Nov. 27, 1951 F. H. KYFFIN 2,576,522

ENGINE SILENCER WITH TRANSVERSE BAFFLE STRUCTURE

Filed Nov. 10, 1947 4 Sheets-Sheet 1

FIG. 1.

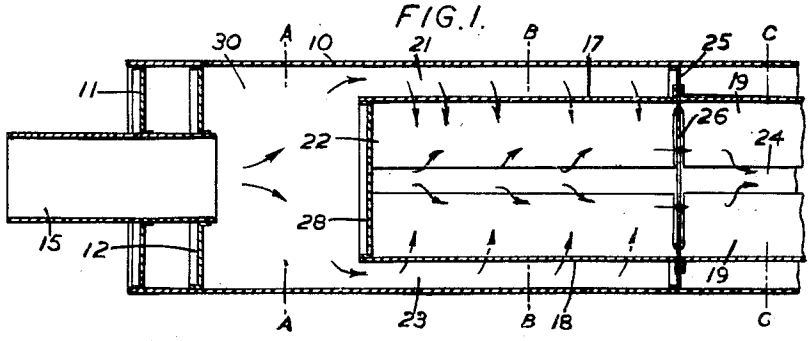



FIG. 2.

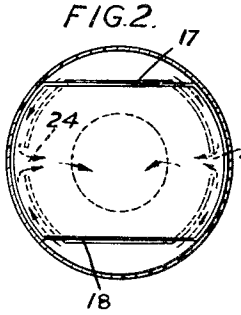



FIG. 3.

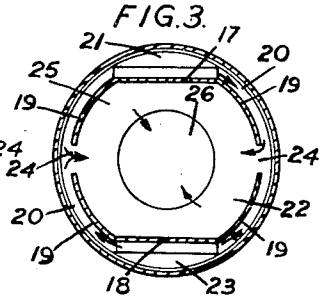



FIG. 4.

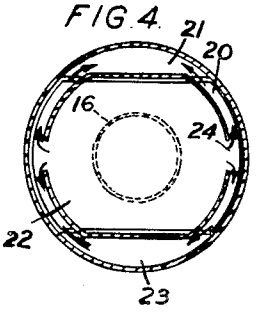



FIG. 5.

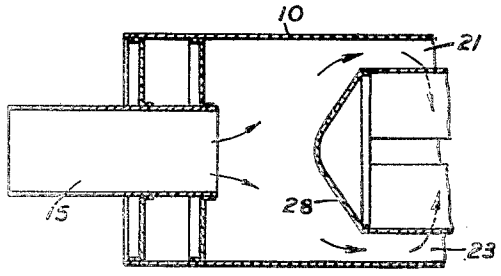



FIG. 7.

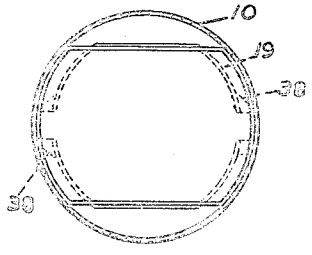
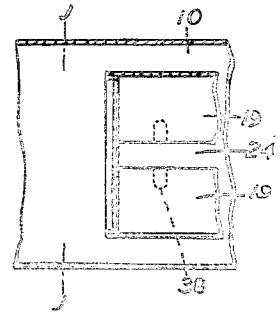



FIG. 6.

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Nov. 27, 1951 F. H. KYFFIN 2,576,522

