April 16, 1929. J. F. WEBB, SR 1,709,333

EXHAUST TREATING MECHANISM

Original Filed May 9, 1927 2 Sheets-Sheet 1

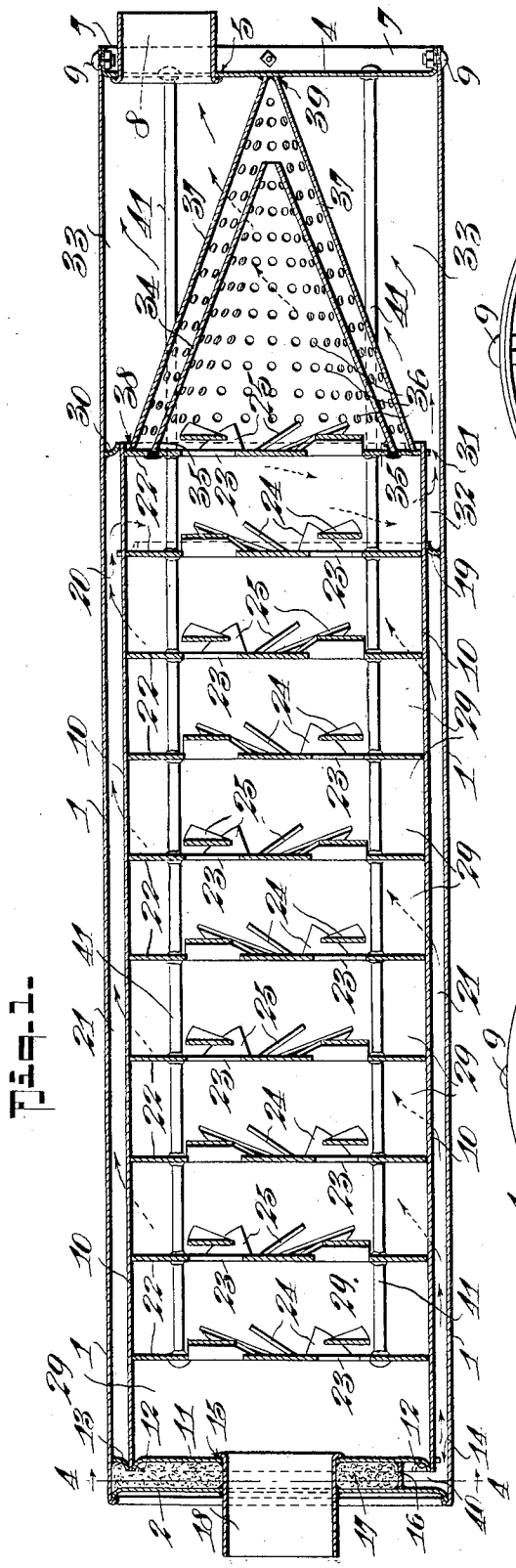

Fig. 1.

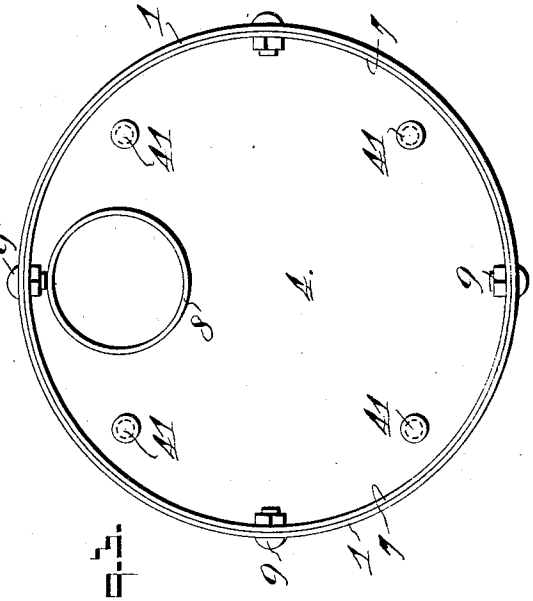

Fig. 3.

