April 7, 1925. 1,532,928

M. J. O'CONNOR

MUFFLER

Filed July 17, 1923 2 Sheets-Sheet 1

Fig. 1.

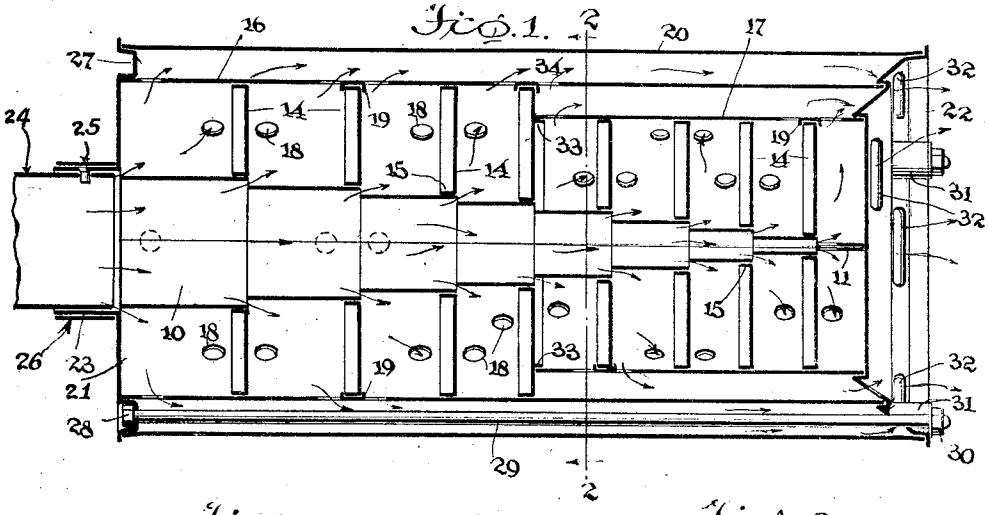


Fig. 2.

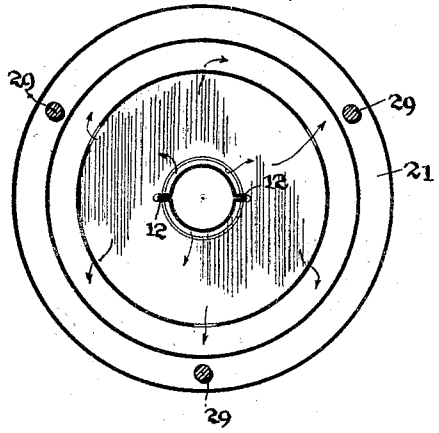


Fig. 3.

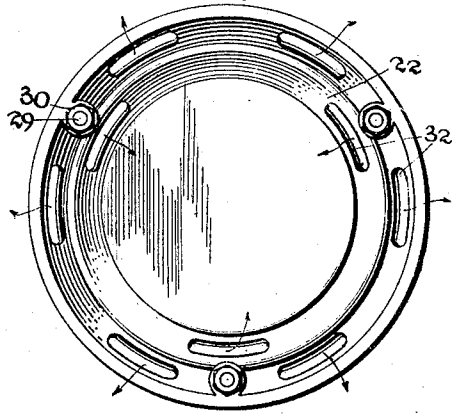
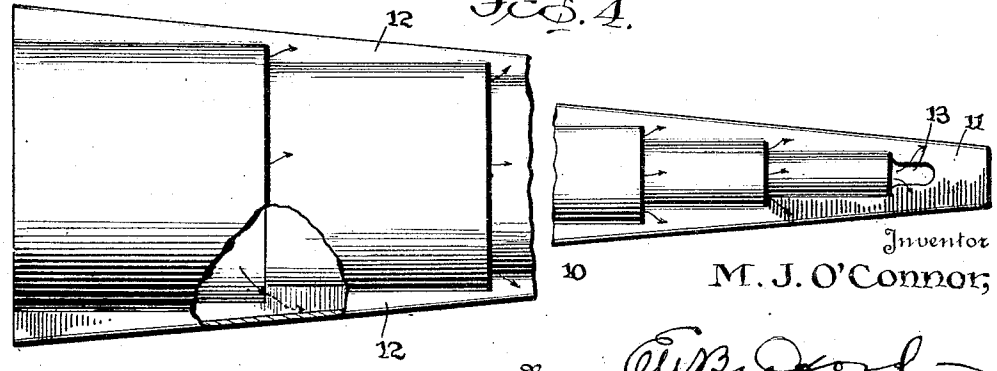


Fig. 4.



