Sept. 4, 1928. 1,683,084

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MUFFLER

Filed Dec. 21, 1925

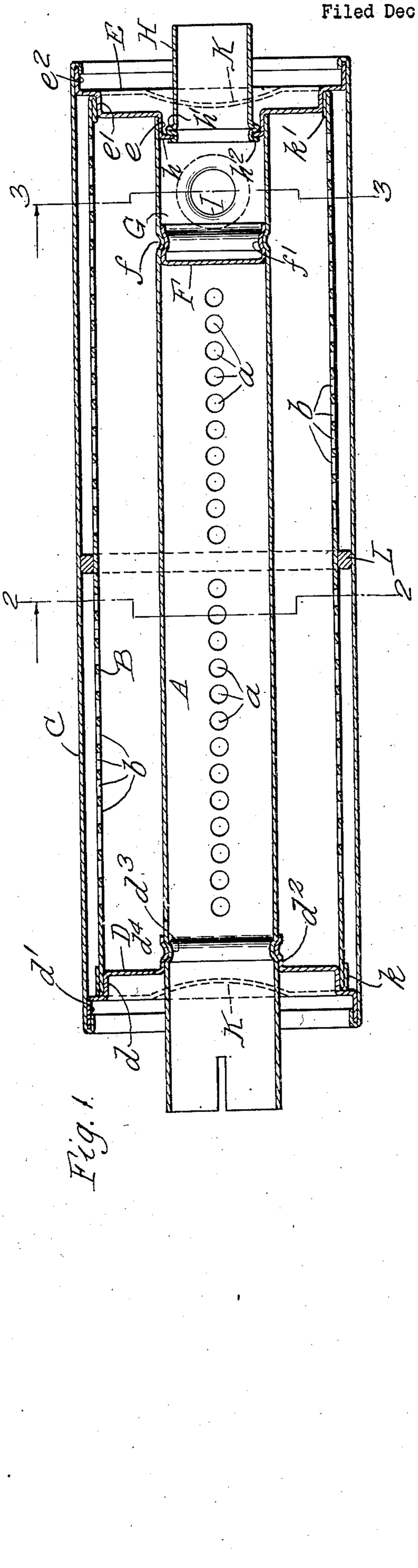

Fig. 1.

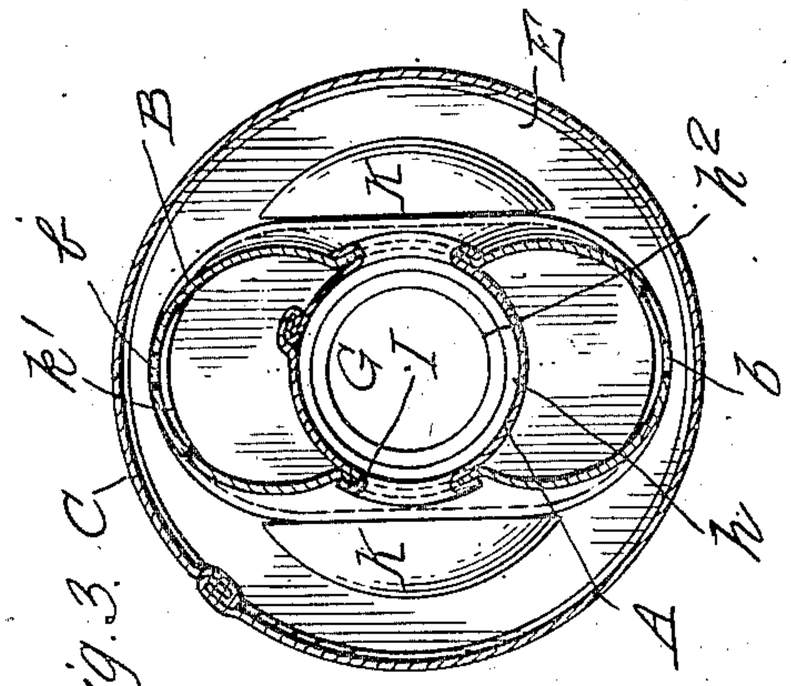

Fig. 3.