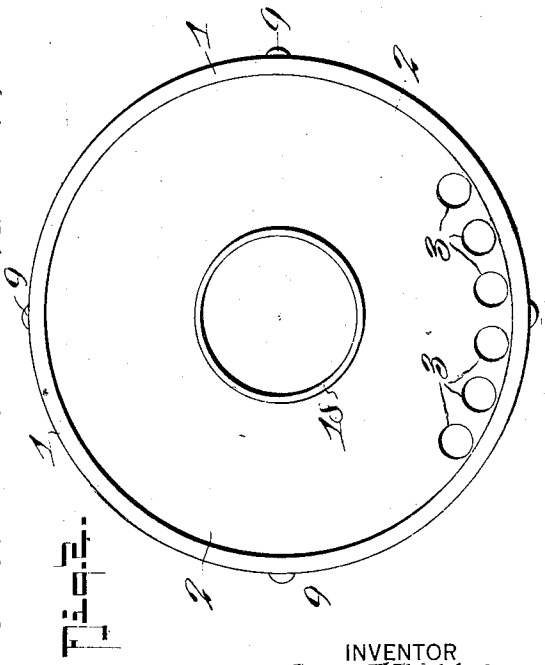

Fig. 2.

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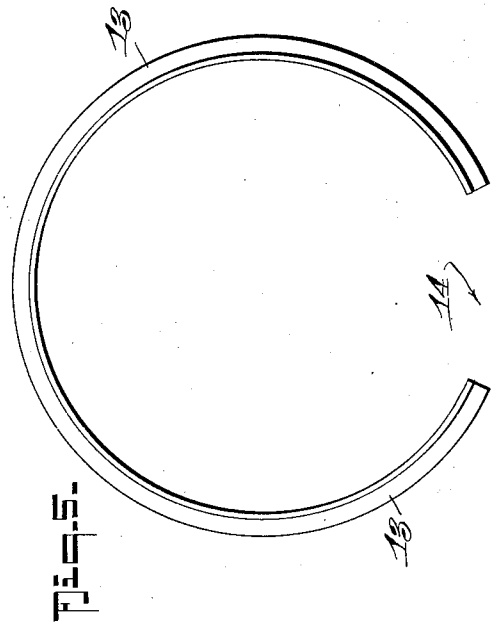

Fig. 5.

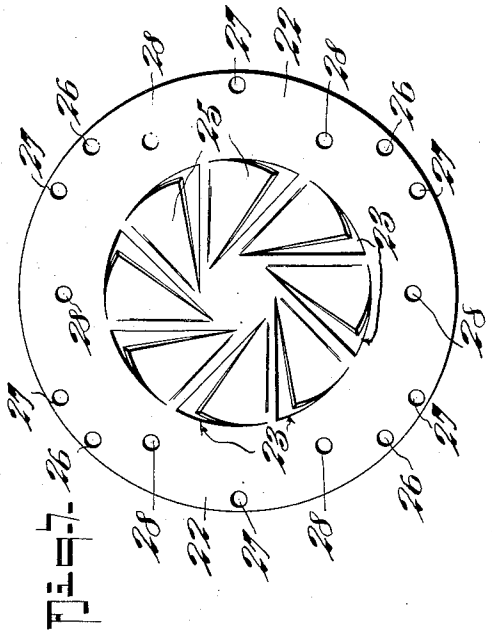

Fig. 7.

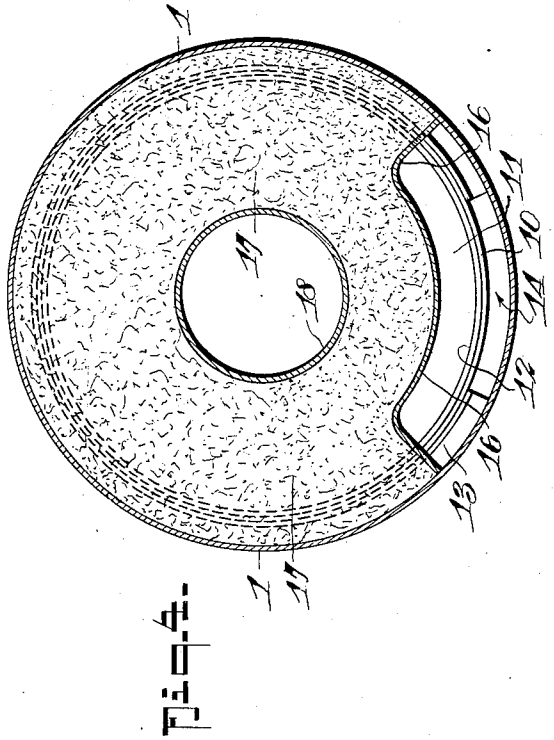

Fig. 4.