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Fig. 5.

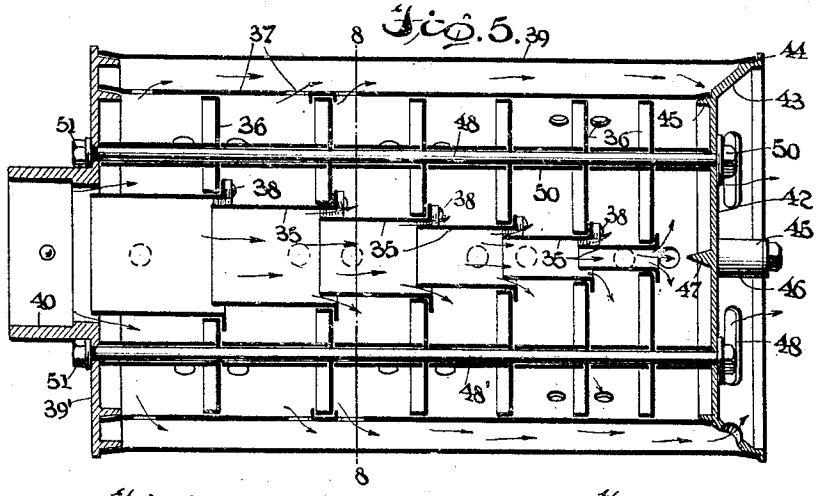


Fig. 6.

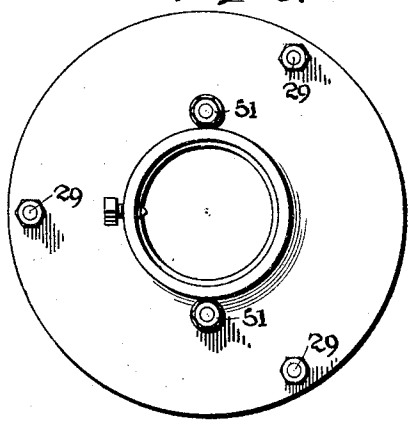
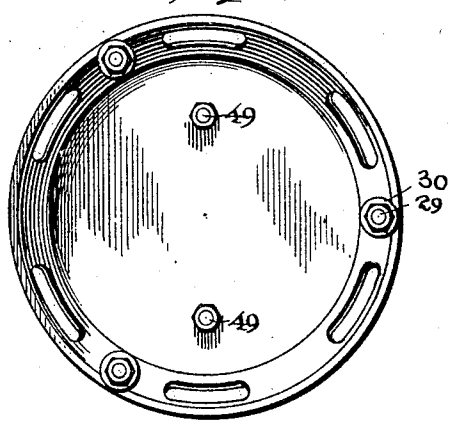


Fig. 7.



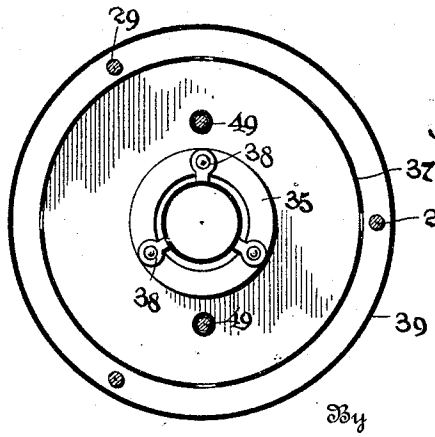


Fig. 8.

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UNITED STATES PATENT OFFICE.

MICHAEL JOSEPH O'CONNOR, OF BLOOMINGDALE, NEW JERSEY.

MUFFLER.

Application filed July 17, 1923. Serial No. 652,133.

To all whom it may concern:

Be it known that I, MICHAEL J. O'CONNOR, a citizen of the United States, residing at Bloomingdale, in the county of Passaic and State of New Jersey, have invented certain new and useful Improvements in Mufflers, of which the following is a specification.

