Feb. 16, 1932. C. BALOUGH 1,845,015

MUFFLER

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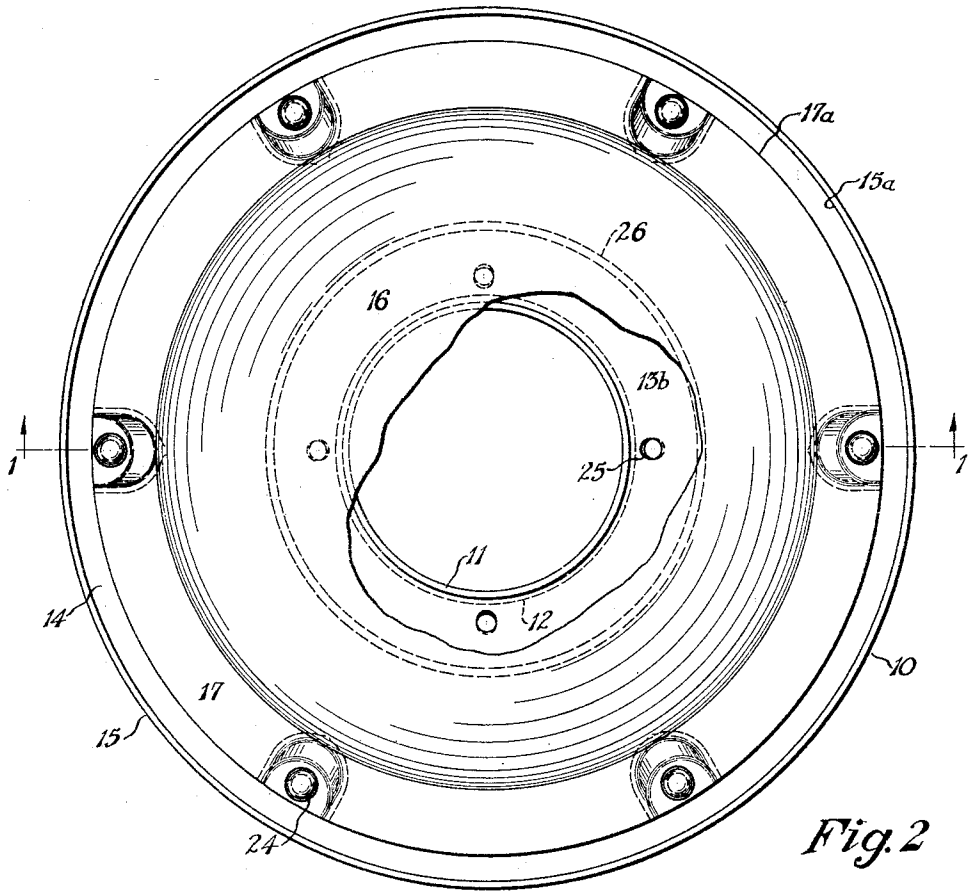

