July 26, 1938. L. L. HAAS ET AL 2,124,916

MUFFLER

Filed June 14, 1937

Fig. 1.

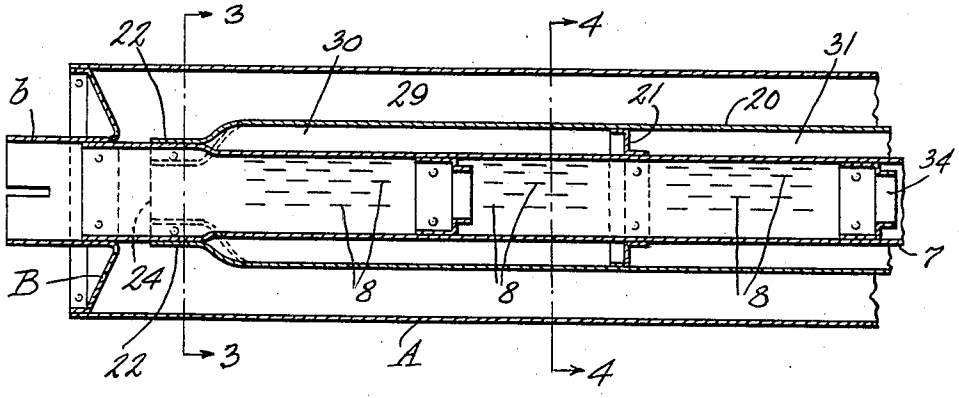


Fig. 2.

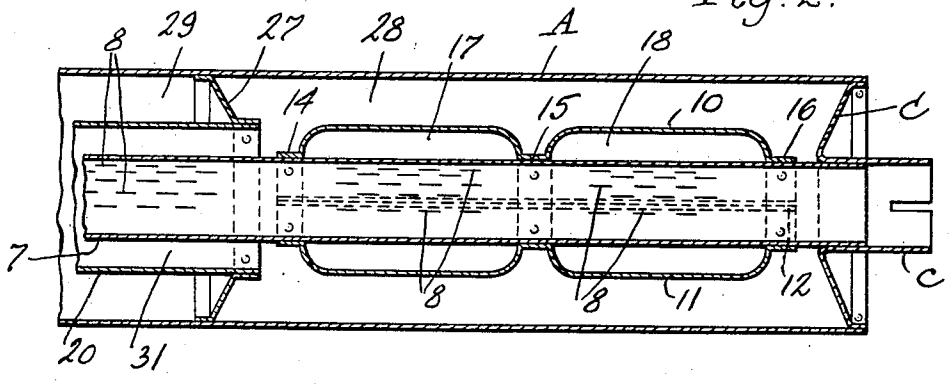


Fig. 3.

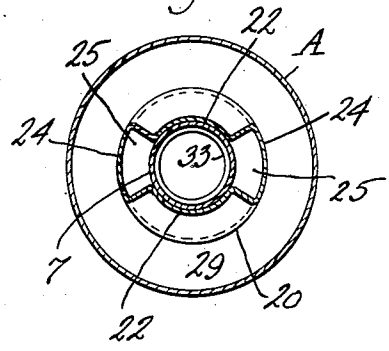
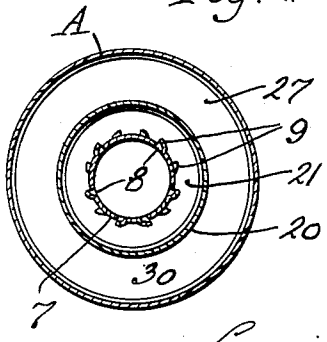


Fig. 4.



INVENTOR
Lucien L. Haas
and Gail C. Blackwelter
By Parker, Prochnow & Farmer.
ATTORNEYS.

Patented July 26, 1938

2,124,916

UNITED STATES PATENT OFFICE

2,124,916

MUFFLER

Lucien L. Haas, Buffalo, and Gail C. Starkweather, Kenmore, N. Y., assignors to Buffalo Pressed Steel Company, Inc., Buffalo, N. Y.