ENGINE SILENCER WITH TRANSVERSE BAFFLE STRUCTURE

Filed Nov. 10, 1947 4 Sheets-Sheet 2

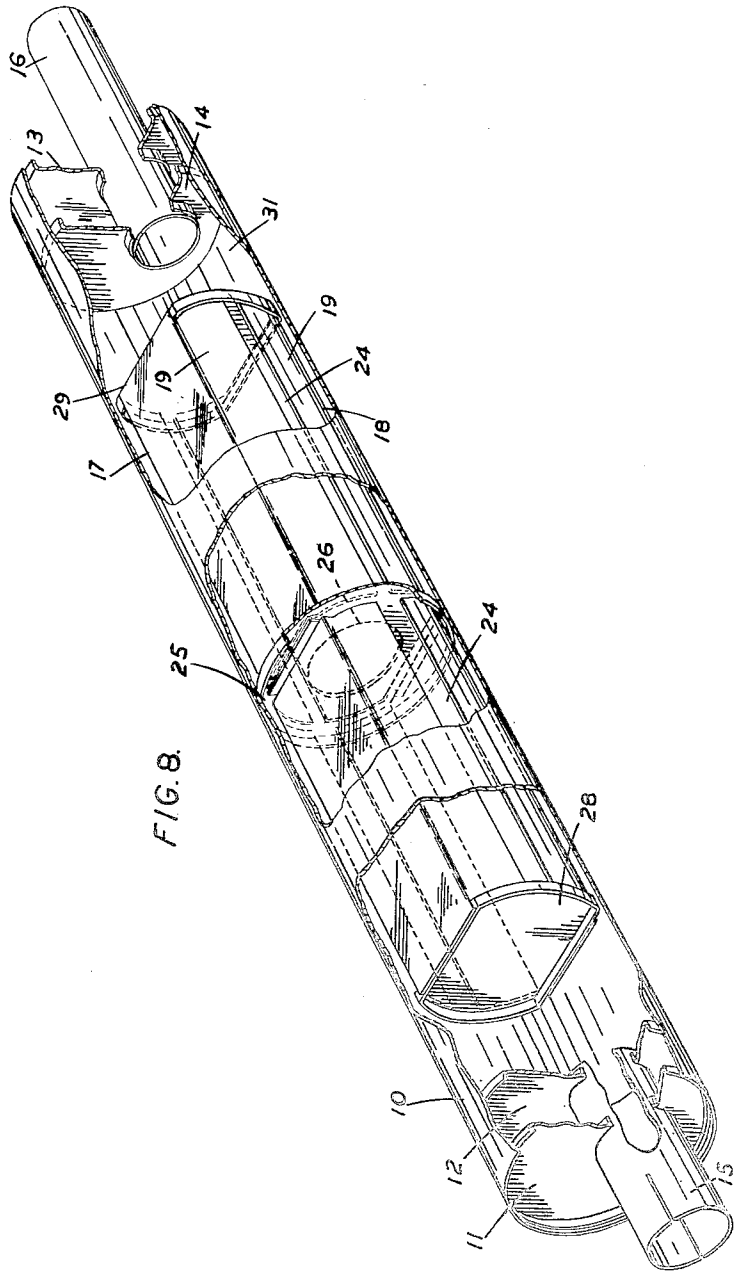


FIG. 8.