Fig. 2

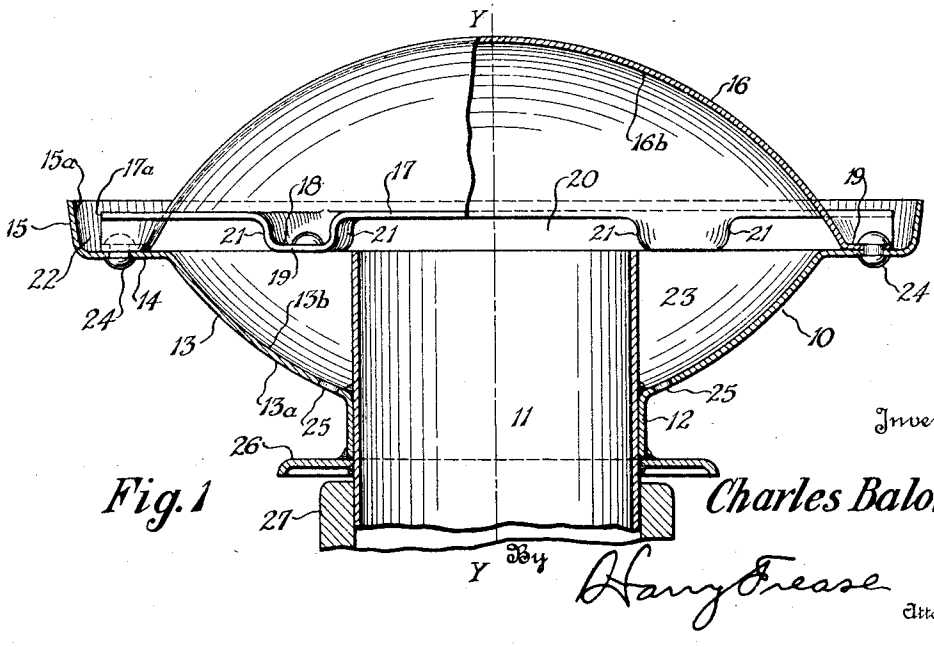

Fig. 1

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UNITED STATES PATENT OFFICE

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MUFFLER

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My invention relates to mufflers more particularly for use on the exhaust ducts of internal combustion engines.

An efficient muffler should not only eliminate the noise otherwise caused by the relatively large stream of exhaust gas at relatively high pressure expanding directly into the atmosphere and producing reports like a series of gun shots, but the muffler must also eliminate this objectionable noise without causing any substantial loss of power in the engine by producing back pressure.

For these purposes a muffler should offer minimum resistance to the passage of the exhaust gases, and the velocity and pressure of the exhaust gases should be reduced so that the gases will expand to nearly atmospheric pressure before they are discharged into the air.

For attaining the foregoing necessary results, mufflers of usual design have included a relatively large number of parts such as baffles, intercommunicating chambers, and the like, and have occupied a relatively large space.

Particularly in connection with internal combustion engines used for industrial power, it is becoming increasingly necessary to make all the parts of the engine as compact as possible, in order that all of the essential parts and accessories now required for efficient engine operation may be included in the total space allotted for the engine as a whole.

Accordingly the objects of the present invention include the provision of an efficient muffler of simplified and economical construction, and the muffler as a whole being very compact and occupying a relatively small space.

These objects are attained in the present invention, as is hereinafter described and claimed.

A preferred embodiment of the invention is illustrated in the accompanying drawings forming part hereof, in which

Figure 1 is a fragmentary side elevation view of the improved muffler hereof, with portions illustrated in section as on line 1—1, Fig. 2; and

Fig. 2, a top plan view thereof with portions broken away.

Similar numerals refer to similar parts throughout the drawings.

The improved muffler indicated generally at 10 includes an inlet tube or duct 11 which communicates with the outlet of the exhaust manifold of an internal combustion engine not shown.

The tube 11 extends through and fits in a sleeve 12, which extends preferably outwardly from the convex face 13*a* of a segmental shell or dome member 13, and the longitudinal common axis Y—Y of the sleeve and tube, preferably passes through the center of curvature of the segmental shell 13.

At the base of the segmental shell 13, an annular flange 14 extends outwardly from the periphery thereof preferably at right angles to the axis Y—Y, and a deflector sleeve flange 15 extends from the outer periphery of the annular flange 14 in the direction towards which the concave face 13*b* of the segmental shell 13 opens.

A dome shell or member 16, the concave face 16*b* of which opens towards the concave face 13*b* of the segmental shell 13, includes an annular base flange 17 extending outwardly from the base periphery of the dome shell 16 preferably parallel with the annular flange 14 of the segmental shell 13.

As shown in the drawings, the maximum distance between each of the concave faces 13*b* and 16*b* and the common plane of the bases of the dome shells 13 and 16 respectively, is preferably less than the radius of curvature of the respective faces.

Preferably integral with the base flange 17, circumferentially spaced feet 18 are secured to the dome shell 16 and each includes a base 19 parallel with the flange 17, but spaced therefrom in the direction of the segmental shell 13.

The diameter of the flange 17 is substantially less than the inner diameter of the sleeve flange 15, whereby the dome shell 16 may be seated with the feet bases 19 abutting against the flange 14, thereby forming a plurality of side opening arcuate slots 20 between the spaced flanges 14 and 17 and the

outer faces of the sides 21 of the preferably integral feet 18.

The arcuate slots 20 are overlapped or traversed by the sleeve flange deflector 15, the inner face 15*a* of which is radially spaced from the outer periphery 17*a* of the dome shell base flange 17, whereby an annular space indicated at 22 is formed between the outer periphery 17*a* of the dome shell flange 17 and the inner face 15*a* of the deflector sleeve flange 15.

