J. M. MILLER.

SILENCER.

APPLICATION FILED JULY 29, 1909.

951,770. Patented Mar. 8, 1910.

Fig. 1.

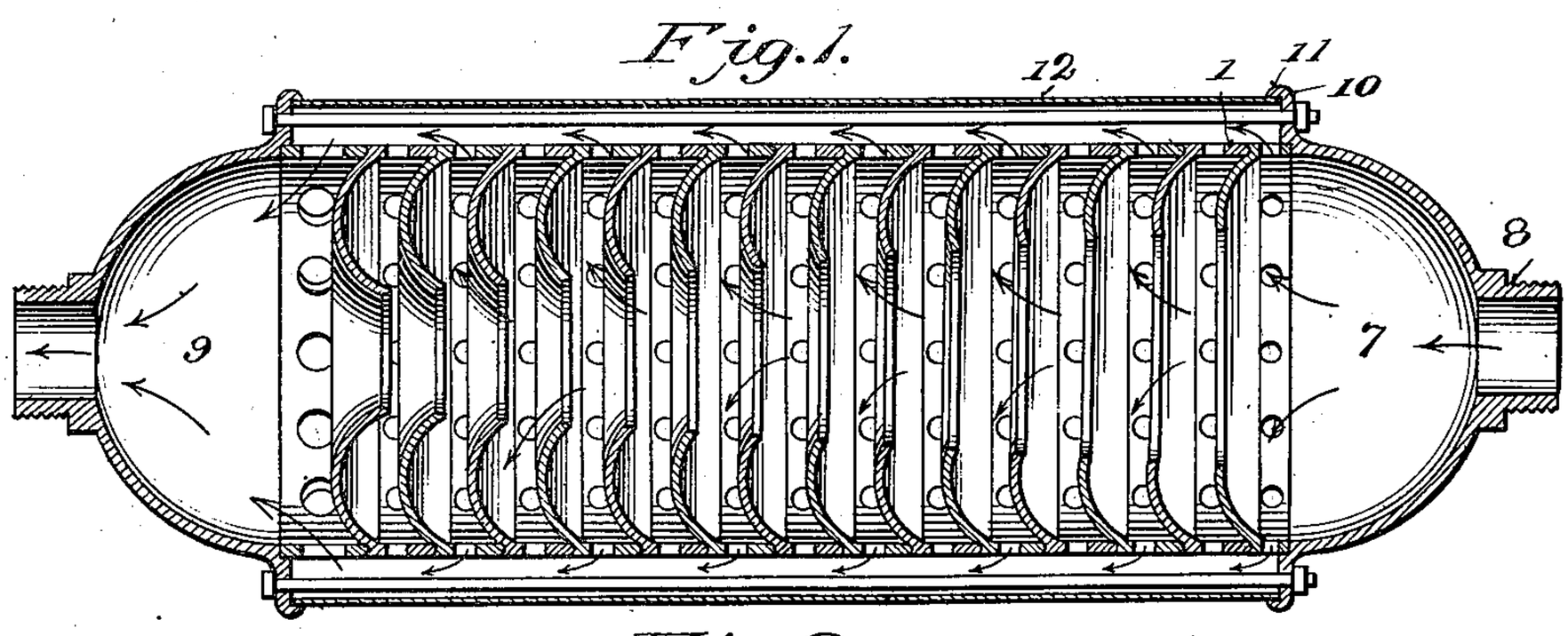

Fig. 2.