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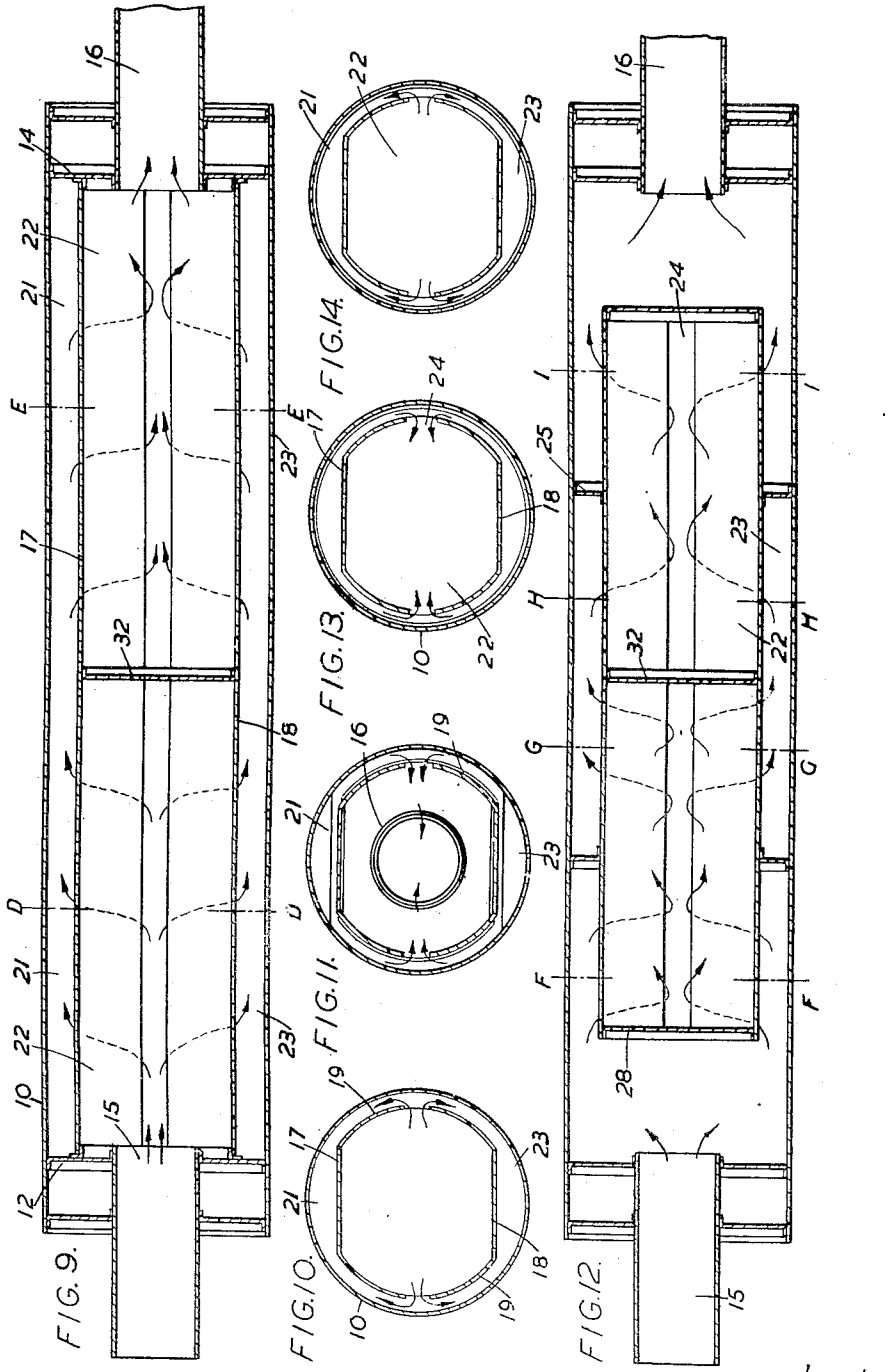
Nov. 27, 1951 F. H. KYFFIN 2,576,522