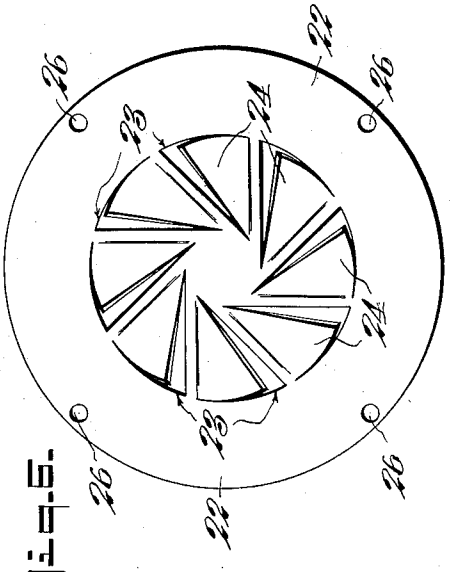

Fig. 6.

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EXHAUST-TREATING MECHANISM.

Application filed May 9, 1927, Serial No. 190,066. Renewed August 27, 1928.

This invention relates to mechanism for receiving the exhaust gases from internal combustion engines and so acting upon the same as to discharge them to atmosphere free from poisonous fumes in a cooled state and noiselessly.

The first and most important object of the invention is to provide a mechanism for so acting upon the exhaust gases as to convert the carbon monoxide gas which is always present (from seven per cent to ten percent of the volume of the exhaust) into harmless carbon dioxide, before passing the exhaust gases into the atmosphere. In order to accomplish this object it is necessary to supply the exhaust gases with sufficient oxygen to change the carbon monoxide into carbon dioxide. Pure air contains approximately twenty-one percent of oxygen, but experience has shown that, while the oxygen of the air will eventually neutralize carbon monoxide the percentage of neutralization under ordinary conditions is not sufficiently rapid, especially where there is heavy traffic, to prevent many of the deleterious effects of slight carbon monoxide poisoning, and recent investigations have shown that a large proportion of the urban increase of cardiac afflictions is due to the often repeated, though very light, attacks of this insidious gas poisoning. Therefore, second only to the neutralization itself, the real and practical problem has been to effect the neutralization so rapidly that it is completed during the passage of the gases from the engine and before the exhaust is delivered into the surrounding atmosphere for inhalation by the public.

With the knowledge that in this case, as in many others, heat hastens the chemical reaction, the problem became one of supplying a sufficient volume of heated air to the exhaust so that the chemical reaction might be accomplished within the mechanism itself before the passage of the exhaust to atmosphere.

In the construction of this mechanism, the amount or volume of oxygen needed to neutralize the percentage of carbon monoxide gas in the engine exhaust is carefully estimated, and the cold air openings in the front head of the mechanism are graduated to admit a little more than double the volume of the oxygen needed to neutralize that poisonous percentage.

When the desired quantity of oxygen-bearing air is passing through the mechanism, the heat, necessary for hastening the chemical combination of the oxygen with the carbon monoxide, is automatically obtained from the source of the monoxide itself by means of the ingenious construction of the mechanism which radiates the heat of the exhaust into the passing air currents, so that when the poisonous exhaust reaches the mixing chamber of the mechanism, having been expanded, cooled and diffused en route, the chemical combination with the heated oxygen is instantly and completely effected there before the expulsion into the atmosphere as a harmless product.

The second object of the invention is to so cool the hot exhaust while it is passing through the mechanism that, when it is finally discharged through the exit pipe, it is so cold that it cannot possibly ignite gasoline or gasoline vapors, thus making the vehicle fire-proof should an accident happen to start a leak in the gasoline tank.

The third object of the invention is to deaden and silence the explosive noise made by engine exhausts.

