Jan. 17, 1928.

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M. S. SULLIVAN

MUFFLER FOR AIRPLANE MOTORS

Filed June 16, 1926

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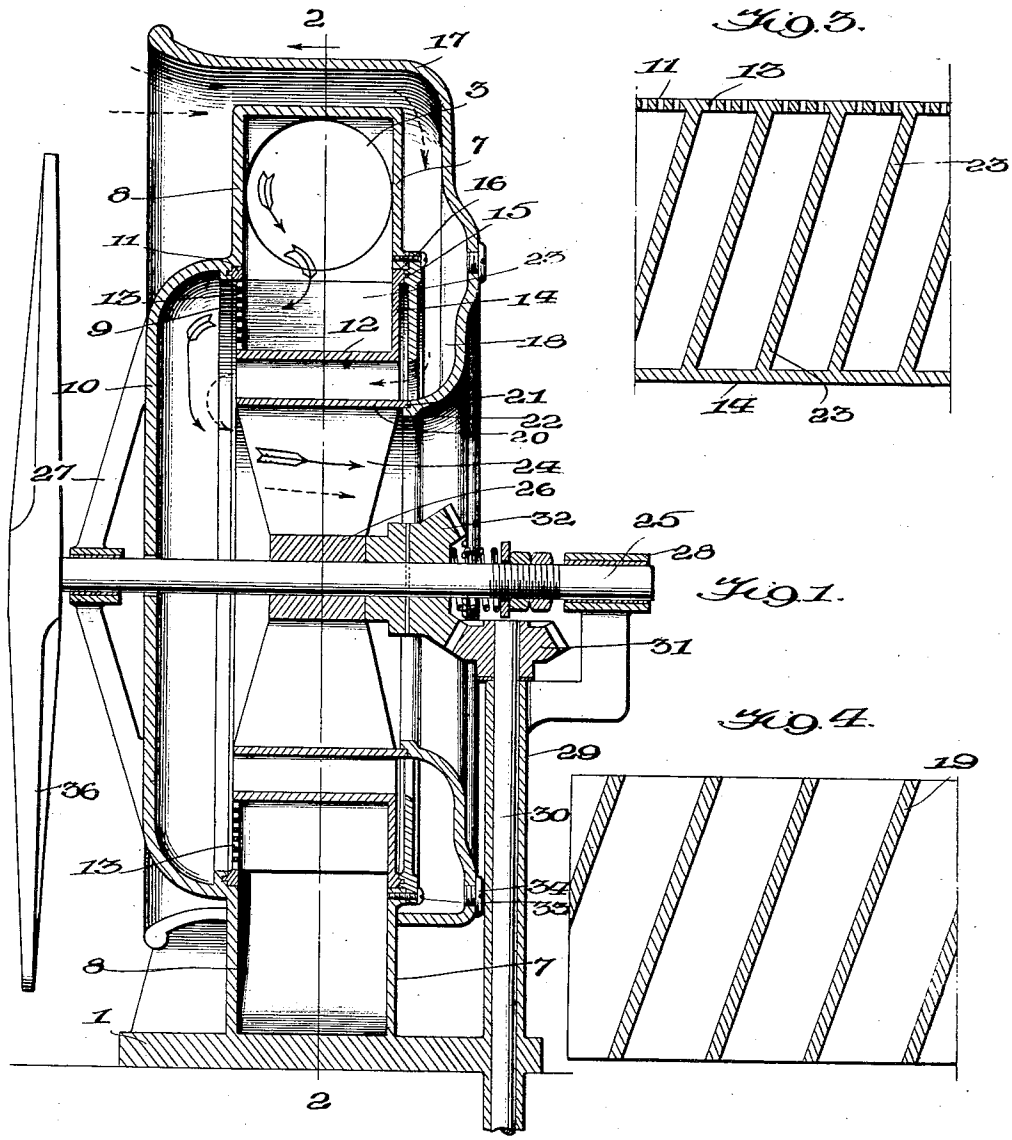


Fig. 3.

Fig. 1.

Fig. 4.