ENGINE SILENCER WITH TRANSVERSE BAFFLE STRUCTURE

Filed Nov. 10, 1947 4 Sheets-Sheet 3

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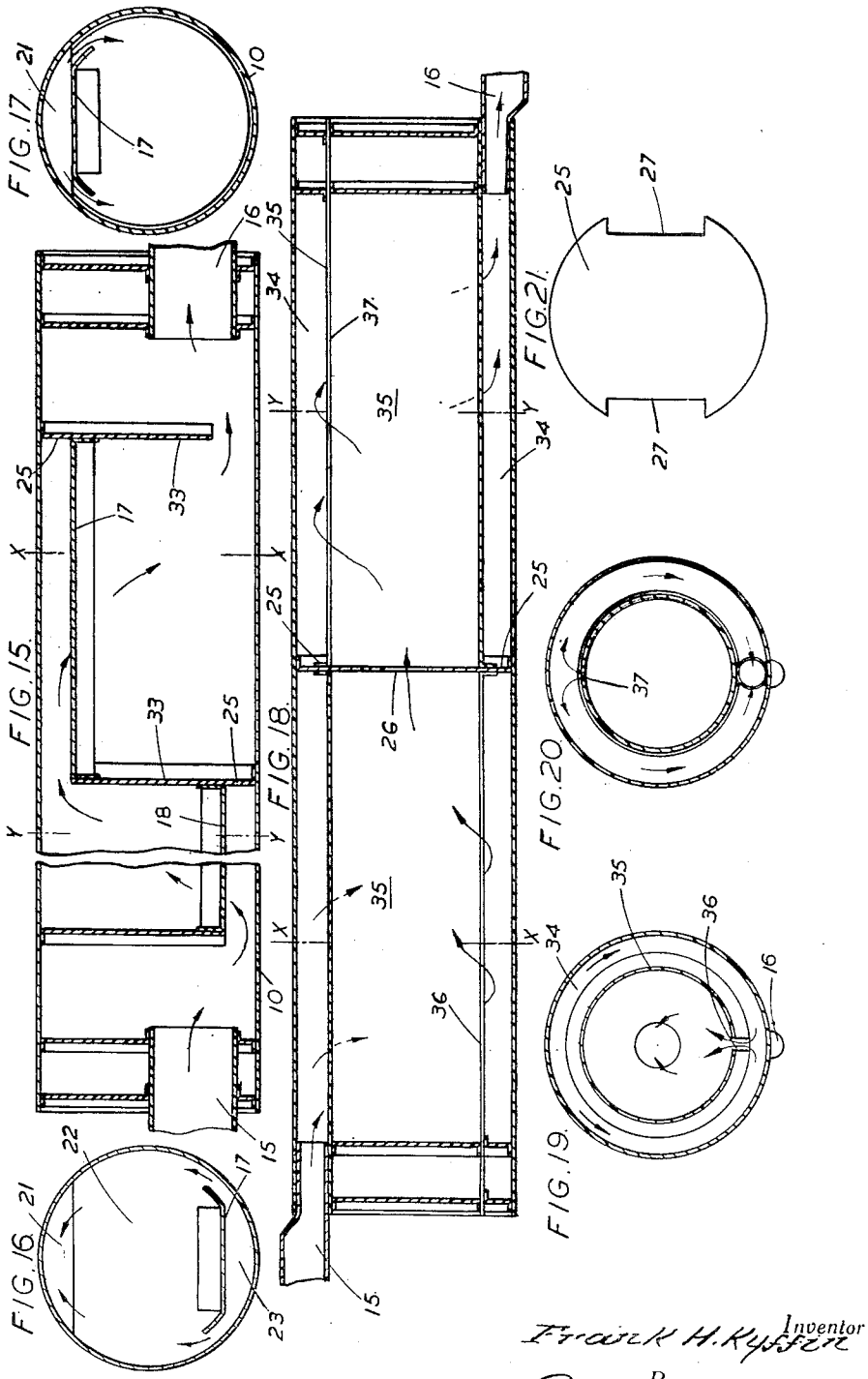
Nov. 27, 1951 F. H. KYFFIN 2,576,522

ENGINE SILENCER WITH TRANSVERSE BAFFLE STRUCTURE

Filed Nov. 10, 1947 4 Sheets-Sheet 4

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# UNITED STATES PATENT OFFICE

2,576,522

## ENGINE SILENCER WITH TRANSVERSE BAFFLE STRUCTURE

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Application November 10, 1947, Serial No. 785,101
In Great Britain December 28, 1946

1 Claim. (Cl. 181—69)

1

This invention is for improvements in or relating to silencers for gases and more particularly engine and like silencers such as are used in connection with internal combustion engines of both the motor-car and stationary type.

According to the present invention there is provided a silencer comprising a casing, at least one longitudinally extending baffle or plate in the casing and at least one transverse baffle in the casing between the ends of the longitudinal baffle, and apertures or gaps in said baffle arrangement and co-operating therewith to permit exhaust gases or the like to flow through or round the baffles only or primarily in a direction around and along the casing and in contact with or relatively close to the wall of the casing. Preferably, the exhaust gases are formed or divided up into a stream or streams of relatively small cross-sectional area so that there is not a thick body of gas passing through the silencer, the inner part of which thick body of gas is insulated to a large extent from the heat extracting walls of the casing. It will be appreciated that a thin stream of gas can be cooled very rapidly by extracting its heat through the silencer walls which are in contact with and are cooled by the atmosphere or by some other cooling arrangement.

In carrying the invention into effect, the utmost use is made of the outer skin or casing of the silencer for cooling purposes and the gases are preferably caused alternately to expand and contract this being effected in the preferred embodiments of the invention by providing within the silencer casing longitudinally extending plates or baffles, which sub-divided the gases into separate streams, and a transverse partition or partitions which retard the stream slightly and cause them to take a somewhat sinuous path.