Carbon monoxide kills; but noise is an irritating annoyance, and the comfort of silent exhausts, which makes the automobile public demand muffling, is incidentally furnished by this mechanism, while preparing the exhaust for the more important feature of neutralization, by conducting the exhaust through a series of expanding, cooling, condensing and silencing chambers within the inner shell. Spacing partitions between the said chambers have near-central openings for the passage of the exhaust, and these openings have deflecting vanes arranged at such an angle that the exhaust and the waves of sound are deflected outwardly and forced against both the periphery of the respective chambers and the imperforated rims of the said partitions to lessen, and finally completely deaden, all waves of sound. The rotary motion imparted by these deflecting vanes hastens the cooling, condensation and consequent silencing of the exhaust, and their action may be made more effective if the angles of the vanes are reversed in each successive partition. These near-central openings are so designed that the entire exhaust passing through them is deflected by the vanes of the respective partitions, there

being no central hole through which some portion of the exhaust might escape without deflection.

A further object of my invention is to provide a mechanism which will attain the three principal objects hereinbefore enumerated and at the same time reduce the customary back pressure so greatly that the power of the engine will be noticeably increased for either climbing, quick acceleration, etc. thereby adding largely to the comfort and economy of operation.

Yet another object is to provide a mechanism in which the parts are so assembled as to permit ready removal of those parts which require (after a long interval of use) to be cleaned of accumulated carbon deposits.

In order to accomplish the objects aforesaid I have devised a means or mechanism, the preferred embodiment of which is illustrated in the accompanying drawings, in which:—

Figure 1 is a vertical longitudinal section of my invention, the arrows indicating the direction of the air currents.

Figure 2 is an elevation of the front end of the device.

Figure 3 is a rear elevation of the mechanism.

Figure 4 is a section on the line 4—4 of Figure 1.

Figure 5 is an elevation of one of the flanged washers used between the inner and outer shells.

Figure 6 is an elevation of one of the intermediate deflecting partitions for the inner shell.

Figure 7 is an elevation of the rear partition.

In the drawings in which like numerals of reference indicate like parts in all the figures, 1 represents the outer shell to which is secured (preferably in a permanent manner) the front head 2. The front head 2 is provided with an opening for the passage of the intake duct 18 by which the exhaust gases are delivered into the apparatus.

The head 2 is also provided with openings 3 for the entrance of cold air, the openings 3 being located at the bottom of the head and of a definite combined area with relation to the area of the duct 18 as will hereinafter more clearly appear.

At the rear of the shell 1 there is provided a removable head 4 which has an opening 5 for the outlet duct 8, the outlet duct 8 being preferably fixedly secured in the opening.

The head 4 is also provided with holes 6 for locating and supporting the back ends of the rods 41, the said rods being riveted or otherwise secured to the head.

The head 4 has an extended flange 7 by which it may be secured to the shell 1 with bolt and nut devices 9.

Located within the outer shell 1 and spaced from the walls thereof is an inner shell 10. This shell 10 has a front head 11 provided with a flange 12 over which and to which the inner shell 10 is preferably permanently secured.

Located between the shells 1 and 10 at the front and in substantially the plane of the head 11 is a flanged washer 13 for locating and supporting the front end of the inner shell 10 within the outer shell and also for closing the front end of the air chamber 21 between the shells except at the bottom where an opening 14 is provided to permit the air that enters through the openings 3 to pass into the chamber 21.

The head 11 has an opening 15 into which the duct 18 passes and fits. The head 11 is also provided with an approximately horizontal flange 16 for supporting the plastic asbestos packing 17 that serves as a heat insulator for the front end of the apparatus.

It will be noted that the inner shell 10 is considerably shorter than the outer shell 1 and the rear end of the inner shell is supported within the outer shell by an intermediate washer 19 of substantially the same construction as the washer 13, the washer 19 being permanently secured to the shell 1 as is also the washer 13. The washer 19 is spaced a short distance from the rear end of the shell 10 and has its opened portion 20 at the top so that the air passing into the chamber 21 at the bottom front end passes out of that chamber at the top rear end into a chamber 32 located between the washer 20 and the rearmost washer 30, the rearmost washer 30 being of like construction to the washers 13 and 19 but having its opening 31 located at the bottom so that the air from chamber 32 will pass into the mixing chamber 33 at the bottom beneath the diffusing cones 34 and 37 hereinafter again referred to.