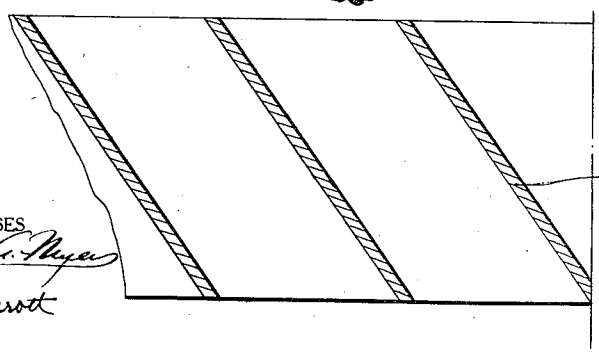


Fig. 5.

WITNESSES

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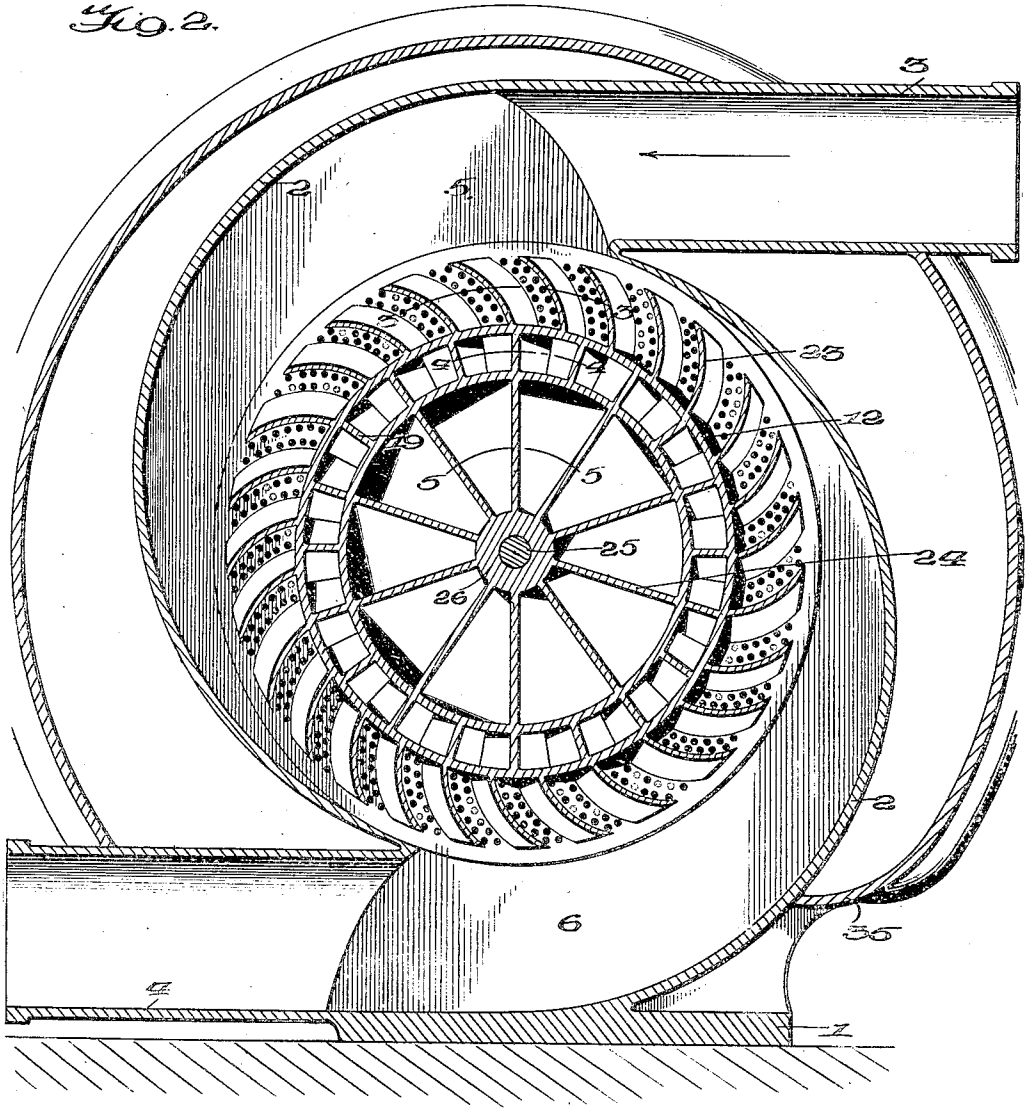
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3 Sheets-Sheet 2

Fig. 2.