My said invention relates to a muffler designed particularly for use with internal combustion engines though capable of use in other relations. Some of the objects of the invention are to provide a muffler which shall be comparatively simple and inexpensive to manufacture, which shall leave the exhaust pipe clean and which by reason of a gradual reduction or what may be called a shaving down of the exhaust shall be particularly efficient and silent in operation.

A further object of the invention is to provide a muffler which shall be constructed mainly of sheet metal and which shall therefore be light in weight and by reason of the fact that the parts may be pressed or stamped into shape shall keep the cost of manufacture down to a minimum.

Referring to the accompanying drawings, which are made a part hereof and on which similar reference characters indicate similar parts,

Figure 1 is a longitudinal section of a preferred form of my invention,

Figure 2, a section on the line 2—2 of Fig. 1,

Figure 3, a rear elevation,

Figure 4, a plan of a stepped tube forming the inner member of the device,

Figure 5 a longitudinal section of a modified form of the invention,

Figure 6, a front elevation of the same,

Figure 7 a rear elevation thereof, and

Figure 8, a vertical section on line 8—8 of Figure 5.

In the drawings reference character 10 indicates a stepped tube preferably of sheet metal, said tube decreasing in diameter step by step from the large open end which is adapted to be connected to the exhaust pipe of the engine toward the front end where the tube flattens into two parallel walls or plates 11 which may lie so close together as to almost touch one another. These parallel end walls constitute the termination of oppositely located flutes 12 running from end to end of the stepped tube. In addition to the parts so far described the tube comprises in effect a series of separate semi-cylindrical parts separated in one direction by crescent-shaped openings, the location of which is indicated by the arrows passing through the tube at intervals along its length: The final opening as indicated at 13 in Figure 4 is of slightly different shape by reason of the juxtaposition of the parallel plates.

In a direction transversely of the tube the semi-cylindrical parts are supported by the fins or flutes 12 which as will be understood are integral with the sections, the latter being pressed out of a single cone of sheet metal in a preferred form of the invention and as will be evident this tube may be made with practically no loss of material and by a simple and inexpensive operation. In the manufacture of the inner stepped tube a series of pairs of transverse slits may be made at opposite sides of the tube and preferably at equally spaced intervals along the same, whereupon the entire tube is immediately pressed into the form shown with cylindrical sections of progressively decreasing diameter.

Adjacent each step from one diameter to another the tube is surrounded by a disk 14 preferably having similarly directed flanges 15 for convenient means of attachment to the adjacent parts. The inner flange of each disk may be welded or brazed or otherwise secured to the outer lips of the semi-cylindrical sections of the stepped tube while the external flange may be similarly secured to the inner face of one of the respective cylindrical tubes 16 and 17 surrounding the stepped tube. As here shown the cylindrical tubes have openings 18, the positions of certain openings being indicated by the arrows extending through the openings and the material of the tube at 19 is bent inwardly in punching out the openings to aid in positioning and securing in place the various disks 14. The tube 16 is surrounded by still another tube 20 forming the imperforate outer wall of the muffler. It will be noted that all the tubes are concentric in the preferred form.

The ends of the muffler are provided with front and rear closures 21 and 22 each of which preferably consists of a sheet metal stamping. The front closure has a flange 23 adapted to surround the exhaust tube 24. The flange 23 and the exhaust tube 24 may

be secured together in any suitable manner, as by pins or rivets 25 which may be concealed and held in place by a collar 26. The forward face of the disk adjacent to the rim 23 abuts against the flutes 12 at the rear end of the stepped tube and the rear face of the front closure 22 also abuts against said flutes to afford a strong bracing action of the parts. The disk 21 is shown as having an annular internal rib 27 spacing and holding in place the respective tubes 16 and 20 and also forming a convenient space to receive and conceal the heads 28 of the bolts 29 a plurality of which extend from end to end of the muffler for holding the parts in place.

