

Feb. 9, 1937.

B. B. CARY ET AL

2,070,543

MUFFLER

Filed Jan. 13, 1936

2 Sheets-Sheet 1

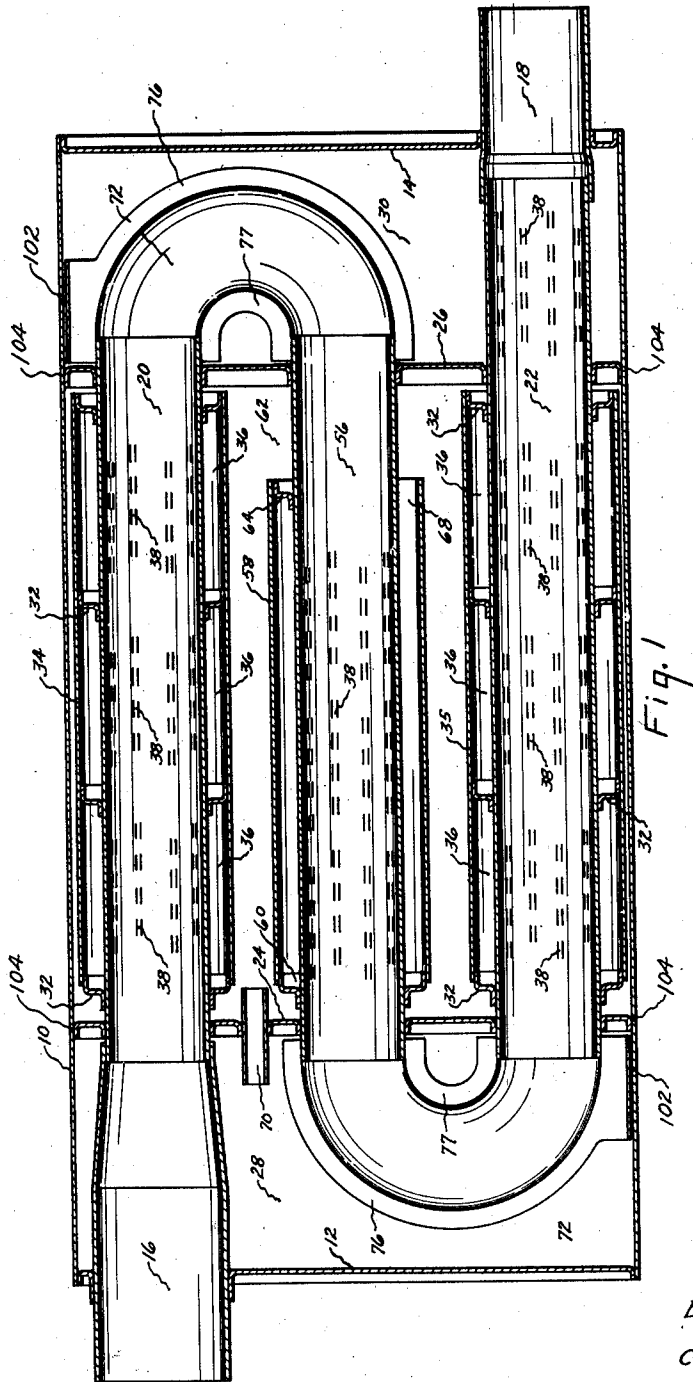


Fig. 1

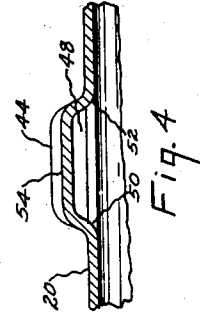


Fig. 4

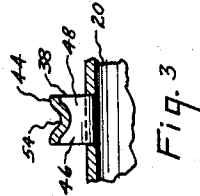


Fig. 3

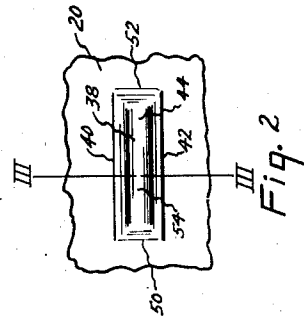


Fig. 2

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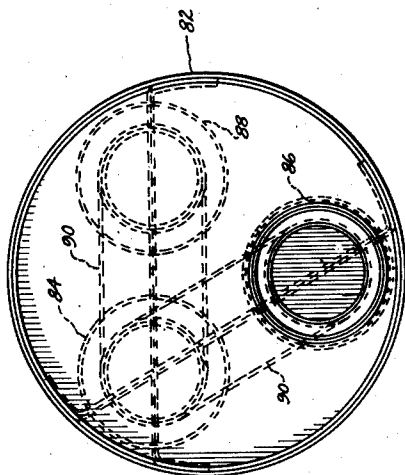


Fig. 6

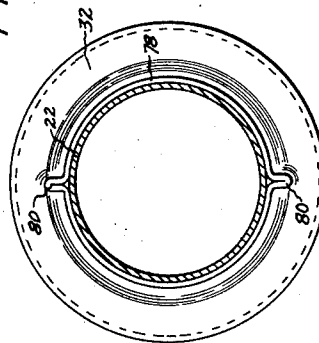


Fig. 7

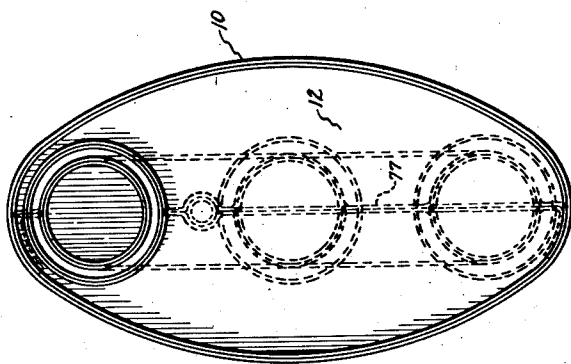


Fig. 5

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UNITED STATES PATENT OFFICE

2,070,543

MUFFLER

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10 Claims. (Cl. 181-54)

The present invention relates to silencers and mufflers and more particularly to mufflers used in connection with internal combustion engines for attenuating the sound of the exhaust.

While several of the features of the invention are independent of the type of gas flow through the muffler, as an important feature resides in improvements in retroverted passage type of mufflers, all the features are illustrated in connection with triple pass constructions.

An object of the invention is to provide a compact, retroverted flow, low back pressure muffler in which the changes in the direction of flow of gas at opposite ends of the muffler is accomplished with the creation of a minimum back pressure by angular conduits as distinguished from the usual practice of direction of the gas at opposite ends of the muffler into expansion chambers.

Another object resides in the improvement in resonator chamber arrangement and construction for acoustic wave attenuation.

Further objects and advantages residing in the specific construction of the conduit louvers, baffles, and other structural parts of the muffler will become apparent from a consideration of the following detailed description and accompanying drawings wherein,

Fig. 1 is a cross-sectional view taken along the longitudinal axis of the muffler,

Fig. 2 is an enlarged fragmentary plan and view of the louver construction in the gas conduit,

Fig. 3 is a cross-sectional view taken on line III-III of Fig. 2,

Fig. 4 is a cross-sectional view taken on line IV-IV of Fig. 3,

Fig. 5 is an end view of the muffler shown in Fig. 1 taken from the left end,

Fig. 6 is a view similar to Fig. 5 of a modified arrangement of the multiple longitudinal extending gas conduits, and

Fig. 7 is a cross-sectional view through the gas conduit showing the construction of a baffle and the method employed for securing the same upon the conduit.