Put another way, in order to reduce noise and back pressure, the exhaust gases are alternately compressed or baulked and then expanded and at the same time full use is made of the maximum area of the silencer outer casing for cooling purposes so as to reduce the volume of the gases. At the same time the gases are sub-divided and caused to flow at least for a substantial distance in longitudinal paths or streams whilst also circulating around or up and down or from side to side and along the casing. These separated streams of gas intermingle again at least once during their passage through the silencer after which they may be separated again but they intermingle before being finally discharged from the silencer so as not to issue from the final exhaust pipe in a series of puffs but as a continuous stream.

Some specific embodiments of silencers according to the present invention will now be described, by way of example, with reference to the accompanying drawings, in which similar reference

2

numerals have been used in the several embodiments to indicate like parts. On the drawings:

Figure 1 is a longitudinal sectional view of part of one embodiment of a silencer according to the present invention,

Figure 2 is a cross section on the line A—A of Figure 1,

Figure 3 is a cross section on the line B—B of Figure 1,

Figure 4 is a cross section on the line C—C of Figure 1,

Figure 5 is a fragmentary sectional view and shows a slight modification of the silencer shown in Figure 1,

Figure 6 is a fragmentary sectional view and shows a further slight modification of the silencer shown in Figure 1,

Figure 7 is a cross-section on the line J—J of Figure 6,

Figure 8 is a perspective view, with the outer casing partly broken away, of the silencer shown in Figures 1 to 4.

Figure 9 is a longitudinal sectional view of a further embodiment of the invention,

Figure 10 is a cross-section on the line D—D of Figure 9,

Figure 11 is a cross-section on the line E—E of Figure 9,

Figure 12 is a longitudinal sectional view of a still further embodiment of the invention,

Figure 13 is a cross-section on both the line F—F and the line H—H of Figure 12,

Figure 14 is a cross-section on both the line G—G and the line I—I of Figure 12,

Figure 15 is a longitudinal sectional view of a still further embodiment of the invention,

Figure 16 is a cross-section on the line Y—Y of Figure 15,

Figure 17 is a cross-section on the line X—X of Figure 15,

Figure 18 is a longitudinal sectional view of a still further embodiment of the invention,

Figure 19 is a cross-section on the line X—X of Figure 18,

Figure 20 is a cross-section on the line Y—Y of Figure 18, and

Figure 21 is a detail elevation of a modified form of transverse baffle plate to that adopted in the embodiment of the invention shown in Figures 1 and 8.

The embodiment of the invention shown in Figures 1 to 8 comprises a tubular casing 10 which is conveniently of circular cross-section but may be square, oval or of other form. The ends of this tubular casing are closed by pairs of slightly spaced end plates 11, 12 and 13, 14 which are apertured and have welded to them respectively an inlet pipe 15 for the exhaust gases and a discharge pipe 16 for said gases after they have passed through the silencer from the inlet end

thereof to the outlet end. The exhaust inlet and outlet pipes may be centrally located or they may be arranged slightly out of centre with respect to the axis of the silencer casing, said pipes being, in the example shown in Figure 8, somewhat nearer the lower part of the casing.

Two longitudinally extending baffle plates 17 and 18 are located within the casing, these plates being spaced one above the other and having their edges 19 turned or flanged towards each other and spaced a slight distance from the walls of the casing as indicated at 20. These baffle plates serve to divide the casing into three longitudinal compartments 21, 22 and 23, the upper and lower compartments, 21 and 23 respectively, being the smallest and being, of course, in the example shown, of segmental cross-section. The turned-in edges or flanges 19 of the plates above referred to may be of relatively shallow form so that the baffles are of tray-like construction or the flanged edges may be relatively deep as shown so that the flanges of one tray almost meet the flanges of the other. In all cases, however, there is a space 24 between the flange of one plate and the flange of the other. The flanges 19 may be flat and straight or inclined at an angle or they may be of curved form as shown, so as to conform to the curvature of the casing from which they are, of course, spaced. Some distance between the ends of the casing (e. g. midway) there is a transverse baffle 25 in the form of a disc having a central aperture 26 or alternatively, its opposite sides formed with rectangular notches or apertures 27, as shown in Figure 21. This transverse baffle serves to divide the foremost portions of the longitudinal passages 21, 23 from the rearmost portions thereof. The ends of the longitudinal plates 17 and 18 terminate some distance short of the neighbouring end plates 12 and 14 of the silencer casing and the space between said longitudinal plates at their ends is filled by end closure plates 28 and 29 welded, for example, to the end edges of the longitudinal plates. The closure plate 28 at the end of the silencer adjacent the inlet pipe 15 may be in the form of a humped deflector, as shown in Figure 5, the peak of the hump being in alignment with the axis of the inlet pipe.