22 designates a set of partitions located within the inner shell 10 and dividing its interior into a series of chambers for expanding, cooling, silencing and condensing the exhaust gases which enter the shell 10 through the intake duct 18.

Certain of the partitions 22 having openings 23 for permitting the rearward escape of the exhaust from one chamber 29 to another.

Vanes 24 are provided on the partitions having the openings 23 for giving a clockwise deflection to the gases passing through the openings of those partitions, while the other partitions are provided with openings 23 and vanes 25 to give a counterclockwise deflection to the gases passing through those openings.

The various partitions 22 have holes 26 of the same size and spacing as the holes 6 for the passage of the rods 41.

The rearmost partition 22 is also provided with holes 27 for convenience in welding

the diffusing cone 37 to that partition. It is also provided with holes 28 for convenience in welding the diffusing cone 34 to that partition.

The inner exhaust diffusing cone 34 has its base 35 welded to the rear partition 22 and it is perforated as at 36 for the initial diffusion of the cooled, expanded and silenced exhaust gases, discharging those gases in the initially diffused state into the outer diffusing cone 37 whose base 38 is also welded to the rear partition 22. The outer diffusing cone 37 has its apex blunted and welded or otherwise fixedly secured at 39 to the removable head 4.

It will be noted by reason of the construction of the front head of the inner shell there is a chamber 40 provided into which the air passes through the openings 3 before passing into the chamber 21.

In constructing my exhaust treating apparatus care should be taken properly to proportion the openings of the ducts 18 and 8 and the air openings 3 so that back pressure is avoided and approximately only slightly more air will pass into the apparatus than is necessary to carry the amount of oxygen required to neutralize the exhaust gases so that the temperatures of the exhaust gases and air when they arrive at the mixing chamber 33 will be at the most efficient point to cause the chemical reaction to take place necessary to change the carbon monoxide into carbon dioxide.

Operation.

In using my apparatus, the exhaust from the gas engine enters the same through the duct 18 and immediately expands in the first chamber 29. As soon as this first chamber is filled, the expanded exhaust begins to pass onward through the spaces 23 of the first partition 22 and encounters the vanes 24 which impart a clockwise rotation to it throwing it outwardly against the periphery of the second chamber 29 and forwardly against the rim of the second partition 22.

This baffling of the onward movement retards that movement sufficiently to make certain a still further expansion in the second chamber 29 and begins the change from an intermittent to a continuous flow of the exhaust; the swirling rotation imparted to the gases against the periphery of the chamber, which is jacketed with air, cools the exhaust more or less and deprives it of a portion of its energy while simultaneously imparting a portion of its heat to the air in the chamber 14. This further expansion, cooling and reduction of energy of the exhaust gases, materially depletes the explosive force thereof and therefore removes a certain percentage of its noise-making possibility.

In passing through the openings 23 of the second partition 22 the vanes 25 give the onward moving exhaust a counterclockwise rotation, thereby increasing the baffling effect and gaining greater efficiency in expansion, cooling and energy reduction in the third chamber 29. This process is repeated in the successive respective chambers 29.

In continuing the onward movement through the respective chambers 29, the limit of expansion is first reached and then the continued cooling begins to condense the volume of the exhaust; also the continued baffling by the respective partitions 22 has more and more effect in the reduction of energy and in changing the intermittent flow into one which is continuous, and the final passage through the two diffusing cones 34 and 37 makes the flow absolutely silent when it escapes into the mixing chamber 33.

The space 21 between the outer shell 1 and inner shell 10 is, of course, always filled with air.

As soon as the exhaust enters the first chamber 29, the inner shell 10 begins to absorb some of its heat, which, in turn, it imparts by radiation and conduction to the surrounding air jacket. Following the well known law of nature, this heated air rises, drawing cold air into the openings 3 and through the flanged washer opening 14 to replace it, and establishing a normal current toward and through the flanged washer opening 20, and then through the chamber 32, the flanged washer opening 31, the mixing chamber 33, and the final exit duct 8 in the rear head 4.