Application June 14, 1937, Serial No. 148,069

6 Claims. (Cl. 181—48)

This invention relates to improvements in mufflers or silencers of the kind which may be used for silencing the exhaust of internal combustion engines.

One of the objects of this invention is to provide a muffler with a novel arrangement of chambers by means of which sound waves are destroyed by destructive interference. It is also an object of this invention to improve the operation of a muffler of this type by means of restrictions in the inner perforate conduit which serve to increase the effectiveness of the chambers. Other objects of this invention will appear from the following description and claims.

In the accompanying drawing:

Fig. 1 is a longitudinal central sectional view of the front or inlet part of a muffler embodying this invention.

Fig. 2 is a similar view of the remainder of the muffler.

Figs. 3 and 4 are transverse sectional elevations respectively on lines 3—3 and 4—4, Fig. 1.

The muffler disclosed in the accompanying drawing and illustrating one embodiment of this invention is of the straight through type and includes an outer housing or casing which may be of any suitable or usual construction, that shown including an outer shell A having at one end thereof an inlet head B which may be provided with an integrally formed duct *b* to which an exhaust pipe from an engine may be connected. At the other end of the outer shell, the muffler is provided with an outlet or discharge head C which may also have an integrally formed duct *c* through which gases are discharged from the muffler and to which the usual tail pipe may be connected, if desired.

The inlet duct *b* and discharge duct *c* in the muffler shown are connected by means of a conduit or inner shell 7 which is provided with a plurality of perforations 8 which may be of any suitable form. For example, as clearly shown in Fig. 4, the perforations may be formed by making longitudinal slits in the conduit and forcing the metal at one side of each slit outwardly to form louvers 9 which cause the gases discharged through the perforations 8 to take a more or less tangential direction with reference to the conduit 7. The perforations 8 are preferably arranged in groups spaced at intervals lengthwise of the conduit. A perforate conduit of any other construction may, of course, be provided, if desired.

An intermediate shell of any suitable or desired form may be employed in the space between the outer shell A and the conduit 7 of the muffler. The intermediate shell may comprise two or more parts and preferably the intermediate shell forms near the discharge end of the muffler one or more high frequency resonator chambers. This part of the intermediate shell, in the particular construction shown, is in the form of two half shells 10 and 11, which may be suitably connected at their longitudinally extending edge portions in any suitable manner to form joints at 12. These half shells may be provided with inwardly extending shoulders 14, 15 and 16, thus forming two high frequency resonator chambers 17 and 18 about two groups of perforations 8. It will, of course, be understood that this part of the intermediate shell may be of any other suitable or usual construction.

The other intermediate shell part may be in the form of a cylinder or tube 20 which may be secured in place in any suitable or desired manner. In the construction shown, a transverse wall or baffle 21 is provided intermediate of the ends of this shell part 20 and connects the part 20 with the conduit 7, and an end of this shell part may be provided with inwardly pressed parts 22 which extend into contact with the conduit 7 and which are arranged between longitudinally extending parts 24 which are spaced from the conduit and form therewith openings in the form of channels or passages 25. In the muffler shown, the opposite end of the intermediate shell part 20 is supported from the outer shell A by means of a transverse partition or baffle 27, which also serves the purpose of dividing the space between the outer shell A and the intermediate shell parts into two outer chambers 28 and 29. In the construction shown in Fig. 2, the baffle 27 is arranged adjacent to an end of the intermediate shell part 20 and the open end of this shell part, consequently, forms an opening communicating with the front end of the chamber 28. The channels or openings 25 establish communication between the chamber 29 and another chamber or space 30 formed between the conduit and the intermediate shell part 20, and form with his chamber a bottle neck type of resonator chamber.