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Filed June 16, 1926 3 Sheets-Sheet 3

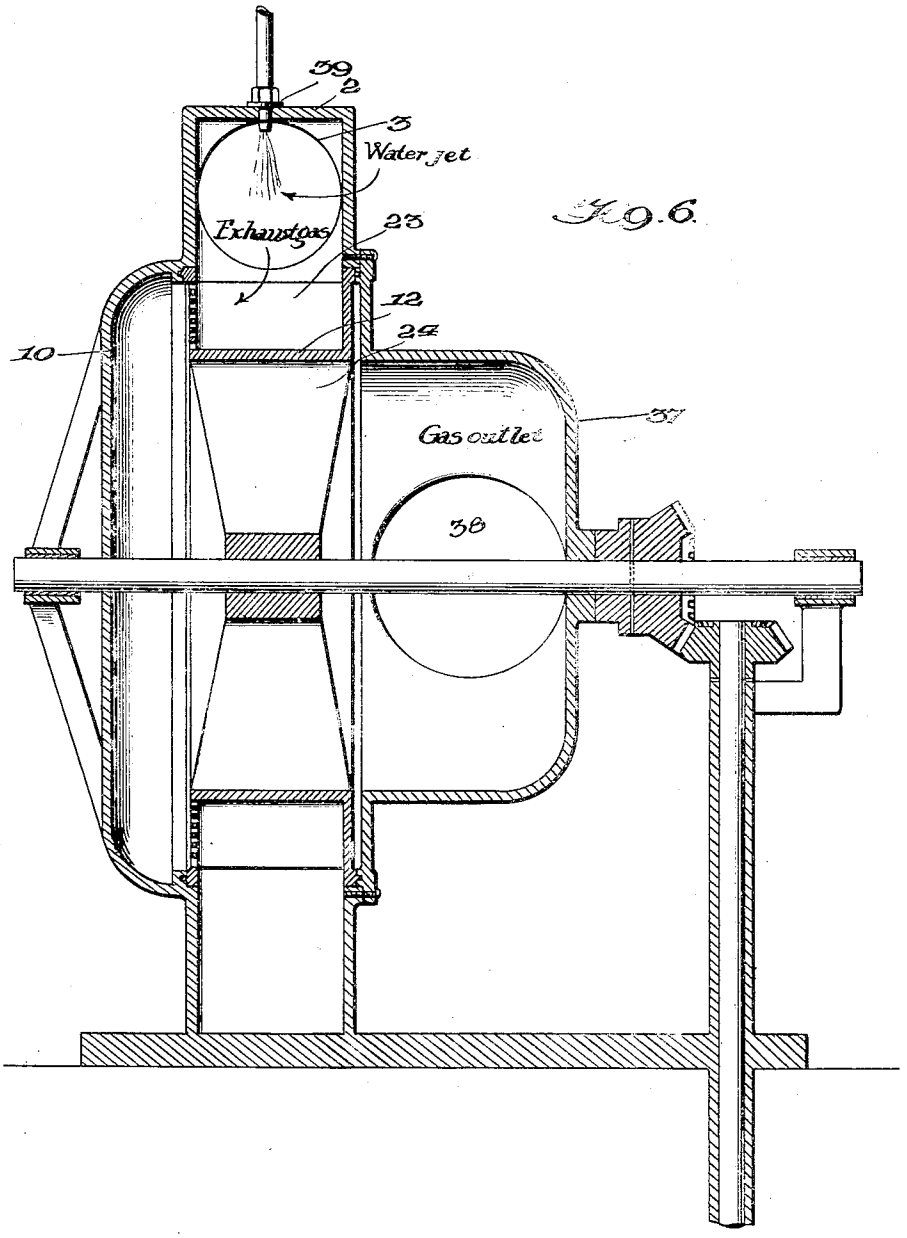


Fig. 6.

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UNITED STATES PATENT OFFICE.

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MUFFLER FOR AIRPLANE MOTORS.

Application filed June 16, 1926. Serial No. 116,443.

This invention relates to improvements in mufflers for internal combustion engines, it being designed particularly for use in connection with airplane motors or internal combustion engines inasmuch as provision is made for the passage through the device of air at high velocity for the purpose of abstracting the exhaust gas and incidentally providing a tortuous passage therefor.

Other objects and advantages of the invention will appear in the following specification, reference being had to the accompanying drawings, in which

Figure 1 is a central longitudinal section of the improved muffler.

Figure 2 is a cross section taken substantially on the line 2—2 of Figure 1.