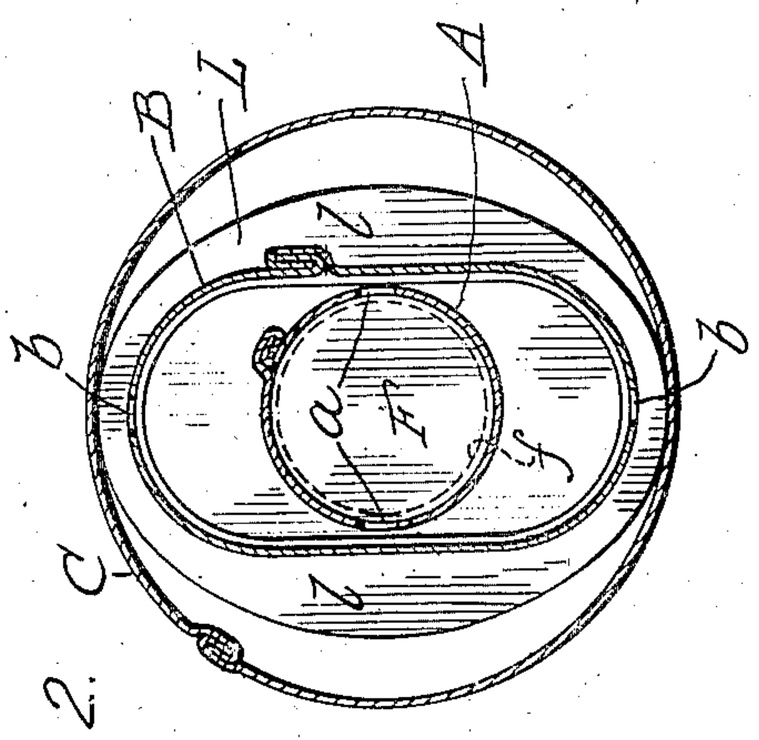

Fig. 2.

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Patented Sept. 4, 1928. 1,683,084

UNITED STATES PATENT OFFICE.

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MUFFLER.

Application filed December 21, 1925. Serial No. 76,711.

This invention relates to improvements in mufflers or silencers of the kind adapted to be used in connection with internal combustion engines.

The objects of this invention are to provide a muffler having a plurality of annular compartments with means for connecting two annular compartments to permit the gases to flow from one of the compartments to the other across an intermediate compartment; also to provide improved means for bracing tubes of non-circular cross section in such a manner that such tubes will maintain their correct shape when subjected to severe internal strains; also to improve the construction of mufflers in other respects hereinafter specified.

In the accompanying drawings:

Fig. 1 represents a longitudinal, central, sectional elevation of a muffler embodying the invention.

Figs. 2 and 3 are transverse sectional elevations thereof on line 2—2, and 3—3, Fig. 1.

This invention may be used in connection with mufflers of different types. The muffler shown in the drawings for the purpose of illustration of my invention includes an inner cylindrical tube or shell A of substantially circular cross section into which the exhaust gases pass from an engine, an intermediate shell or tube B of substantially elliptical or other non-circular cross section, having its smallest diameter greater than the diameter of the inner tube A and arranged substantially concentric with regard to the inner tube, and an outer tube or shell C also substantially circular in cross section and of greater diameter than the major axis of the elliptical shell B, and arranged concentric with regard to the inner tube A. The tubes or shells are held in place with regard to each other by means of a head D arranged at the inlet end of the muffler, and a head E at the discharge end thereof. The heads are preferably made of sheet metal and are provided with shoulders by means of which the shells are held in place, the head D having a shoulder d for the elliptical shell B and an outer flange or shoulder d' for the outer tube C, and the head E having shoulders e and e' engaged respectively by the shells A and B; and an outer flange or shoulder e^2 around which the outer shell C of the muffler extends. The head D also has an inwardly extending flange d^2 which engages the outer periphery of the inner shell A and which is suitably secured to this shell, to form a substantially air tight joint therewith, for example, by means of an inwardly extending bead d^3 of the shell A, which cooperates with a bead d^4 on the flange d^2. These beads therefore not only serve to securely hold the inner shell A in place, but in addition, positively insure a tight joint.