The silencer above described operates as follows:

The exhaust gases enter the casing via the inlet pipe 15 and strike the end closure or deflector plate 28 just referred to. They are then distributed more or less evenly upwardly and downwardly and flow through the foremost longitudinal passages 21 and 23 between the longitudinal baffle plates and the casing. These passages are of relatively shallow segmental cross-section so that there are two streams of gases of relatively small volume flowing in intimate contact with the walls of the casing 10 to which they rapidly lose heat and thereby volume. Some distance before they arrive midway along the length of the silencer the gases are baffled by the transverse baffle plate 25 and are caused to flow towards the axis of the silencer casing and into the foremost centre space 22 between the longitudinal plates 17 which space serves as a species of mixing chamber for the gases. It will be appreciated that the gases can pass into this space via the space 20 and the clearance 24 between the longitudinal edges 19 of the longitudinal baffle plates. The gases escape from this foremost mixing chamber 22 via the hole 26 and/or notches 27 in the transverse baffle 25 and pass into the rearmost centre space 22 between the longitudinal baffle plates beyond the transverse baffle 25. From this space the gases again pass upwardly and downwardly around the longitudinal edges 19 of the longitudinal baffle plates and into the rearmost upper and lower longitudinal passages 21 and 23 along which they flow in contact with the cooling walls of the silencer casing 10. Beyond the longitudinal baffle plates 17 and 18 the gases again intermingle to be discharged as a steady stream through the outlet pipe 16. It will be noted that this embodiment of the invention makes good use of the outer casing of the silencer as a cooling means and the longitudinal baffles and transverse baffle cause the gases to flow in at least two streams along and around and with a somewhat sinuous motion from one end of the silencer to the other. This cooling effect on the gases as they flow through the compartments of the silencer effectively reduces back pressure and noise. It has been found that the most efficient results are obtained when the gases are divided so as to flow above the upper longitudinal plate and below the lower longitudinal plate in streams of substantially equal volume. It is believed that the space 22 between the two longitudinal baffles serves as a mixing and expansion and/or compression chamber (i. e. there may be expansion at one point and compression at another). It is also to be noted that there are somewhat similar mixing and expansion chambers 30 and 31 adjacent the ends of the silencer casing.

In a further embodiment of the invention shown in Figures 9, 10 and 11, the silencer comprises a tubular casing 10 closed towards its ends by transverse plates 12 and 14. Longitudinal baffle plates 17 and 18 spaced some relatively small distance from the tubular casing extend between and are welded to said transverse end plates. There is also a further transverse plate 32 located, say, midway between the ends of the sliencer casing and extending between the two longitudinal baffle plates 17 and 18. An inlet 15 for the exhaust gases, which may be centrally located or eccentric, is located in the end plate 12 so as to discharge into the foremost centre space 22 between the two baffle plates. The exhaust gases pass from this foremost centre space around the edges or flanges 19 of the longitudinal baffles and flow along the spaces 21 and 23 between these baffles and the casing. Beyond the intermediate baffle plate 32 the exhaust gases flow from the rearmost spaces 21 and 23 into the rearmost centre space 22 between the two longitudinal baffles and are discharged from the silencer through a discharge pipe 16 located similarly to the inlet pipe.