Figure 3 is a detail section taken on the line 3—3 of Figure 2,

Figure 4 is a detail section taken on the line 4—4 of Figure 2,

Figure 5 is a detail section taken on the line 5—5 of Figure 2.

Figure 6 is a sectional view of a modification.

As already indicated in the foregoing brief statement of the invention the improved muffler is adapted particularly for use in connection with airplane motors which ordinarily do not employ mufflers and for that reason make so much noise that special means have been devised for permitting communication between any two persons, for example, pilot and mechanic. A rapidly revolving and mechanically driven rotor creates an air current of high velocity and defines part of a tortuous air passage in which exhaust gas passes after abstraction by the air current.

In carrying out the invention provision is made of a base 1 having an integral casting generally indicated 2 with the interior of which a pair of pipes 3 and 4 communicates. These pipes lead to each of a pair of motor blocks (not shown) which the muffler is designed to serve, the showing of a pair of pipes 3 and 4 being intended as no limitation upon the use of the muffler because in principle more or less than a pair of motor blocks may be accommodated.

The chambers 5 and 6 (Fig. 2) into which the pipes 3 and 4 discharge diminish in the circumferential direction so that one chamber terminates substantially at the place where the other begins. The vertical walls 7 and 8 (Fig. 1) of the chambers 5 and 6 are parallel, but the height of the chambers 5 and 6 is gradually reduced from the entrance point of the pipes 3 and 4, producing the so-called circumferential diminution.

A circular opening 9 in the front wall 8 affords communication of the chambers 5 and 6 with what may be known as a mixing chamber 10 in that a mixture of exhaust gas and atmospheric air occurs therein. The foregoing communication is, in a sense, interupted by the upstanding flange 11 of the rotor 12, but communication is had, nevertheless, by means of numerous perforations 13 in said upstanding flange.

The rotor has a complementary upstanding flange 14, the two flanges having ribs 15 on the outside near the peripheral extremity riding in grooves 16 in the walls 7 and 8. The grooves obviously are circular. The peripheries of the flanges 11 and 14 ride in the grooves, and make sufficiently tight joints (in which the ribs ride) to insure the passage of exhaust gas through the perforations 13 of the flange 11.

A shell or casing 17 fits around the internal casting structure in a manner that can be understood by reference to Figures 1 and 2. The back of the shell is closed, being formed to produce an atmospheric air channel 18 which leads to a circumferential series of vanes 19. These are formed between the primary rim 12 and secondary rim 20 of the rotor. The rear of the rim 20 projects at 21 (Fig. 1) and rides in a rabbet 22 in the innermost portion of the shell thereby making a sufficiently tight joint to prevent an undesirable leakage of air. Other vanes 23 and 24 are concerned with the rotor, and these are described later.

The front of the casing 17 extends approximately to the plane in which the outer surface of the mixing chamber 10 is located, and it flares slightly as shown to more readily intercept the air and direct it with slightly increasing velocity to the air channel 18. The open or bell-end of the casing 17 faces the wind, the device being so mounted upon an airplane in the neighborhood of the engine block that there may be an uninterrupted flow of air into the muffler.

An axle or shaft 25 carries the hub 26 of the rotor, as well as a propeller 36. The vanes 24 connect the hub and secondary rim 20 thereby serving as a spoke. The vanes 24 have a decided slant when viewed along the line 5—5 in Figure 2 (see Fig. 5) act-

ing as fans to force the air to the rear of the muffler and consequently drawing air in through the chamber 10. The vanes 19 slant in a direction opposite to that of the vanes 24 (Fig. 4) and the slant of the vanes 23 is less than that of the vanes 19. The function of the vanes 19 is to draw air from the air channel 18 and expel it into the chamber 10. For this purpose the slant of the vanes 19 must be sufficient to perform as a fan, the purpose of slanting the vanes 19 in the direction opposite to that of the vanes 24 is to make the air pass forwardly instead of rearwardly as is required of the vanes 24. The vanes 23 do not need to be set on a slant quite so decided as that of the vanes 19, these being open at the peripheries to permit entrance of exhaust gas from the periphery of the rotor and into the chamber 10 where mixture of atmospheric air occurs.