At the forward end of the muffler the bolts extend through the front closure 22 and are provided with nuts 30 and with spacers 31 resting against the irregular front face of the closure. This closure is so formed as to provide a pair of flanges within which the ends of the respective tubes 16 and 17 fit closely to hold them in place and has also a concentric outer face to receive the end of the outer tube 20. The closure 22 has openings 32 arranged in two series, the outer series communicating with the annular chamber between tubes 16 and 20 and the inner series communicating with the annular chamber between tubes 16 and 17.

The tube 17 is supported at its front end by an annular flange 33 formed on or secured to the adjacent disk 14. In some instances the sleeve 17 may be dispensed with and all of the disks will then be formed of equal size so that the various steps of the inner tube will open into successive chambers of equal diameter which therefore may be of increasing size.

In the operation of my device above described the exhaust from the engine will enter at the front end of the stepped tube and concentric crescent shaped segments will be shaved or peeled off the outer surface of the blast of hot exhaust gases. Such parts of the exhaust may expand in the chambers between the concentric parts of tubes 10 and 16 and may gradually pass through the small openings 18 into the chamber between the tubes 16 and 20, after which the gas may gradually pass out through the outer series of openings 32. The blast passing along the stepped tube is cut off by gradual increments and passes out into the respective chambers and then through the openings 18 into the outer annular chamber in a gradual and very silent manner, the last part of the blast passing through the openings 13 near the rear end of the tube.

In the embodiment of the invention so far described the parts of the blast reaching the rear end of the muffler will have a stage of expansion distinct from that of the gas passing through the other compartments and partly additional thereto by reason of the openings 34 leading from the inner annular chamber through tube 16 to the outer chamber between tubes 16 and 20. Such a muffler I prefer to use on such engines as are used on airplanes and the like where they will add to the efficiency of the device.

In a modified form of the invention, as shown in Figures 5 to 8, a stepped tube is shown similar to that shown in Figure 1 but formed different in that each of the sections 35 is distinct and separate from every other. These sections at their free ends are surrounded by disks 36 which may be welded or brazed to a tube 37 and at their inner edges may be connected to outwardly extending flanges of the sections 35 by means of rivets 38 or in any other desired manner. Between the concentric ends of the adjacent section 35 there will be annular passages for exhaust gases to escape into the respective chambers located between the stepped sections and the tube 37 and this tube is provided with openings through which the gases may escape into an annular chamber between sleeve 37 and the outer tube or casing 39. As in the modifications illustrated in Figure 1 the parts of the sleeve 37 which are bent down in forming the exit openings may serve to position and secure the disks 36 in place.

The front end closure 39′ may consist of a flat circular plate having a rearwardly extending central flange 40 to be connected to the exhaust pipe in any usual or convenient manner. A rear closure 42 has a flange 45 fitting within the tube 37 and a flaring annulus 43 has a surface fitting within the tube 39 and a flange 44 against which the end of said tube abuts. The annulus 43 at its inner periphery engages the outer edge of the disk 42 and thus serves to space tubes 37 and 39 from one another.

It will be seen that the rearward tube 35 is open and that the disk 42 and a cross-bar 45 carried by the annulus 43 support between them a spacer 46 carrying a pointed member 47 so located that the point is spaced from said tube 35 but is directed toward the center line of the same. The annulus 43 is perforated at 48 to provide an outlet for the gas from the chamber between the sleeves 37 and 39. The parts are held together by bolts 29 similar to those in the preferred modification and having nuts 30. In addition to these bolts a pair of bolts 48′ are provided for holding the parts together. These bolts extend from end to end of the muffler and are held in place by nuts 50. Spacers 49 surround the bolts and separate the disks 36 equally from one another at all points.

I have shown the parts made of pressed sheet metal in the form shown in Figures 1 to 4, while in that of Figures 5 to 8 all parts

are similar except the end pieces of the muffler which are castings. It is to be understood, however, that I do not limit myself to any specific material or any particular way of handling it.

It is to be understood also that my device may be modified in various ways without departing from the scope of the invention and therefore I do not limit myself to the forms shown in the drawings and described in the specification but only as indicated in the appended claims.