The tube 11 preferably terminates within the dome chamber 23 formed by the segmental shell 13 and the dome shell 16, and preferably in the plane of the annular flange 14 of the segmental shell 13.

The shells are secured to each other by any suitable fastening means such as rivets 24 which pass through registering apertures in the feet bases 19 and the flange 14.

The walls of the shells 13 and 16 thus form a domed chamber 23 which receives exhaust gas through the inlet tube 11 and the opposite concave inner faces of the shells reduce the velocity of the incoming gas and change the direction of its flow first by the impact of the molecules of the gas with the inner concave face 16*b* of the dome shell 16, and then by deflection therefrom to impact with the inner concave face 13*b* of the segmental shell 13 and subesquent deflections back and forth between the concave faces.

The velocity of the exhaust gas entering the muffler is largely in the direction Y—Y, consequently the tendency of any unit quantity of exhaust gas entering the chamber 23 is to be deflected first between the concave faces of the shells and then to move laterally of the axis Y—Y towards the side opening slots 20. By the time any unit quantity of gas has reached the side opening slots, its velocity and pressure has been reduced substantially to atmospheric pressure by impact and deflection between the concave shell faces.

The slots 20, being relatively long arcuately, and relatively narrow in the direction of the Y axis, do not permit the escape of any gas having a substantial velocity component in the direction of the Y axis; but the slots 20 provide large outlet openings for gas, the velocity and pressure of which has been reduced substantially to the desired magnitudes.

The gas emitted through the arcuate slots 20 is again deflected by the sleeve flange 15 and this final deflection of the gas passing through the improved muffler 10 serves to absorb any remaining pressure or velocity energy in the gas of sufficient magnitude to make a sound upon sudden expansion to atmospheric pressure, and also prevents gas striking the face of a person standing near the muffler.

While the structure of the improved muffler 10 is exceedingly simple and very compact as illustrated, it is very efficient for absorbing the velocity and high pressure energy in the exhaust gases by impact and bombardment between the concave shell faces, and at the same time the muffler 10 has a large capacity by reason of the relatively long and numerous arcuate outlet slots 20.

As illustrated, the segmental shell 13 and the dome shell 16, and the parts connected respectively therewith, are each made from integrally formed sheet or strip metal.

Thus forming the shells of sheet metal, not only decreases the production cost thereof, but it has been found that the operation of the improved muffler when formed of sheet metal parts, is superior to the operation of the same structure when made of cast and machined parts.

The sheet metal shells, being much thinner than the equivalent cast and machined shells, absorb by their own resilience, the energy lost by the bombardment of the exhaust gases on the inner concave faces of the chamber 23.

Each of these shells act as diaphragms which are vibrated by the impact of the exhaust gas thereagainst, but the frequency of the vibration of the shells is not usually within audible range.

Moreover, the relatively thin sheet metal shells act as superior heat transfer walls for transferring to the atmosphere any heat generated in the material of the shell by the bombardment of the exhaust gases.

The mufflers 10 when in use on internal combustion engines are frequently exposed to the atmosphere, and moisture from rain, fog, snow, or the like may enter the muffling chamber 23 through the annular space 22 and the slots 20.

Suitable draining apertures 25 are formed in the normally lower segmental shell 13, preferably adjacent the sleeve 12, whereby any water collected in the muffler chamber 23 may drain out of the same through the apertures 25.

An outwardly extending drip flange 26 is preferably secured upon the pipe 11 preferably at the outer end of the sleeve 12 and extends outwardly from the pipe over the normally upper end of an engine duct 27 into which the pipe 11 extends thereby preventing water from dripping from the chamber through the apertures 25 into the engine through the duct 27 by deflecting the water and causing it to flow outwardly over the outer periphery of the drip flange.

It will be seen that since the inlet tube 11 terminates in the plane of the annular flange 14 of the segmental shell 13, that is, adjacent the plane of the slots 20, gases entering the chamber through the inlet are directed against the concave face 16*b* to be deflected therefrom without first permitting sufficient

expansion of the gases to allow any portion thereof to escape out through the slots before the velocity of the gases has been substantially reduced.