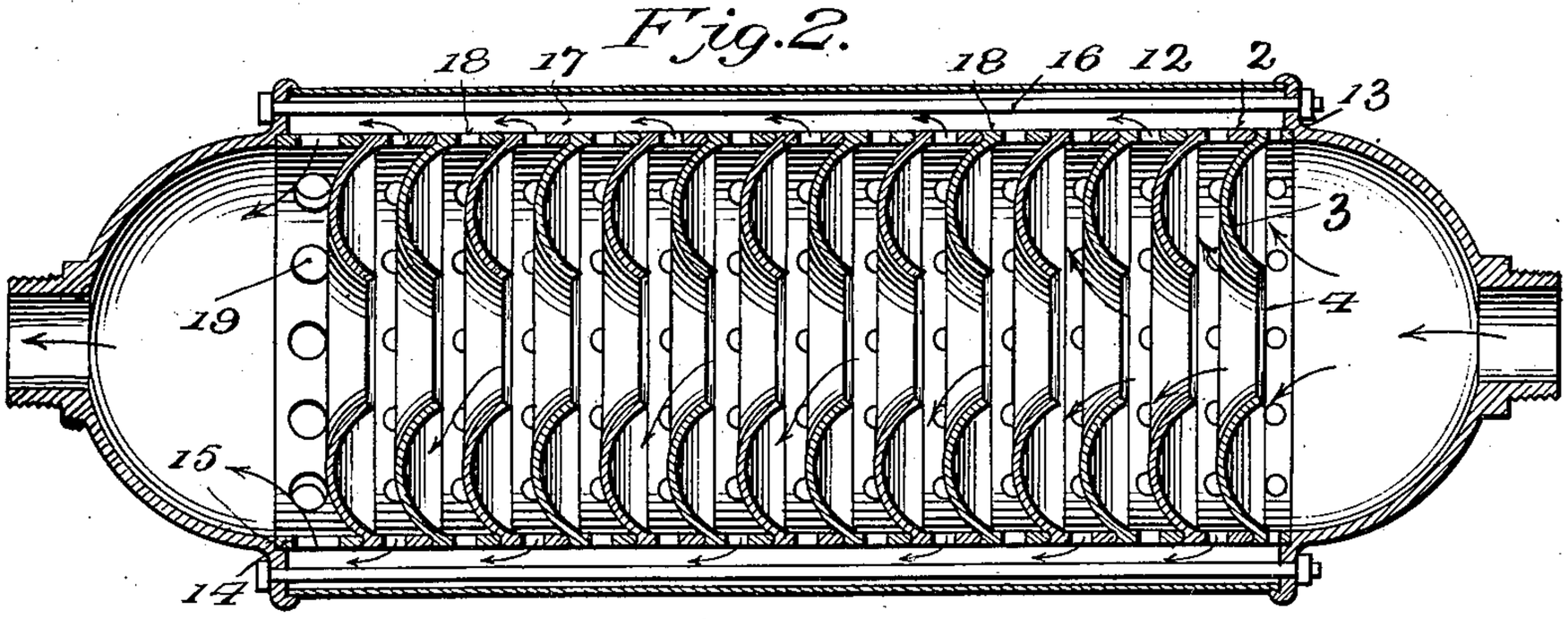

Fig. 3.