A spider 27 on front of the chamber 10 supports one end of the axle 25. The other end is supported by a bearing 28 extending from the tubular upright 29 on the base 1. A drive shaft 30 extends through and is housed by the tubular upright. This shaft carries a pinion 31 meshing with and housing a gear 32 fixed on the axle. The drawing omits showing the means for driving the shaft 30, but in practice it is intended to use a section of flexible shafting such as is employed for driving the speedometer of an automobile, only the shafting for driving the rotor must be heavier.

It has been stated that the shell or casing 17 fits over the internal casting structure. The shell 17 is made separate from the internal structure, but the two are secured together by suitable means, such as screws 33 which are introduced through larger openings in the rear of the shell. These openings are later closed by plugs 34. The greater portion of the shell 17 is concentric with the rotor as can be seen in Figure 2, but the lower portion of the shell is flattened as at 35 chiefly for convenience in assembling the shell upon the internal casting. It is noted that the lower pipe 4 extends out to the left from the internal casting, and as a detail in the manufacture of the muffler it is easier for future assembly to make the lower part of the shell flat rather than completely round.

It has been stated that the axle 25 carries the propeller 36. The propeller and mechanical drive 30, 31, etc. are not necessarily used at the same time, the two being shown merely to illustrate an alternative form of mechanism for revolving the rotor 12. In practice, provision may be made for disconnecting the shaft 30 from the source of power in which event the air blowing against the propeller 36 at a high rate will turn the axle 25 and so revolve the rotor 12 for the purpose already brought out. In the event that the propeller 36 is not desired, the operation of the rotor 12 may be accomplished by the mechanical drive 30, 31, etc. The propeller 36 may either be left on the axle or taken off.

Reference is next made to the modification in Fig. 6. Such parts as correspond with similar parts in Figure 1 are identified by corresponding reference characters without repeating the description. The particular form in Figure 6 is adapted for marine work, in which case the apparatus is located in the hull of the ship and is so arranged as to expel the exhaust gas but without the advantage of the outside air currents.

The casting 2 must be regarded as identical with the casting 2 in Figure 2. The exhaust gas inlet pipe 3 in Fig. 2 is similarly designated 3 in Figure 6. The rotor 12 has vanes 23, as before, but the intermediate vanes 19 are now omitted. The rotor is supported by spoke vanes 24 which, upon rotation of the axle 25 draw the exhaust gas through the mixing chamber 10 and expel it into a chamber 37. This chamber has an outlet 38 to atmosphere, or elsewhere.

A tapering pipe 39 introduced into the casing 2 delivers a jet of water upon the rotor 12 and across the exhaust gas screen, thereby assisting in cooling the interior of the apparatus. It is noted that the shell 17 (Fig. 1) is now omitted, the reason being, as already stated, that the device is now adapted for interior work (in the hull of a ship) rather than on the outside as where it is used upon an airplane. The driving mechanism is located outside of the chamber 37.

The operation may be readily understood. It has already been brought out that the muffler faces the wind, that is to say the open side or bell-end of the shell 17 faces the front of the airplane so that air is readily admitted to the air channel 18. The axle 25 of the rotor 12 is driven at a sufficiently high rate to establish the velocity of air through the channel 18, chamber 10 and the central part of the rotor at a point where it will continuously exhaust the gas from the motor blocks at the pipes 3 and 4. In other words, the rotor must keep ahead of its work.

The exhaust gas in passing through the numerous minute perforations 13 will be broken up, so that it no longer discharges in a solid stream. The exhaust gas stream is further broken by the air currents impinging thereupon at the vanes 19, the resulting mixture passing out through the center of the muffler and thus to atmosphere.

In case the muffler is intended to be used upon boardship the working parts are restricted to the rotor 12 as clearly shown in Figure 6. The exhaust gas is discharged into the casting 2 whence it is abstracted by

the action of the rotor. The gas is cooled by the transverse jet of water emerging at the pipe 39, and the fluids escape at the outlet 38. Of necessity, the parts in Figure 6 must be made of some non-corrosive metal to resist the action of the water.

While the construction and arrangement of the improved muffler is that of a generally preferred form, obviously modifications and changes may be made without departing from the spirit of the invention or the scope of the claims.

I claim:—

1. A device of the character described comprising a pipe for receiving exhaust gas, and a rotor being so disposed in reference to the pipe as to change the direction of flow of the gas through the rotor and having means for drawing a current of air to abstract the exhaust gas from the pipe.