Although only a two compartment silencer has been described above, the silencer may, of course (see Figures 12, 13 and 14) consist of any number of chambers formed by increasing the number of transverse baffle plates 25 and providing one or more baffles 32 between the plates 17 and 18 and preferably by increasing the length of the silencer casing.

Figures 15, 16 and 17 show an embodiment of the invention in which there is only a single longitudinal baffle 18 at the foremost end of the silencer and a single longitudinal baffle 17 at the rearmost end. Transverse baffles 33 co-operate with the baffles 17 and 18 to constrain the gases to flow along and around the casing from the inlet to the outlet.

In a still further embodiment of the invention (see Figures 18, 19 and 20) an annular space or passageway 34 for the flow of the gases as a rela-

tively thin skin, film or body in contact with the walls of the silencer casing, is formed by locating a tubular body 35 within the casing 10 the walls of the tubular body being spaced from the walls of the casing. Longitudinal apertures 36 and 37 and a transverse baffle 25 co-operate to constrain the gases to flow along and around the space 34 somewhat after the manner described with reference to Figure 1 of the drawings. The end of the tubular inner body adjacent the inlet for the exhaust gases may be made conical or otherwise shaped to deflect the gases towards the wall of the casing. There may be longitudinal partition plates and/or transverse partition plates in said passage to divide the gases into several streams.

The spacing of the flanges 19 of the longitudinal baffle plates from the casing may be as small as $\frac{1}{16}$'' or even less. It is believed that the flanges 19 or equivalent device should be as close as possible to the casing, the actual spacing depending on the cubic capacity of gases to be dealt with.

The longitudinal plates may be slotted, perforated, or pierced to assist the distribution of the gases. Furthermore, where a central or approximately central entry and/or exit pipe is not desired it may be advantageous to pass the gases along the foremost passages 21 and/or 23 first through the central chamber 22 and then along the rearmost passages 21 and/or 23.

The casing of the silencer can be of any shape and it may have a double or single skin and may be corrugated. In some cases a second skin is spaced from the inner skin to form a jacket through which a cooling medium may be passed. This cooling medium may be a current of cold air from the atmosphere induced to flow through the cooling jacket by the motion of the car and/or the use of a Venturi tube arrangement.

The interior or baffle structure may be preformed and be slid as a unit into the silencer casing. Bosses 33 (see Figures 6 and 7) may be punched up out of the flanges 19 and serve to locate and secure the inner baffle structure in the outer casing. The inner structure may be secured to the casing by spot welding or the like or alternatively the flanges of the inner structure may be made slightly over size, and are inserted under pressure and after insertion spring out and exert pressure on the outer casing.

Satisfactory results have been obtained with the sides of the space between the upper and lower longitudinal plates open, but it is generally found advantageous to close this space partially by the flanges 19 formed on or welded to the side edges of the longitudinal plates.

The parts of the silencers above described lend themselves to a construction on mass production lines.



The tubular body part or casing of the silencer may be of double or multi-skin form, e. g. it may comprise several concentric tubes fitted snugly one into the other.

There may, of course, be more than two spaced apart longitudinal plates in the deflector means. Furthermore, the chambers formed by the deflector means may differ in size as regards their length and/or cross-section.

It will be appreciated that the silencer may be fitted with the longitudinal plates in a horizontal, vertical or inclined plane.

The silencer according to the present invention can be applied to various purposes for which a silencer is required. One particular further application which may be mentioned is to the air intake of an internal combustion engine, compressor or the like.

The transverse baffle herein referred to may, of course, also be an end-plate of the silencer.

I claim:

A silencer for exhaust gases comprising two tubular members located one within the other to define an elongated annular space therebetween and of small thickness relative to the diameter of the inner tubular member, a transverse baffle at each end and intermediate the ends of the silencer, at least one of said transverse baffles closing the inner tubular member and at least one of said transverse baffles closing the annular space, inlet means for exhaust gases at one end of the silencer, and outlet means for exhaust gases at the other end of the silencer, the inner tubular member being formed by two oppositely disposed plates having their longitudinal side portions curved inwardly towards but terminating short of one another so as to define small aperture means in the side walls of the inner tubular member, whereby exhaust gases are caused to flow primarily around and along the annular space.

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