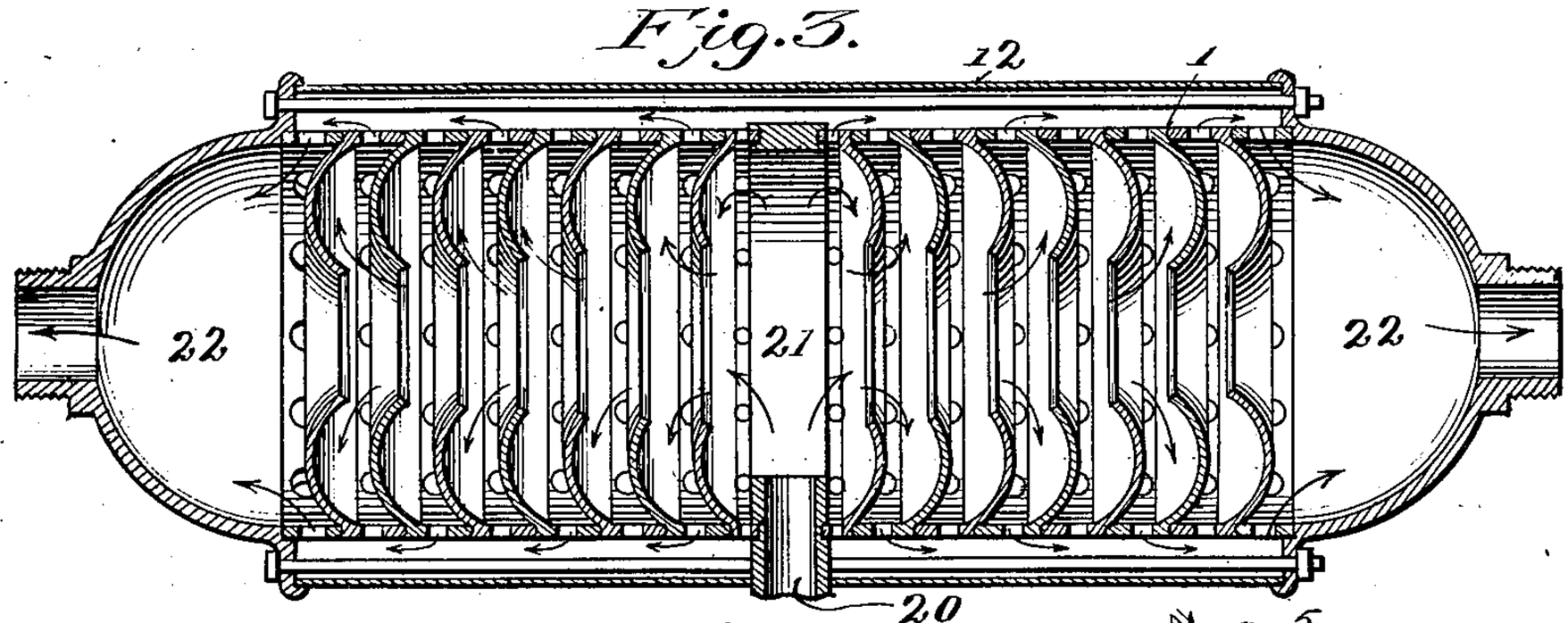

Fig. 4.

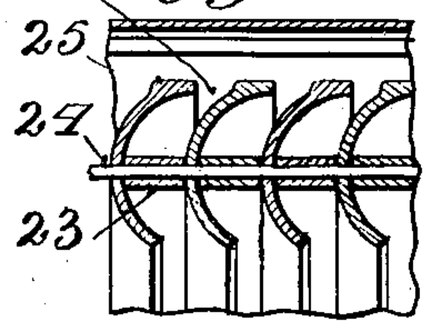

Fig. 5.

WITNESSES

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SILENCER.

951,770. Specification of Letters Patent. Patented Mar. 8, 1910.

Application filed July 29, 1909. Serial No. 510,323.

To all whom it may concern:

Be it known that I, JAMES M. MILLER, a citizen of the United States, residing at Washington, District of Columbia, have invented certain new and useful Improvements in Silencers, of which the following is a specification.

The invention relates to an improvement in silencers designed for use with any type of engine, being more particularly directed to a muffler in which the energy of the exhaust gases is dissipated by counteracting their velocity of movement and changing their path of direction within the silencer.

A primary object of the present invention is the provision of a silencer in which the volume of exhaust gas is deflected from its ordinary direction of movement and divided into a series of succeeding rotary or whirling currents to dissipate or reduce the velocity of movement of the gas and thereby its energy, the gases finally escaping from the silencer under the power of its expansive force alone, with the effect to cause a silent discharge thereof.

Another object of the invention is the provision of a silencer in which the deflecting planes within the silencer are of continuously increasing diameter from the inlet to the discharge end of the silencer, with the effect to increase the angular deflection of the gases lengthwise the silencer or muffler and thereby decrease the angular velocity of the gases lengthwise the silencer. This effect results in the formation of a pull upon the gases within the silencer and thus supplementing the tendency to create a vacuum at the inlet end of the muffler caused by that portion of the gases which passes directly through the silencer in a practically straight course, the bell-like formation of said end of course tending to facilitate the formation of the vacuum, the result being to avoid back pressure on the engine and to assist in the scavenging of the cylinder.

Another object of the invention is the provision of a muffler made up of a series of interchangeable units, whereby to provide a variety of combinations of the different elements with particular regard to their deflecting surfaces, readily adapting the muffler to be arranged for coöperation with different types of engines.

Another object of the invention is the provision of a muffler in which the deflecting surfaces form curved planes throughout, thereby preventing the deposit of carbon or the like on such surfaces in the use of the muffler.

Another object of the invention is the provision of a muffler in which the gases after being influenced by the deflecting surfaces are collected from said surfaces in an enveloping casing from which they are discharged by their expansive force, whereby the volume of gas affected by each deflecting surface is by said surface directed into the casing beyond the influence of the succeeding deflecting surfaces. The effect of the respective deflecting surfaces is thus direct upon the initial velocity of the exhaust gas and does not act upon any portion of the gas in which the initial velocity has been decreased by a preceding deflecting surface.

The invention will be described in the following specification, reference being had particularly to the accompanying drawings, in which:—

Figure 1 is a vertical section of the improved muffler. Fig. 2 is a similar view, showing a slightly modified form. Fig. 3 is a similar view of a double type of muffler. Fig. 4 is a broken sectional view of another form of muffler. Fig. 5 is an enlarged broken sectional view illustrating the connection between the cup members.