The inner shell, which is connected directly with the exhaust pipe of the engine, is provided with a series of perforations or holes a which are so arranged that the gases passing through these perforations enter into the chamber between the tubes A and B at the portions thereof of smallest cross section, or in other words, the gases impinge upon the portions of the elliptical tube B at the minor axis, and pass from the portion of the chamber of smaller dimension to those of greater dimension causing expansion of the gases. The elliptical shell B is provided at the portions thereof of greater dimension with a plurality of perforations or holes b through which the gases pass into the outer chamber formed by the tubes or shells B and C and are further expanded in this chamber by passing from the portions of smaller cross sectional area to those of greater area.

The gases are discharged from the outer chamber into the rear end of the inner shell or tube A, which for this purpose is separated or divided from the front portion of the inner tube or shell by means of a partition plate F which may be suitably secured in the inner tube, preferably by means of an internally extended bead f which enters a smaller annular bead f' on the partition F and is secured by means of spot-welding or other securing means. This partition forms at the rear end of the inner shell A a discharge compartment or space G from which the gases flow out of the muffler through a discharge pipe or nozzle H. In the construction shown, this discharge nozzle is secured to an inwardly extending annular flange h formed on the head E, the discharge tube or nozzle H being preferably provided for this purpose with an expanded bead flange h' which abuts against one side of the flange h, and the inner ends of the tube or nozzle are turned outwardly against the opposite side of the flange h as indicated at h^2. Any other means for securing the discharge nozzle to the muffler may be employed.

Means are provided for passing the gases from the outer chamber to the discharge chamber G without permitting the gases to come in contact with those in the intermediate chamber between the shells A and B, the means shown being constructed as follows: The portions of the non-circular tube C which extend into closest proximity to the discharge chamber G are provided with holes or perforations adapted to communicate with similar holes or perforations in the discharge chamber G, and in order to form a connection between the outer chamber and the discharge chamber, the portions of the shell B around the perforations therein are pressed inwardly into contact with the shell A, and a suitable connection is made between the shell B and the shell A around the holes therein. This connection in the construction shown is made by bending the metal of the shell A around the edges of the perforations in the shell B in such a manner as to form a seam therewith as indicated at I. By means of this construction the connection between the outer chamber and the discharge chamber G is made in an inexpensive and efficient manner without necessitating the provision of any additional part other than the shells themselves and the arrangement of the connecting passage is such that the gases flow from the portions of the outer chamber of greatest cross sectional area so that these gases are fully expanded in the outer chamber before they are discharged into the discharge chamber. Furthermore, the connections from the outer chamber to the discharge chamber are arranged at opposite sides of the discharge chamber, which causes the two currents of gas which pass from the outer chamber into the discharge chamber to impinge and thus further deaden any sound or noise. The connection between the elongated sides of the elliptical shell B and the inner shell A also serves to hold the portion of the elliptical shell near the discharge chamber C from assuming a substantially circular cross sectional shape when the muffler is subjected to severe internal explosions.

It is well known that if a tube of non-circular cross section is subjected to internal explosive pressure, the tendency of this pressure is to change the shape of the tube to a circular cross section. Consequently the elliptical tube or shell B may, if the muffler is subjected to an explosion of sufficient violence, be changed from its form as shown in the drawings to a form more resembling a shell of circular cross section, and in order to avoid distortion of the shell B due to unusually severe explosions in the muffler, the heads D and E are provided adjacent to the shoulders *d* and *e'* thereof with which the shell B engages with inwardly extending projections K having substantially square shoulders arranged in proximity to and substantially parallel with the shoulders *d* and *e'* and engaging the shell B. Also the ends of the shell B are preferably turned over, one end of the shell being turned over outwardly to form a cuff *k* and the other end being turned inwardly to form a cuff *k'*. These projections K together with the connection I between the shell B and the shell A effectually serve to hold the ends of the shell B against assuming a more or less circular cross section due to internal pressure.