I claim:

1. A muffler including dome shaped walls forming an exhaust gas receiving chamber, opposite inner faces of the chamber walls being concave and having their bases located in a common plane, the maximum distance between each inner concave face and the plane of the bases being less than the radius of curvature of the face, walls forming an inlet duct for directing exhaust gas toward one of the concave faces, and there being a side opening outlet slot formed in the domed chamber walls, and a wall forming a deflector spaced from and traversing the slot.

2. A muffler including dome shaped walls forming an exhaust gas receiving chamber, opposite inner faces of the chamber walls each being concave and having their bases located in a common plane, the maximum distance between each inner concave face and the plane of the bases being less than the radius of curvature of the face, walls forming an inlet duct extending into the chamber and terminating substantially at the plane of the bases for directing exhaust gases toward one of the concave faces, there being a side opening outlet slot formed in the domed chamber walls, and a wall forming a deflector spaced from and traversing the slot.

3. A muffler including dome shaped walls forming an exhaust gas receiving chamber, opposite inner faces of the chamber walls each being concave and having their bases located in a common plane, the maximum distance between each inner concave face and the plane of the bases being less than the radius of curvature of the face, walls forming an inlet duct extending into the chamber and terminating substantially at the plane of the bases for directing exhaust gases toward one of the concave faces, there being a side opening outlet slot formed in the dome chamber walls.

4. A muffler including a pair of domed members secured together at their bases and forming an exhaust gas receiving chamber having its opposite inner faces each concave, walls forming an inlet duct for directing exhaust gas toward one of the concave faces, there being side opening outlet slots formed in one of the domed members at its base, and a deflecting wall formed on the other domed member and spaced from and traversing the outlet slots.

5. A muffler including a pair of domed members secured together at their bases and forming an exhaust gas receiving chamber having its opposite inner faces each concave, walls forming an inlet duct extending into the chamber and terminating substantially at the plane of the jointure of the bases for directing exhaust gas toward one of the concave faces, there being side opening outlet slots formed in one of the domed members at its base, and a deflecting wall formed on the other domed member and spaced from and traversing the outlet slots.

6. A muffler including a pair of domed members secured together at their bases and forming an exhaust gas receiving chamber having its opposite inner faces each concave, walls forming an inlet duct for directing exhaust gas toward one of the concave faces, the maximum distance between each inner concave face and its base being less than the radius of curvature of the face, there being side opening outlet slots formed in one of the domed members at its base, and a deflecting wall formed on the other domed member and spaced from and traversing the outlet slots.

7. A muffler including a pair of domed members secured together at their bases and forming an exhaust gas receiving chamber having its opposite inner faces each concave, walls forming an inlet duct extending into the chamber and terminating substantially at the plane of the jointure of the bases for directing exhaust gas toward one of the concave faces, the maximum distance between each inner concave face and its base being less than the radius of curvature of the face, there being side opening outlet slots formed in one of the domed members at its base, and a deflecting wall formed on the other domed member and spaced from and traversing the outlet slots.

8. A muffler including a pair of domed sheet metal members having inner concave faces oppositely disposed towards each other to form an exhaust gas receiving chamber, an outwardly extending peripheral flange formed at the base of each of the domed members, one of said flanges having depressions formed therein for connection with the other flange, means for connecting the depressed portions of the one flange with the other flange, and an inlet tube secured within one of the domed members for directing exhaust gas toward the inner concaved face of the other domed member.

9. A muffler including a pair of domed sheet metal members having inner concave faces oppositely disposed towards each other to form an exhaust gas receiving chamber, an outwardly extending peripheral flange formed at the base of each of the domed members, one of said flanges having depressions formed therein for connection with the other flange, means for connecting the depressed portions of the one flange with the other flange, and an inlet tube secured within one of the domed members and extending into the exhaust gas receiving chamber for directing exhaust gas toward the inner concaved face of the other domed member.

10. A muffler including a pair of domed sheet metal members having inner concave faces oppositely disposed toward each other to form an exhaust gas receiving chamber, an outwardly extending peripheral flange formed at the base of each of the domed members, one of said flanges having depressions formed therein for connection with the other flange, an angular deflecting member formed upon the other flange, means for connecting the depressed portions of the one flange with the other flange, and an inlet tube secured within one of the domed members and extending into the exhaust gas receiving chamber for directing exhaust gas toward the inner concaved face of the other domed member.

In testimony that I claim the above, I have hereunto subscribed my name.

CHARLES BALOUGH.