Referring particularly to the accompanying drawings, my improved muffler is made up primarily of a series of muffling elements 1, including cup-like bodies having edge flanges or walls 2 and bottom walls 3. The edge walls are in the form of plain annular flanges while the bottom walls are of double concavo-convex form. The form of the bottom walls is concave inside and convex outside, having the meeting lines of curvature at the central point of the bottom, so that from said central point the bottom curves in all directions toward the side wall.

The bottom of each cup member is formed with a centrally disposed opening 4, and by reason of the formation of the bottom previously described said bottom intermediate the edge of the opening and the side wall is concaved on the inner surface and convex on the outer surface. At the juncture of the bottom

and side wall of each cup member there is formed in the relatively outer surface a slight annular depression or groove 5, and the inner edge of the free end of each side wall is formed with a slight projection 6 to fit within the annular depression 5 of the next or adjacent cup member. By this means the cup members are arranged in successively alined positions with the central points of their openings 4 in longitudinal alinement, the projection 6 and depression 5 serving to permit the convenient assemblage of the members and to maintain them in such position during assemblage of the parts.

The muffler proper is provided with an inlet shell 7 of semispherical shape formed with a connection 8 for the exhaust pipe from the engine. An outlet shell 9 also of semispherical shape is arranged at the outlet end of the muffler and formed for the connection of an escape bell or pipe. The free edges of each of the inlet and outlet shells are formed with radially projecting annular flanges 10 having outwardly turned edge lips 11, and a collector 12, in the form of a sleeve-like casing, is secured between the flanges 10 of the respective shells, the end edges of the collector being engaged beneath the lips 11 of the flanges.

In assembling the parts the series of cup members are secured in connected relation as described, any desired number being used. The forward edge of the cup member immediately adjacent the inlet shell seats in a recess 13 formed in the free edge of the shell, while the final cup member is engaged by an outlet band 14, the forward edge thereof fitting in the depression 5 of the final member and the rear edge seating in a recess 15 in the outlet shell. The collector casing 12, which has a diameter exceeding the maximum diameter of the cup members is applied prior to the application of the outlet shell, and tie rods 16 are passed lengthwise the casing with the ends passing through openings in the flanges 10 of the shell, the usual nuts securing the bolts, and thereby the other parts in connected relation.

As before stated the diameter of the collector casing 12 exceeds that of the cup members so as to provide what will be hereinafter termed an annular collection chamber 17 surrounding the side walls of the cup members throughout the length of the muffler. The side wall of each cup member is formed with a series of openings 18 establishing communication between the interior of the cup member and the collection chamber, and the outlet ring 14 is formed with a series of openings 19 to establish communication between the collection chamber and the outlet shell.

It is to be understood, of course, that the central openings in the cup members may be varied as desired in the particular muffler and that having such variation of openings the cup members owing to their interchangeability may be arranged with relation to each other as desired. For example, as shown in the preferred form in Fig. 1, the central openings of the cup members gradually decrease in diameter from the inlet shell toward the outlet shell, this arrangement gradually increasing the size of the deflecting surfaces of said members from the inlet toward the outlet end of the member. With the size of said surfaces of the respective members differing in area, it is obvious that said members may be arranged in any desired relation, for example the first member next the inlet shell may have the maximum or minimum central opening, and the next succeeding member a larger or smaller opening. Any number of combinations may be thus produced and with two series of members having differently sized openings in each series, a stepped arrangement of deflecting surfaces may be secured by arranging first a small or large opening and next the reverse.

In Fig. 2 the central openings to the cup members are of uniform diameter throughout the length of the muffler, in which arrangement the deflecting surfaces of said members are of course equal throughout the muffler.

In Fig. 3 I have shown a double type of muffler in which the inlet pipe 20 communicates with a ring 21 arranged centrally of the muffler, to the respective edges of which ring are secured the cup members. The cup members have their concaved surfaces toward the ring, that is opposing each other, the final member of each series being connected as in the preferred form to an outlet shell 22. As illustrated the central openings of the respective members gradually decrease in size from the inlet ring 21 to the respective outlet shells. It is of course obvious that, if desired, as a result of the interchangeability of the cup members, the two series of members illustrated in Fig. 3 may be transposed and their concave faces disposed in reversed formation to that illustrated, in which arrangement the exhaust gases will simultaneously enter the ends of the silencer and exit through the pipe 21. The usual collector casing 12, and means of securing the parts together is used in this form.

