a series of communicating annular whirl chambers each having a plurality of discharge openings into the succeeding chamber, the initial whirl chamber being provided with a series of apertures into the equalizing chamber.

14. In silencers adapted for use with gas engines or the like, a casing comprising end members having an outlet and an inlet opening provided with an internal deflector to direct the entering gases around the end of the casing, an internal shell mounted within said casing to form an inner substantially cylindrical equalizing chamber, a series of multiple curved partitions mounted on spacing members between said shell and said casing to form a series of communicating annular whirl chambers each having a plurality of discharge openings into the succeeding chamber, the initial whirl chamber being provided on its inner side with a series of accelerating discharge apertures provided with coöperating deflecting guides to promote the passage of the initial gas impulses into the equalizing chamber and a discharge baffle plate mounted within said casing adjacent the discharge opening therefrom and having a restricted annular discharge slot extending around said casing beyond said shell.

15. In silencers adapted for use with gas engines or the like, a casing comprising end members having an outlet and an inlet opening provided with a deflector to direct the entering gases around the end of the casing, an internal shell mounted within said casing to form an inner equalizing chamber, a series of multiple curved partitions mounted on spacing members between said shell and said casing to form a series of communicating annular whirl chambers each having a plurality of discharge openings into the succeeding chamber, the initial whirl chamber being provided with a series of accelerating discharge apertures provided with coöperating deflecting guides to promote the passage of the initial gas impulses into the equalizing chamber.

16. In silencers adapted for use with gas engines or the like, a casing comprising end members having an outlet and an inlet opening provided with a deflector to direct the entering gases around the end of the casing, an internal shell mounted within said casing to form an inner equalizing chamber, a series of curved partitions mounted between said shell and said casing to form a series of communicating annular whirl chambers each

having a plurality of discharge openings into the succeeding chamber, the initial whirl chamber being provided with a series of discharge apertures to promote the passage of the initial gas impulses into the equalizing chamber.

17. In silencers adapted for use with gas engines or the like, a casing having an outlet and an inlet opening, an internal shell mounted within said casing to form an inner substantially cylindrical equalizing chamber, a series of multiple curved partitions mounted on spacing members between said shell and said casing to form a longitudinal series of communicating annular whirl chambers in said casing each having a plurality of retarding discharge openings into the succeeding chamber, there being three lapping substantially semi-circular partitions between each two chambers, and a discharge baffle plate mounted within said casing adjacent the discharge opening therefrom and having a restricted annular discharge slot extending around said casing beyond said shell.

18. In silencers adapted for use with gas engines or the like, a casing having an outlet and an inlet opening, an internal shell mounted within said casing, a series of multiple curved partitions mounted on spacing members between said shell and said casing to form a longitudinal series of communicating annular whirl chambers in said casing each having a plurality of retarding discharge openings into the succeeding chamber, there being three lapping substantially semicircular partitions between each two chambers.

19. In silencers for use with gas engines or the like, a casing having an outlet and an inlet opening, an internal shell mounted within said casing, a series of multiple curved partitions mounted between said shell and said casing to form a longitudinal series of communicating annular whirl chambers in said casing each having a plurality of discharge openings into the succeeding chamber, there being three lapping substantially semicircular partitions between each two chambers.

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