The silencing action of the muffler is further enhanced by providing in the conduit 7 one or more restrictions or diffusers, such as described in the Starkweather and Haas Patents Nos. 2,047,442 and 2,047,443. These restrictions, of course, may be of any suitable or desired form, and in the muffler illustrated, there are provided sleeves 33 and 34 having portions secured to the inner wall of the conduit 7 and annular portions of reduced diameter. One of these restrictions is

located in the portion of the conduit in advance of the intermediate baffle 21 and the other restriction is placed in rear of the baffle, so that the restriction 33 will tend to increase the quantity of gas and sound waves which pass through the perforations 8 located in advance of the restriction. In this manner, an increased flow of gas and sound waves into the chambers 30 and 31 results, which in turn results in a corresponding increase in the flow of gas or sound waves into the outer low frequency chambers 29 and 28, so that the silencing action of the muffler is materially improved with a relatively small increase in the back pressure.

As a result of the construction described, gas impulses and sound waves entering into the muffler through the inlet *b* thereof will pass into the conduit 7 and upon reaching the perforations thereof, portions of the sound waves and the peaks of the pressure pulses will pass through those perforations 8 leading into the chamber 30 and parts of these pressure impulses and some of the sound waves will also pass through the channels or bottle necks 25 into the outer or low frequency resonator chamber 29. The restriction 33 tends to hold back slightly the rush of pressure impulses through the conduit and consequently, increases the extent to which parts of pressure impulses enter into the chambers 30 and 29. The portions of the gas pressure impulses entering the chambers 30 and 29 are returned to the conduit 7 through apertures 8 and enter into the troughs or low pressure portions between gas pulsations, and sound waves entering the low frequency chamber 29 will be returned through the channels or bottle necks 25, chamber 30, and apertures 8 into the conduit and will be out of phase with sound waves passing directly through the conduit, so that such sound waves will in general be silenced by destructive interference. The gas impulses and sound waves which continue through the inner conduit past the partition 21 may then pass in part through the perforations in the inner conduit into a chamber 31 between the conduit and intermediate shell from which they may pass through the opening or open end of the intermediate shell part 20 into the outer or low frequency resonator chamber 28 arranged about the intermediate shell parts 10 and 11. This chamber 28 acts in a similar manner upon the gas pulsations and low frequency sound waves, as the chamber 29, but may be of different dimensions than the chamber 29 and may consequently, act upon a group or band of low frequency sound waves of different wave lengths than those silenced by the action of the chamber 29. The restriction 34 also acts in the same manner as the restriction 33 and forces a larger portion of gas to pass through openings or perforations in the conduit and also materially increases the effectiveness of the chamber 28. The chambers 28 and 29, in addition to their action on sound waves also act to equalize the flow of gas through the conduits by taking in the crests or peaks of pressure pulsations and returning them into the conduit between pulsations. Consequently, by the time the gases pass through the portion of the inner conduit about which the high frequency chambers 17 and 18 are formed, these high frequency chambers will be particularly effective in acting on high frequency sound waves and upon gas pressure pulsations of greatly reduced intensity, so that an exceptionally effective silencing results.

The muffler described has the advantages of being of relatively simple and inexpensive construction and of being very effective in silencing the exhaust. The provision of an intermediate shell part about the conduit eliminates shell noises and the openings in the intermediate shell are located at one end of each outer chamber, thus causing these outer chambers to act very effectively as low frequency resonator chambers.

We claim as our invention:

1. A muffler including a single housing having an inlet and an outlet, a conduit having perforations arranged in groups spaced at intervals lengthwise of said conduit and connecting said inlet and outlet, an intermediate shell part arranged in said housing about said conduit near said outlet which encloses a perforate portion of said conduit to form therewith a high frequency resonator chamber, and a second intermediate shell part located in said housing forwardly of said first part also enclosing a perforate portion of said conduit and having an opening leading to a space between the first intermediate shell part and said housing, and a transverse baffle connecting said second part and said housing and located forwardly of said opening to form a low frequency resonator chamber about said first part and into which sound waves and gases may enter through said opening.