As the inner shell 10 absorbs more and more heat, these natural air currents flow faster and faster in direct proportion to the increasing quantity of the exhaust. These heated air currents, carrying their 21% of oxygen, meet the diffused and comparatively inert exhaust gases, carrying the 7% to 10% of carbon monoxide, in the mixing chamber 33 in just the proper condition to effect a rapid chemical action in combining with the poisonous carbon monoxide sufficient oxygen and thus change it into harmless carbon dioxide before the exit through the duct 8 to atmosphere.

From the foregoing it will be observed that by my apparatus the entire process of expanding, cooling, condensing and silencing of exhaust gases is automatically effected within a single inner shell or tube, which could replace the mufflers now in daily use on automobiles and do better work than they are doing. However, while such construction alone attains a portion of the objects of my invention it does not destroy or neutralize the carbon monoxide; therefore, for the purpose of securing this most important result in a most efficient manner, an outer shell is preferably placed around the inner shell to heat and control the currents of pure air bearing the oxygen necessary automatically

to neutralize the poisonous carbon monoxide by converting it into harmless carbon dioxide before it is passed out through the discharge tube as a cool and harmless mixture.

From the foregoing description, taken in connection with the accompanying drawings, it is thought the construction, operation and the many advantages of my invention will be clear to those skilled in the art to which it appertains.

What I claim is:

1. In exhaust treating apparatus, a shell, front and rear heads for the shell, said front head being fixedly secured to said shell, said rear head being removable, means to admit exhaust gases into said shell through the front head, a set of flat apertured partitions within the shell through which, successively, the gases pass, at least one diffusing member within said shell to the rear of said partitions and into and through which the exhaust gases pass, said shell having a chamber surrounding said diffusing member to receive the gases from said diffusing member, means for mounting said partitions and said diffusing member as a unit on said rear head whereby upon removal of said rear head said partitions and said diffusing member may be withdrawn from the shell simultaneously.

2. In exhaust treating apparatus, a shell, front and rear heads for the shell, said rear head being removable, means to admit exhaust gases into said shell through the front head, a set of apertured partitions within the shell through which, successively, the gases pass, at least one diffusing member within said shell to the rear of said partitions and into and through which the exhaust gases pass, said shell having a chamber surrounding said diffusing member to receive the gases from said diffusing member, means for mounting said partitions and said diffusing member as a unit on said rear head whereby upon removal of said rear head said partitions and said diffusing member may be withdrawn from the shell simultaneously, and means for causing air to effect neutralization of the carbon monoxide contained in the gases passed into said chamber through said diffusing member.

3. In exhaust treating apparatus, an outer shell, front and rear heads for said shell, an inner shell, a head closing the front end of said inner shell against communication with the outer shell, a duct leading through said front heads for delivering exhaust gases into said inner shell, said inner shell being shorter than said outer shell to leave a space to the rear of said inner shell, at least one perforated diffusing cone extending rearwardly from the rear end of said inner shell, a set of partitions within said inner shell and having passages through the same, and means for spacing said inner shell from said outer shell and means for spacing and supporting said partitions and said cone by said rear head as a unit therewith whereby upon removal of said rear head said partitions and said cone will be withdrawn with the rear head from the inner shell as a unit, and means to admit air into the space between said shells in heat exchange relation to the exhaust gases and means to direct the air into said space that is located to the rear of said inner shell, said rear head having an exhaust outlet.

4. In exhaust treating apparatus, an outer shell, front and rear heads therefor, an inner shell, a front head for said inner shell, means to admit exhaust gases into said inner shell, said front heads being spaced apart, heat insulation in said space, the inner shell being of less length and diameter than the outer shell to leave an air space surrounding the inner shell and a receiving chamber to the rear of said inner shell, the front head of the outer shell at its lower portion having air passages into the space between said shells, a partition washer between said shells at the rear of the inner shell and having an air passage at the bottom, an intermediate partition washer between said shells and having an air passage at the top, and a set of spaced partitions within the inner shell having passages for the exhaust gases, means in said receiving chamber to cause the air and exhaust gases to mix to change the carbon monoxide present in the exhaust gases to carbon dioxide, said rear head having an outlet for the treated gases.