Referring to the drawings, it will appear that the illustrated muffler in Fig. 1 comprises an outer oval shaped imperforate casing 10 having headers 12 and 14 at opposite ends. Inlet and outlet conduits 16 and 18 opening through the headers 12 and 14 and connected with straight through gas conduit sections 20 and 22 supported by baffles 24 and 26 spaced inwardly from the headers 12 and 14 to provide resonator chambers 28 and 30.

Spaced along the conduit sections 20 and 22

are baffles 32 supporting the tubes 34 and 35 to jointly define acoustic wave filter chambers 36. Each louver 38 in the conduits 20 and 22 opening into the chamber 36 preferably is formed by piercing the sections 20 and 22 along short parallel lines 40 and 42 and deflecting the central portion 44 outwardly to define an arch with openings at 46 and 48 between the curvilinear anchored ends of the portion 44 merging at 50 and 52 with the general contour of the conduit. To prevent closing of the openings 46 and 48 by inwardly deflecting the arch during handling and to strengthen the conduit a reinforcing and stiffening rib 54 is provided in the central portion 44. Such louver construction does not appreciably weaken the conduit as no metal is removed. Moreover, and of more importance, louver construction as illustrated does not create objectionable high frequency sounds upon passage of the exhaust gases along the conduit as is oftentimes experienced with conventional perforations. This characteristic perhaps may be attributed to the tangential location of the openings 46 and 48 disposed transversely of the direction of the gas flow and to the curvilinear structure of the portions 50 and 52 of the arch 44 which eliminate the presentation of any rough and sharp edges or abrupt shoulders over which the rapidly traveling exhaust gases flow. We have also observed the fact that our louver construction possesses acoustic wave attenuating characteristics which may be varied by regulating the height of the arch 44. Under some conditions the attenuating characteristic is increased by lowering the arch. As this accordingly reduces the openings between the arch and the conduit wall a large number of closely positioned louvers may be required which is possible without objectionable reduction in the strength of the conduit with our louver construction.

The return conduit section 56 is supported in the baffles 24 and 26 in the manner of the conduit sections 20 and 22. Embracing the section 56 is a tube 58 closed at one end and supported in spaced relation therefrom by an angular baffle 60 and opening into the resonator chamber 62 at the opposite end. One or more small brackets 64 support the tube 58 at the open end from the section 56. It will be noted that the louvers 38 in the section 56 only open into the chamber 66 defined by the section 56 and the tube 58 throughout a portion of its longitudinal extent so that a neck or orifice is defined at 68 opening into the resonator chamber 62. Between the resonator chambers 28 and 62 is located a neck or 55

orifice 70 similar in function to the orifice at 68. The orifices 68 and 70 may be varied as to diameter and length to alter the acoustic characteristics of the resonator chambers 28 and 62 which it will be noted are in compounding relation. While it may be desirable in some cases to also place the resonator chamber 30 in compounding relation with the chamber 62, in the illustrated embodiment a portion of the conduit 22 is embraced by the chamber 30 and opens into the same through the louvers 38.

Preferably the tortuous conduit defining the retroverted passageway for the exhaust gases is made up of a plurality of sheet metal sections welded together. After the separate straight through conduit sections 28, 22 and 56 have been assembled in the baffles 24 and 26 the return bend conduit sections 72 are telescoped with adjacent ends of the straight through conduit sections and welded or otherwise secured in position. As shown, the sections 72 are made up of complementary stamped halves 73 and 74 welded together along the flanges 76 and 77 to form an angular conduit for changing the direction of gas flow through 180° at opposite ends of the casing 10.

Referring more particularly to Figs. 1 and 7 it will be noted that the louvers 38 are located in spaced groups along the conduit sections 20 and 22 and that the baffles 32 are assembled upon these conduit sections in between the louver groups. As it is desirable that the baffles 32 be threaded upon the conduit sections, after the louvers have been fabricated, it is necessary that the annular flange 78 defining the central opening in the baffle 32 be of greater inside diameter than the outside diameter of the conduit section in order to be threaded over the louvers. Accordingly, to assemble the baffles 32 in position upon the conduit section between the louver groups the opening 78 must be reduced in some suitable manner in order to firmly secure the baffle 32 upon the conduit section. In Fig. 7 this has been accomplished by distorting the annular flange 78 by shrinking the same upon the conduit in a suitable die; the surplus material being deflected to define ears 80.