Having thus fully described my said invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a muffler for explosive engines, an annular outer chamber, a conical tube concentric therewith, said tube having stepped integrally formed cylindrical portions, separate secondary chambers between the tube and the outer chamber, and passages connecting the secondary chamber respectively to the outer chamber and to one of the steps of the conical tube, substantially as set forth.

2. A muffler for explosive engines comprising an outer annular chamber, a tube concentric therewith comprising a series of integrally formed cylindrical sections progressively decreasing in size, secondary chambers between the tube and the outer chamber, and passages connecting the secondary chambers respectively with one of said cylindrical sections and with the outer chamber, substantially as set forth.

3. A muffler for explosive engines comprising an outer annular chamber, a tube concentric therewith comprising a series of integrally formed cylindrical sections progressively decreasing in size, annular secondary chambers between the tube and the outer chamber, and passages connecting the secondary chambers respectively with one of said cylindrical sections and with the outer chamber, substantially as set forth.

4. In a muffler for explosive engines, a pair of concentric tubes forming an outer chamber between them, a tube composed of integrally formed cylindrical sections of progressively decreasing diameter extending lengthwise of the muffler, a disk adjacent an end of each section closely embracing the same and secured at its outer periphery within the inner concentric tube, passages leading from said sections to spaces between adjacent disks and passages leading from such spaces to the outer chamber, substantially as set forth.

5. In a muffler for explosive engines, a pair of concentric tubes forming an outer chamber between them, a tube composed of integrally formed cylindrical sections of progressively decreasing diameter extending lengthwise of the muffler, a disk adjacent an end of each section closely embracing the same and secured at its outer periphery within the inner concentric tube, substantially crescent shaped passages leading from said sections to the spaces between adjacent disks, and passages leading from such spaces to the outer chamber, substantially as set forth.

6. In a muffler for explosive engines, an annular outer chamber, a tube arranged concentrically with said chamber comprising a plurality of integrally formed cylindrical sections of progressively decreasing diameter, passages through the tube between said sections, secondary chambers between the tube and the outer chamber opening out of said passages, and passages between the secondary chamber and the outer chamber, substantially as set forth.

7. A muffler for explosive engines having an annular outer chamber, a tube in said chamber having communication with the exhaust pipe of the engine and comprising a plurality of integrally formed cylindrical sections progressively decreasing in diameter, a closure for the rear end of the muffler, passages leading through said closure, an outer annular chamber connected to said passages, secondary chambers within the outer chamber, and passages leading from said tube to said secondary chamber, substantially as set forth.

8. A muffler for explosive engines having an annular outer chamber, a tube in said chamber having communication with the exhaust pipe of the engine and comprising a plurality of integrally formed cylindrical sections progressively decreasing in diameter, a closure for the rear end of the muffler, passages leading through said closure, an outer annular chamber connected to said passages, secondary chambers within the outer chamber, passages leading from said tube to said secondary chamber, a front closure for the muffler, and concentric structural variations on the adjacent faces of said closures for holding the walls of the outer chamber in spaced relation, substantially as set forth.

9. In a muffler for explosive engines, a plurality of tubes forming concentric annular chambers, a tube having stepped integrally formed walls arranged concentrically of such chambers, a disk for each step of the tube separating the space between the stepped tube and the adjacent concentric tube into secondary chambers, passages leading from the stepped tube into the secondary chambers, passages leading from the secondary chambers into said concentric chambers, closures for the ends of the muffler, and structural variations on said closures for holding the concentric tubes in spaced relation to each other, substantially as set forth.

10. In a muffler for explosive engines, a plurality of tubes forming concentric annu-

lar chambers, a tube having stepped integrally formed walls arranged concentrically of such chambers, a disk for each step of the tube separating the space between the stepped tube and the adjacent concentric tube into secondary chambers, passages leading from the stepped tube into the secondary chambers, passages leading from the secondary chambers into said concentric chambers, closures for the ends of the muffler, structural variations on said closures for supporting the concentric tubes in spaced relation to each other, and bolts extending from end to end of the muffler through the outer annular chamber for holding said closures in place, substantially as set forth.

11. In a muffler for explosive engines, a substantially conical tube, a tube concentric therewith, apertured disks surrounding the inner tube and separating the space between said tubes into annular compartments, the outer tube having openings punched therein providing outlet passages for said compartments, the material displaced from said tube securing said disks in place, substantially as set forth.