2. A device of the character described comprising a chamber receiving the exhaust gas of a motor, a shell so disposed in reference to the chamber as to define an air channel, a mixing chamber for exhaust gas and air currents, and a rotor interposed between the exhauts gas and mixing chambers and air channel, said rotor having vanes drawing the gas from the exhaust chamber and air from the air channel through the rotor and expelling the gas and air into the mixing chamber prior to expulsion.

3. A device of the character described comprising a chamber receiving the exhaust gas of a motor, a shell so disposed in reference to the chamber as to define an air channel extending in a direction different from that of the gas stream in the chamber, a mixing chamber serving as a connector between the gas chamber and air channel, and a rotor so formed as to constitute continuation of the air channel and having vanes drawing the exhaust gas into the mixing chamber.

4. A device of the character described comprising a chamber for receiving the exhaust gas of a motor, a rotor having upstanding flanges defining part of the chamber, one of said flanges being perforated, a shell so disposed in relation to the chamber as to form a channel at one side thereof, a mixing chamber situated at the other side of the gas chamber, and vanes in the rotor drawing air from said channel and drawing gas through said perforations to commingle in said mixing chamber.

5. A device of the character described comprising a chamber into which the exhaust gas of a motor is conducted, a rotor having primary and secondary rims in spaced relationship with spaced connecting vanes therebetween, flanges upstanding from the primary rim completing said exhaust gas chamber with said primary rim, one of the flanges being perforated, vanes extending between the flanges being open at the perimeter to the exhaust gas chamber, a shell in spaced relationship to the exhaust gas chamber defining a channel communicating with the spaces between said connecting vanes, a mixing chamber fitted over the perforations and the outlet side of said spaces, and fan-vanes in the rotor adapted to draw a current of air through said channel and the spaces between said connecting vanes to thereby abstract the exhaust gas through said perforations into the mixing chamber.

6. A device of the character described comprising a chamber for receiving the exhaust gas of a motor, a rotor having a primary rim and upstanding flanges defining part of said chamber, one of said flanges being perforated, spaced vanes extending across the rotor between the flanges, the spaces therebetween being open to the chamber and to the perforations, a secondary rim of smaller diameter being connected with the primary rim by spaced vanes, a shell situated at one side of the chamber and rotor and extending over the chamber where it forms an air-receiving bell, said shell communicating with the spaces between said last vanes, a mixing chamber disposed at the opposite side of the chamber and rotor communicating with said perforations and the spaces between said vanes but closing the front of the rotor at the air bell of the shell, and spoke-vanes supporting the rotor adapted to draw a current of air through the shell and mixing chamber to abstract the gas from the gas chamber through said perforations.

7. A device of the character described comprising a shell having a bell mouth and a substantially upright wall on the opposite side thereof, a casting situated in the shell in spaced relationship therewith to define an air channel, a rotor having a primary rim and upstanding flanges completing an exhaust gas chamber in said casting, one of the flanges being perforated, a mixing chamber in front of the casting on the side of the perforations situated in the bell mouth but closing off the rotor from said bell mouth, a secondary rim in the rotor having vanes connecting the primary rim and defining spaces with which the air channel communicates, vanes situated between the upstanding flanges upon the primary rim defining spaces which are open to the gas chamber and to the perforations and through which exhaust gas is drawn, means for driving the rotor including an axle, said rotor having a hub mounted upon the axle, and spoke-vanes connecting the hub with the secondary rim adapted to draw a current of air through the air channel, the spaces of said connecting vanes and the mixing chamber to thereby abstract the exhaust gas from said chamber through said perforations.

8. A device of the character described

comprising a casting defining part of an exhaust gas chamber having upstanding walls with circular grooves, a rotor comprising a primary rim having upstanding flanges the peripheries of which ride in said grooves thereby forming a joint to close and complete the gas chamber, vanes connecting said flanges defining spaces which are open to the gas chamber and to said perforations, a mixing chamber formed on one side of the casting extending sufficiently far to cover the perforations, a secondary rim in spaced relationship to the primary rim on the inside of the rotor and having vanes connecting the two rims, a shell disposed in spaced relationship to the casting having a bell mouth on the side of the mixing chamber and defining a channel communicating with the spaces between the connecting vanes, means for supporting and driving the rotor, said means including an axle, said rotor having a hub mounted on the axle, and spoke-vanes connecting the hub with the secondary rim being capable of drawing a current of air through the mixing chamber from the air channel and through the spaces between said connecting spokes to thereby abstract exhaust gas from the gas chamber through said perforations.

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