In Fig. 6 is shown a slight modification of the arrangement of the tortuous sections making up the conduit defining the passageway for the exhaust gases through the muffler. In lieu of having the parallel straight sections disposed in a single plane in an oval-shaped casing, with a cylindrical casing 82, the parallel straight conduit sections 84, 86 and 88 may be arranged at 120° apart and a tortuous conduit defined by connecting the straight through section through the employment of return bend sections 90 corresponding to the sections 72. The arrangement of the filter and resonator chambers shown in Fig. 1 may be likewise employed in connection with the arrangement of the straight through conduit sections shown in Fig. 6.

Heretofore in retroverted passage types of mufflers it has been the practice for the straight through conduit sections to open directly into expansion chambers at opposite ends of the muffler and to employ the expansion chambers for directing the exhaust gases along the return conduit or into the conduit leading to the outlet. With such a construction the exhaust gases in traveling from the inlet to the outlet do not have the well defined passage accomplished by the return bend conduit sections 72 disclosed in Fig. 1 and as a result there is greater resistance

to the gas flow. Moreover, the acoustic wave attenuating characteristics of the expansion chambers into which the straight through conduit sections open are not comparable with that of the resonator chambers 28 and 30.

To enumerate some of the structural features of our muffler construction: As the flanges of the angular conduit 72 are preferably welded to the casing 10 at 102 to support the same in position it is possible and may be desirable in some cases to omit the baffles 24 and 26 and support the straight through conduit sections within the casing entirely by the conduit 72. Such a construction would find application in cases where the compounding of the resonator chambers is not required and it is desired to open into a single chamber defined by the casing 10. It will also be readily seen that the entire internal structure of the muffler may be assembled outside the casing 10 and then inserted and welded in position at 102 and 104. Preferably the sections 20, 22 and 56 are only welded in the assembly at one end to permit the same to expand and contract in position. With reference to these sections, in practice they may be of different relative diameter and not of the same diameter as shown in Fig. 1.

In lieu of the louvers 38 opening into the chamber 30, a tube or opening may be stamped in and defined by the stamped halves conducting the sections 72 and open into the chamber 30.

The proportions of the acoustic wave attenuating structure of our muffler will, of course, vary in practice. Generally speaking, with the acoustic range of the exhaust system determined by a wave frequency analyzer or in some other suitable manner, the chambers 36 are proportioned to attenuate the higher frequency wave ranges or bands and the resonator chambers 28, 30 and 62 will be proportioned and tuned to attenuate the lower frequency ranges or bands. The compounding of the resonator chambers 28 and 62 materially increases the attenuating characteristics of the muffler and enables the capacity to be at a higher value with minimum chamber volume defined within the casing 10 which accordingly enables compactness of construction.

Having thus described our invention what we desire to protect by Letters Patent and claim is:

1. A muffler for internal combustion engines comprising an outer casing, a conduit made up of a plurality of sections collectively defining a retroverted passage for exhaust gases through said casing including inlet and outlet sections at the extremities thereof, spaced sections disposed longitudinally of the casing, angular sections connecting said spaced sections, said conduit being continuous and of substantially the same general cross-sectional area throughout its entire length, acoustic wave attenuating structure embracing portions of said conduit, and means defining communication between said conduit and said structure.

2. A muffler for internal combustion engines comprising an outer casing, a conduit made up of a plurality of sections collectively defining a retroverted passage for exhaust gases through said casing including inlet and outlet sections at the extremities thereof, spaced straight through sections disposed longitudinally of the casing, angular sections for changing the direction of the gas flow connecting said spaced sections, said conduit being continuous throughout its entire length, acoustic wave attenuating structure embracing portions of said conduit, and means de-

fining communication between said conduit and said structure.