The portions of the non-circular shell B intermediate of the ends thereof are preferably reinforced against the distorting action of explosions in the muffler by means of a bridge or truss member L which surrounds the shell and engages the elongated sides thereof so as to prevent these sides from bending or bulging outwardly. In the particular construction shown this truss member is made of a single stamping of relatively heavy sheet metal and the portions *l* of the truss member which are adjacent to the portions of least dimension of the shell B are made of greatest depth and this depth gradually decreases toward those portions of the shell B of greatest dimension. The truss member, as will be seen in Fig. 2, provides spaces at opposite sides thereof between the outer shell C and the shell B through which the gases in the outer chamber may move lengthwise of the shell B toward the discharge end thereof.

By reinforcing the non-circular shell B as described, this shell may, if desired, be made of thinner metal than has heretofore been used without any sacrifice of strength and a muffler may be provided with expansion chambers which are much smaller in cross section at the portions where the gases enter the chambers than at those portions in which the gases leave the chambers which results in very efficient silencing.

We claim as our invention:

1. In a muffler, the combination of a plurality of shells of different sizes arranged one within another forming a plurality of chambers in which the gases of combustion expand, said shells being provided with openings through which the gases flow from one chamber to another, two adjacent shells being provided with registering holes and being bent to cause the portions having said holes to be brought into contact to permit gas to flow through said holes without mixing with the gas in the chamber between said two shells, and means for securing said shells together around said holes.

2. In a muffler, the combination of an inner shell provided with a partition dividing said shell into an inlet portion and a discharge chamber, an intermediate and an outer shell, said intermediate shell being formed so that portions thereof are in contact with said inner shell adjacent to said discharge chamber, said contacting portions of said inner

and intermediate shells being provided with registering holes, and means for securing said contacting portions of said shells together.

3. In a muffler, the combination of an inner shell provided with a partition dividing said shell into an inlet portion and a discharge chamber, an intermediate and an outer shell, said intermediate shell being formed so that portions thereof are in contact with said inner shell adjacent to said discharge chamber, said contacting portions of said inner and intermediate shells being provided with registering holes, the metal surrounding the hole in one of said shells being bent around the edges of the hole in the other shell to secure said shells together.

4. In a muffler, the combination of inner and outer shells of substantially circular cross section and an intermediate shell of substantially elliptical cross section, the inner shell having a partition dividing said inner shell into an inlet portion and a discharge chamber, portions of the elongated sides of said elliptical shell extending into proximity to and being connected with said inner shell and being provided with holes which register with corresponding holes in said inner shell, whereby gases are discharged into said discharge chamber from opposite sides thereof to form two currents which impinge against each other in said chamber.

5. In a muffler, the combination of a plurality of shells of different sizes arranged one within another forming a plurality of chambers in which the gases of combustion expand, means for permitting gases to flow from the inner shell toward the outer shell, and a connection between shells to permit gases to flow from an outer shell toward an inner shell without mixing with the gases which are flowing in the opposite direction, said connection being formed by bending portions of adjacent shells into contact with each other, and perforating and securing together the contacting portions of said shells.

6. In a muffler, the combination of shells of circular and non-circular cross section arranged one within another, and a connection between a circular shell and a portion of a shell of non-circular cross section, said connection being provided for permitting gases to pass from the chamber outside of the outer of said shells to a chamber inside of the inner of said shells and for bracing said shell of non-circular cross section.

7. In a muffler, the combination of inner and outer shells of substantially circular cross section and an intermediate shell of substantially elliptical cross section arranged between the shells of circular cross section, openings in said inner circular shell adjacent to the portions of said elliptic shell of smallest diameter through which gases may flow from one shell to another, openings in said elliptic shell in the portions thereof of greatest diameter through which gases may flow, whereby the gases expand inside and outside of said elliptic shell by flowing from spaces of reduced cross sectional area to spaces of increased cross sectional area, a portion of said elliptic shell being bent toward said inner shell of circular cross section and secured thereto and apertured to establish a communication between the chamber enclosed by said outer shell of circular cross section and the chamber enclosed by said inner shell, whereby gases are discharged from the chamber enclosed by said outer shell at the portions thereof of greatest cross sectional area.

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