12. A muffler for explosive engines comprising a series of cylindrical sections of progressively decreasing diameter, said series of sections being arranged in end to end relation and connected at their ends by oppositely disposed integral flutes, substantially as set forth.

13. A method of preparing stepped tubes comprising transversely slitting a conical tube equally at opposite sides through nearly its entire circumference and pressing the tube to form simultaneously a series of cylinders of progressively decreasing diameter and oppositely located flutes connecting said cylinders, substantially as set forth.

14. A method of preparing stepped tubes comprising transversely slitting a conical tube equally at opposite sides through nearly its entire circumference and pressing the tube to form simultaneously a series of cylinders of progressively decreasing diameter, oppositely located flutes connecting said cylinders and a parallel sided flattened end portion, substantially as set forth.

15. A method of preparing stepped tubes comprising transversely slitting a conical tube equally at opposite sides through nearly its entire circumference and pressing the tube to form simultaneously a series of cylinders of progressively decreasing diameter and oppositely located flutes connecting said cylinders the contiguous ends of adjacent cylinders being separated by substantially crescent-shaped openings, substantially as set forth.

16. In a muffler for explosive engines, a pair of concentric tubes forming an outer annular chamber extending the length of the muffler, a third concentric tube forming with the inner of said first-named tubes a chamber of shorter length, end closures for the muffler having their faces shaped to sustain the tubes in concentric relation, a stepped tube concentric with said first-named tubes, a series of disks surrounding said stepped tube and dividing the space between said tube and the adjacent concentric tube into annular secondary chambers, a flange on one of said disks supporting the inner end of the third concentric tube, passages leading from the stepped tube into the secondary chambers and from the secondary chambers into the outer chamber, and passages leading from the outer chamber through one of said end closures, substantially as set forth.

17. In a muffler for explosive engines, a pair of concentric tubes forming an outer annular chamber extending the length of the muffler, a third concentric tube forming with the inner of said first-named tubes an annular chamber of shorter length, end closures for the muffler having their faces shaped to sustain the tubes in concentric relation, a stepped tube concentric with said first-named tubes, a series of disks surrounding said stepped tube and dividing the space between said tube and the adjacent concentric tube into annular secondary chambers, a flange on one of said disks supporting the inner end of the third-concentric tube, passages leading from the secondary chambers into the outer chamber, one or more passages leading from the second annular chamber into the first, and passages leading from said concentric chambers into the atmosphere, substantially as set forth.

18. In a muffler for explosive engines, a plurality of concentric tubes of sheet metal providing one or more outer chambers, a stepped inner tube of sheet metal providing a secondary chamber between said tube and the adjacent concentric tube, sheet metal disks surrounding each step of the tube and secured to the same and to the interior of the adjacent concentric tube, and passages leading from each step to the chamber about the next step and from the secondary chamber into the outer chamber respectively, substantially as set forth.

19. A sheet metal element for mufflers comprising a series of cylindrical sections of progressively decreasing diameter arranged in end to end relation and connected at their ends by oppositely disposed flutes of metal integral with said cylindrical sections, substantially as set forth.

20. A muffler comprising an outer casing, a tube concentric therewith consistng of a plurality of cylindrical sections of progressively decreasing diameter, lateral flutes connecting said sections extending from end to end of the muffler, end closures for the

muffler bearing against the extremities of said flutes, and bolts connecting said end closures, substantially as set forth.

21. A muffler comprising an outer annular chamber having inner and outer walls, a concentric inner chamber having a series of stepped walls, a partition member carried by each of said stepped walls dividing the space between said outer chamber and said concentric chamber into compartments, said partition member being secured in position by inwardly extending portions struck out from the inner wall of said annular outer chamber, said struck out portions providing passages leading out of said compartments, substantially as set forth.

In witness whereof, I have hereunto set my hand and seal at Washington, District of Columbia, this sixteenth day of July, A. D. nineteen hundred and twenty-three.

MICHAEL JOSEPH O'CONNOR. [L. S.]

Witnesses:

CHAS. E. RIORDON,

FRANK W. DAHN.