2. A muffler including a single housing having an inlet and an outlet, a conduit having perforations arranged in groups spaced at intervals lengthwise of said conduit and connecting said inlet and outlet, an intermediate shell part arranged in said housing about said conduit near said outlet which encloses a perforate portion of said conduit to form therewith a high frequency resonator chamber, and a second intermediate shell part located in said housing forwardly of said first part also enclosing a perforate portion of said conduit and having an opening leading to a space between the first intermediate shell part and said housing, a transverse baffle connecting said second part and said housing and located forwardly of said opening to form a low frequency resonator chamber about said first part and into which sound waves and gases may enter through said opening, and a restriction in the portion of said conduit about which said second intermediate shell part extends, and located rearwardly of perforations enclosed by said second part to produce an increased passage of gases and sound waves through perforations ahead of said restriction into the space within said second part and through the opening in said second part.

3. A muffler including a single housing having an inlet and an outlet, a perforate conduit in said housing connecting said inlet and said outlet, an intermediate shell part arranged in said housing about said conduit near said outlet which encloses a perforate portion of said conduit to form therewith a high frequency resonator chamber, a second intermediate shell part located in said housing forwardly of said first part and arranged about a perforate portion of said conduit, and a baffle connecting said second part and said housing and dividing the space between said second shell part and said housing into a plurality of outer chambers, one of said chambers including the space arranged between said first mentioned intermediate shell part and said housing, said second shell part having openings near opposite ends thereof and each communicating with one of said outer chambers.

4. A muffler including a single housing having an inlet and an outlet, a perforate conduit in said

housing connecting said inlet and said outlet, an intermediate shell part arranged in said housing about said conduit near said outlet which encloses a perforate portion of said conduit to form therewith a high frequency resonator chamber, a second intermediate shell part located in said housing forwardly of said first part and arranged about a perforate portion of said conduit, a baffle connecting said second part and said housing and dividing the space between said second shell part and said housing into a plurality of outer chambers, one of said chambers including the space arranged between said first mentioned intermediate shell part and said housing, said second shell part having openings near opposite ends thereof and each communicating with one of said outer chambers, and transversely extending means forming a dividing wall between said second intermediate shell part and said conduit and arranged with perforations forwardly and rearwardly thereof.

5. A muffler including a single housing having an inlet and an outlet, a perforate conduit in said housing connecting said inlet and said outlet, an intermediate shell part arranged in said housing about said conduit near said outlet and enclosing a perforate portion of said conduit to form therewith a high frequency resonator chamber, a second intermediate shell part located in said housing forwardly of said first part and arranged about a perforate portion of said conduit, a baffle connecting said second part and said housing and dividing the space between said second shell part and said housing into a plurality of outer chambers, one of said chambers including the space arranged between said first mentioned intermediate shell part and said housing, said second shell part having openings near opposite ends thereof and each communicating with one of said outer chambers, and a restriction in said conduit in the portion thereof about which said second shell part extends for inducing an increased flow of gases and sound waves through perforations in advance of said restriction for passage to said outer chambers.

6. A muffler including a single housing having an inlet and an outlet, a perforate conduit in said housing connecting said inlet and said outlet, an intermediate shell part arranged in said housing about said conduit near said outlet and enclosing a perforate portion of said conduit to form therewith a high frequency resonator chamber, a second intermediate shell part located in said housing forwardly of said first part and arranged about a perforate portion of said conduit, a baffle connecting said second part and said housing and dividing the space between said second shell part and said housing into a plurality of outer chambers, one of said chambers including the space arranged between said first mentioned intermediate shell part and said housing, said second shell part having openings near opposite ends thereof and each communicating with one of said outer chambers, transversely extending means forming a dividing wall between said second intermediate shell and said conduit and arranged with perforations forwardly and rearwardly thereof, and restrictions in said conduit, one arranged in advance of said transversely extending means, and the other in rear thereof to increase the flow of gases and sound waves into the spaces within said second intermediate shell part in front of and in rear of said transversely extending means to increase the effectiveness of said outer chambers in silencing sound waves.

LUCIEN L. HAAS.
GAIL C. STARKWEATHER.