5. In exhaust treating apparatus, a pair of shells one located within and spaced from the other, means to admit exhaust gases only into the front end of the inner shell, means to admit air into the front end of the outer shell at a place below the axis of the shells whereby the air admitted will flow upwardly around the inner shell as well as along the same toward the rear end thereof in a quantity of predetermined proportion with relation to the exhaust gases, baffling partitions within said inner shell, said outer shell projecting rearwardly beyond said inner shell whereby to provide a mixing chamber, said outer shell having a rear head with outlet to atmosphere, means between said shells for causing the air to flow downwardly around said inner shell as it approaches the rear end of the same and be liberated into said mixing chamber near the bottom thereof, and a diffusing member projecting into said mixing chamber from the rear end of said inner shell, the walls of said shells being in relatively close relation to cause sufficient heat exchange between gases and air passing along the shells to bring the temperature of the air and gases to an approximate uniform degree by the time they enter the mixing chamber for the purposes specified.

6. In exhaust treating apparatus, a shell

having front and rear heads, means separately to admit exhaust gases and air through the front head, the rear head having an outlet, said shell enclosing a mixing chamber, means including said shell for separately conducting the exhaust gases and air in heat exchange relation to one another to the mixing chamber, means in the mixing chamber for mixing the exhaust gases and air, means for whirling the gases in alternate directions along the axis of the apparatus while they are being conducted from the front toward the rear of the shell, and means to cause the air currents to be diverted upwardly and downwardly around the axis of the apparatus while being conducted from the front toward the rear.

7. In exhaust treating apparatus, an outer shell having front and rear heads, separate means to admit exhaust gases and a predetermined proportion of air separately through said front head, the rear head having an outlet, said shell including a mixing chamber, means including said outer shell separately conducting the exhaust gases and air in heat exchange relation to one another from the front head to the mixing chamber during a sufficient time interval to bring the temperature of the air and gases to approximately the same degree, and means including at least one diffusing element to cause the gases and air to come into intimate contact on delivery thereof into the mixing chamber, for the purpose specified.

8. In exhaust treating apparatus, an outer shell having a front and a rear head, separate means for admitting air and exhaust gases through one end of and into said shell, and means for discharging them through the other end, means within said shell extending to a place relatively adjacent the outlet for maintaining said exhaust gases and air separated and in heat exchange relation to each other until the temperature of both have become substantially equalized, and means for thereafter mixing the exhaust gases with the air to reduce the carbon monoxide present to carbon dioxide before discharge of the same from the shell.

9. In exhaust treating apparatus, an outer shell having a front and a rear head, separate means for admitting air and exhaust gases through one end of and into said shell, and means for discharging them through the other end, means within said shell extending to a place relatively adjacent the outlet for maintaining said exhaust gases and air separated and in heat exchange relation to each other until the temperature of both have become substantially equalized, and means for thereafter mixing the exhaust gases with the air to reduce the carbon monoxide present to carbon dioxide before discharge of the same from the shell, and means within the shell to act on said exhaust gases to insure a silent discharge from the apparatus.

10. In exhaust treating apparatus, in combination with an inner shell through which exhaust gases pass, and which is provided with silencing partitions and chambers, of an outer shell having a mixing chamber into which the exhaust gases are delivered from the said inner shell and from which the chambers' contents pass to atmosphere, means including said shells for admitting into said outer shell a definite quantity of air and maintaining the air in heat exchange relation to and separate from said exhaust gases en route to said mixing chamber until the air and exhaust gases assume approximately equal temperatures, and thereafter permit passage of the air into said mixing chamber to mix with the gases and reduce the carbon monoxide carried thereby to carbon dioxide prior to their discharge to atmosphere.