3. A muffler for internal combustion engines comprising an outer casing, a conduit made up of a plurality of sections collectively defining a retroverted passage for exhaust gases through said casing including inlet and outlet sections at the extremities thereof, spaced straight through sections disposed longitudinally of the casing, angular sections for changing the direction of the gas flow, said conduit being continuous throughout its entire length and of substantially the same general cross-sectional area, acoustic wave attenuating structure embracing portions of said conduit, and means defining communication between said conduit and said structure.

4. A muffler for internal combustion engines comprising an outer casing, headers at opposite ends of said casing, a conduit defining a retroverted passage for exhaust gases through said casing including inlet and outlet sections at the extremities thereof opening through said headers, said conduit being continuous throughout its entire length with the intermediate portion thereof defining a tortuous path, spaced supporting structure disposed inwardly from said headers for supporting the tortuous portion of said conduit within said casing, acoustic wave attenuating structure embracing the intermediate portion of said conduit, and means defining communication between said conduit and said structure.

5. A muffler for internal combustion engines comprising an outer casing, a conduit defining a passage for exhaust gases through said casing having an inlet and an outlet, headers at opposite ends of said case through which said inlet and outlet extend, a baffle within said casing spaced from said headers defining resonator chambers upon opposite sides thereof, acoustic wave attenuating structure embracing one portion of said conduit, another portion of said conduit opening into one of said resonator chambers, and means defining an opening between said chambers.

6. A muffler for internal combustion engines comprising an outer casing, a conduit defining a passage for exhaust gases through said casing having an inlet and an outlet opening through said casing, a baffling means defining a resonator chamber within said casing, acoustic wave attenuating structure embracing a portion of said conduit within said casing and without said chamber, said chamber being disposed entirely to one side and longitudinally spaced from said structure, and means defining communication between said chamber and said conduit.

7. A muffler for internal combustion engines comprising an outer casing, means defining a passageway within said casing for conducting ex-

haust gases therethrough, means dividing said casing into a plurality of resonator chambers, acoustic wave attenuating structure embracing portions of said passageway, perforations in said passageway along said portion opening into and communicating only with said structure, perforations in another portion of said passageway opening into one of said resonator chambers and means defining a communicating passage between said resonators.

8. A muffler for internal combustion engines comprising an outer casing, headers located at opposite ends of said casing, baffling members within said casing spaced from said headers and from each other to provide resonator chambers at opposite ends and centrally of said casing, a conduit having an inlet and an outlet opening through said headers and supported by said baffling member within said casing, said conduit extending back and forth between said baffle members with sections thereof between said baffles substantially straight and supported in spaced parallel relation, angular conduit sections for reversing the direction of flow of exhaust gases through said parallel sections, said angular conduit sections being disposed within said resonator chambers located at opposite ends of said casing, acoustic filter chambers embracing portions of said conduit between said baffling members, and means defining communication between said conduit and said filter chambers and two or more of said resonator chambers.

9. A muffler for internal combustion engines comprising an outer casing, headers at opposite ends of said casing, a supporting structure disposed within and transversely of the longitudinal axis of said casing and spaced inwardly from said headers, a conduit defining a retroverted passage for exhaust gases through said casing, sections of said conduit being disposed and spaced in substantially parallel relationship and being supported between said supporting structure, and angular conduit sections for directing the exhaust gas through 180° F. located upon opposite sides of said supporting structure and constituting continuations of said first sections.

10. A muffler for internal combustion engines comprising an outer casing, a conduit for the passage of gases having raised louvers defined upon the exterior surface thereof, a structural member supported upon said conduit having an inner wall structure of sufficient dimension as to when circularly extended to be capable of passing over said conduit and raised louvers, said members in place upon said conduit closely conforming to the exterior surface of said conduit with portions of said wall structure defining a fold or fin.

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