In Fig. 4 a slightly different form is shown in which the cup members are held in spaced relation through the medium of spacing sleeves 23 encircling a tie rod 24 passed lengthwise through all of the members, the relative lengths of the sleeves 23

and the side walls 25 of the cup members being such that the forward edges of said side walls when the sleeves are in place are spaced from the adjacent edges of the next succeeding cup member, thereby providing an annular space 26 between the cup members through which the gases may escape into the collection chamber.

In use the exhaust gases directed into the silencer are gradually taken up in the travel through the silencer by the deflecting surfaces of the respective cup members. That portion of the gases taken up by each deflecting surface is given a rotary or whirling movement between said surface and the convex surface of the next deflecting surface toward the inlet. This whirling movement develops a centrifugal action, forcing the gases against the walls of the members until the velocity of movement has been so reduced as to permit the expansive force of the gas to direct the same through the adjacent opening 18 into the collection chamber. The reduction of velocity tends to dissipate the energy of the gases, so that when delivered into the collection chamber the gases are practically moving under their expansive force alone.

In the forms shown particularly in Fig. 1 it will be noted that the deflecting surfaces at the outlet end of the muffler have the maximum area, and that, therefore, that proportion of the gases taken up at this point will exceed that at any other point. Therefore, the velocity of the gases at this point will act to draw upon the gases following in the central openings of the cup members with the effect to create a suction at the inlet end of the muffler or in other words the tendency to a vacuum. This result, coupled with the fact that the gases deflected by each succeeding surface are not directed back to the next surface, but sent into an outside chamber, tends to relieve the cylinder of all back pressure incident to a retardation of the direct escape of the gases, and the vacuum created materially increases the scavenging of the cylinder.

The gases from the collecting chamber pass through the openings 19 into the outlet shell, and by reason of the elimination of their energy in the muffler are discharged noiselessly into the atmosphere.

It is, of course, to be understood that any desired number of cup members may be used, and that the sizes of the adjacent deflecting surfaces may be varied with relation to each other to any desired extent.

I claim:—

1. A muffler including a series of deflecting surfaces, and a collection chamber to receive the gases directly from said deflecting surfaces.

2. A muffler including a series of deflecting surfaces of different areas, each of said deflecting surfaces being arranged transverse the direct path of the escaping fluid.

3. A muffler including a series of curved deflecting surfaces of different areas, each of said deflecting surfaces being arranged transverse the direct path of the escaping fluid.

4. A muffler including a series of connected cup members, each of said members being formed to provide throughout its deflecting area a concavo-convex deflecting surface.

5. A muffler including a series of connected cup members, each of said members being formed to provide throughout its deflecting area a concavo-convex deflecting surface, the surfaces of said members being arranged in parallel spaced relation.

6. A muffler including a series of connected cup members, each of said members being formed with a deflecting surface, and a collector encircling the members.

7. A muffler including a series of connected cup members, each of said members being formed with a deflecting surface, and a collector encircling the members and in open communication with the space between the adjacent deflecting surfaces of the members.

8. A muffler including a series of cup members, an inlet shell connected to the first cup member, an outlet shell connected to the final cup member, and a collection casing encircling the cup members between the shells.

9. A muffler including a series of cup members, an inlet shell connected to the first cup member, an outlet shell connected to the final cup member, and a collection casing encircling and in communication with the cup members between the shells.

10. A silencer made up of a series of cup members formed for interlocking one with another, and means arranged beyond the members for securing them together.

11. A silencer made up of a series of cup members each including a deflecting portion and an annular flange, the outer surface of the member being formed with an annular groove and the forward edge of the flange formed with a groove-fitting projection.

12. A silencer including a series of cup members having central openings and deflecting surfaces arranged beyond the openings, said members being formed for interlocking to maintain their openings in alinement.

13. A deflecting member for silencers including a cup-shaped body having an annular flange and a deflecting surface concaved in all directions from a central point.

14. A deflecting member for silencers including a cup-shaped body having an annu-

lar flange and a deflecting surface concaved in all directions from a central point, the flange being formed with openings.

15. A deflecting member for silencers including a cup-shaped body having an annular flange and a deflecting surface concaved in all directions from a central point, the deflecting surface being formed with a central opening.

16. A deflecting member for silencers including a cup-shaped body having an annular flange and a deflecting surface concaved equally in all directions from a central point.

In testimony whereof, I affix my signature in presence of two witnesses.

JAMES M. MILLER.

Witnesses:
HERBERT L. FRANC,
HARRY L. GOULD.