11. In an exhaust treating apparatus, an outer shell, end heads therefor, one head having a discharge outlet, an inner shell spaced within said outer shell, a head for one end of said inner shell, spacing washers located between said shells, means for admitting exhaust gases into the headed end of said inner shell, means for admitting air into the outer shell at the end adjacent to the place where the exhaust gases are admitted, to pass between said shells and in heat exchange relation to the exhaust gases, said outer shell enclosing a mixing chamber beyond one end of said inner shell and into which the heated air passes, a set of spaced and apertured partitions located within said inner shell and through which the exhaust gases pass seriatim, and a diffusing member projecting from an end of said inner shell into said mixing chamber for the purposes specified.

12. In an exhaust treating apparatus, an outer shell, end heads therefor, one head having a discharge outlet, an inner shell spaced within said outer shell, a head for one end of said inner shell, spacing washers located between said shells, means for admitting exhaust gases into the headed end of said inner shell, means for admitting air into the outer shell at the end adjacent to the place where the exhaust gases are admitted, to pass between said shells and in heat exchange relation to the exhaust gases, said outer shell enclosing a mixing chamber beyond one end of said inner shell and into which the heated air passes, a set of spaced and apertured partitions located within said inner shell and through which the exhaust gases pass seriatim, and a diffusing member projecting from an end of said inner shell into said mixing chamber, said spaced par-

titions having fan-like blades adjacent the openings therein to whirl the passing gases for the purposes specified.

13. In an exhaust treating apparatus, an outer shell, end heads therefor, one head having a discharge outlet, an inner shell spaced within said outer shell, a head for one end of said inner shell, spacing washers located between said shells, means for admitting exhaust gases into the headed end of said inner shell, means for admitting air into the outer shell at the end adjacent to the place where the exhaust gases are admitted, to pass between said shells and in heat exchange relation to the exhaust gases, said outer shell enclosing a mixing chamber beyond one end of said inner shell and into which the heated air passes, a set of spaced and apertured partitions located within said inner shell and through which the exhaust gases pass seriatim, and a set of diffusing members projecting from an end of said inner shell into said mixing chamber, said diffusing members comprising perforated cones, the larger ends of which lie adjacent the said one end of the inner shell.

14. In an exhaust treating apparatus, an outer shell, end heads therefor, one head having a discharge outlet, an inner shell spaced within said outer shell, a head for one end of said inner shell, spacing washers located between said shells, means for admitting exhaust gases into the headed end of said inner shell, means for admitting air into the outer shell at the end adjacent to the place where the exhaust gases are admitted, to pass between said shells and in heat exchange relation to the exhaust gases, said outer shell enclosing a mixing chamber beyond one end of said inner shell and into which the heated air passes, a set of spaced and apertured partitions located within said inner shell and through which the exhaust gases pass seriatim, and a set of diffusing members projecting from an end of said inner shell into said mixing chamber, said spaced partitions having fan-like blades adjacent the openings therein to whirl the passing gases, said diffusing members comprising perforated cones, the larger ends of which lie adjacent the said one end of the inner shell.

15. In an exhaust treating apparatus, an outer shell, end heads therefor, one head having a discharge outlet, an inner shell spaced within said outer shell, a head for one end of said inner shell, spacing washers located between said shells, means for admitting exhaust gases into the headed end of said inner shell, means for admitting air into the outer shell at the end adjacent to the place where the exhaust gases are admitted, to pass between said shells and in heat exchange relation to the exhaust gases, said outer shell enclosing a mixing chamber beyond one end of said inner shell and into which the heated air passes, a set of spaced and apertured partitions located within said inner shell and through which the exhaust gases pass seriatim, and a set of diffusing members projecting from an end of said inner shell into said mixing chamber, said spaced partitions having fan-like blades adjacent the openings therein to whirl the passing gases, said diffusing members comprising perforated cones, the larger ends of which lie adjacent the said one end of the inner shell, and means uniting said partitions, said diffusing members and one of said end heads of the outer shell into a unitary structure for the purposes specified.

16. An exhaust treating apparatus, an outer shell having a front entrance and a rear head with an outlet opening, separate means for passing air and exhaust gases through one end of and into said shell, and means for discharging them through the other end, means within said shell extending to a place relatively adjacent the outlet for maintaining said exhaust gases and air separated and in heat exchange relation to each other until the temperatures of both have become substantially equalized, means for thereafter mixing the exhaust gases with the air before discharge of the same from the shell for the purposes specified.

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